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)*
0005	09 APR 99		

6. ISSUED BY CODE

Department of the Army
Corps of Engineers
Fort Worth District

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 SOLICITATION NO.
DACA63-99-B-0004

9B. DATED *(SEE ITEM 11)*
24 FEBRUARY 1999

10A. MODIFICATION OF CONTRACTS/ORDER NO.

10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers [ ] is extended, [X] 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 you 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 APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(√) 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 UPGRADE RECRUIT DORMS, BUILDINGS 9110 AND 9210, LACKLAND AIR FORCE BASE, SAN ANTONIO, TEXAS, is amended as follows:

See Continuation Sheets.

NOTE: Bid Opening Date remains "20 April 1999, 2 p.m., local time," 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 BY *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

a. Bidding Schedule.- The Bidding Schedule shall be voided and the accompanying new Bidding Schedule, bearing the notation "ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004," shall be substituted therefor.

b. Specifications.- The following listed sections shall be voided and the accompanying new sections of the same title and number, each bearing the notation "ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004," shall be substituted therefor:

Section No.	Title
01000	CONSTRUCTION SCHEDULE
02050	DEMOLITION
02222	EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS
02660	WATER DISTRIBUTION SYSTEM
02685	GAS DISTRIBUTION SYSTEM
09000	BUILDING COLOR AND FINISH SCHEDULE
11400	FOOD SERVICE EQUIPMENT
15320	FIRE PUMPS
15330	WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
15400	PLUMBING, GENERAL PURPOSE
15556	FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS
15569	WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH
15650	CENTRAL REFRIGERATED AIR-CONDITIONING SYSTEM
15652	COLD STORAGE REFRIGERATION SYSTEMS
15895	AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
15974	BUILDING AUTOMATION & CONTROL SYSTEMS FOR LACKLAND AFB
16415	ELECTRICAL WORK, INTERIOR
16710	PREMISES DISTRIBUTION SYSTEM

c. Drawings.- The drawings listed below shall be voided and the attached new drawings of the same sequence and sheet numbers, shall be substituted therefor:

	Sheet No.	Title
Bldg 9110		
Seq 3	C-3	CRAWL SPACE GRADING PLAN AND SECTIONS
Seq 21	A-12	EXISTING ROOF PLAN - MASTER DEMO
Seq 40	A-31	TYPICAL BATH PLANS & INTERIOR ELEVATIONS
Seq 43	A-34	INTERIOR ELEVATIONS
Seq 45	A-36	1st FLR DOOR NEW WORK SCHEDULE & ELEVATIONS
Seq 51	A-42	1st FLR REFLECTED CEILING PLAN - AREA "A"
Seq 52	A-43	1st FLR REFLECTED CEILING PLAN - AREA "B"
Seq 59	A-50	1st FLR ROOM FINISH SCHEDULE
Seq 60	A-51	2nd FLR ROOM FINISH SCHEDULE
Seq 61	A-52	3rd FLR ROOM FINISH SCHEDULE
Seq 62	A-53	MASTER ROOF PLAN - NEW WORK
Seq 63	A-54	PARTIAL ROOF PLAN - AREA "A"
Seq 65	A-56	ROOF DETAILS
Seq 66	A-57	BUILDING ELEVATIONS A-D
Seq 67	A-58	BUILDING ELEVATIONS E-P
Seq 68	A-59	BUILDING SECTIONS - NEW WORK
Seq 69	A-60	1st FLR LAUNDRY & LATRINE FLOOR PLANS & DETAILS
Seq 70	A-61	INTERIOR ELEVATIONS & DETAILS - CLASSROOMS

Seq 73	FS-1	FOOD SERVICE EQUIPMENT SCHEDULE - KITCHEN
Seq 78	FS-6	FOOD SERVICE EQUIPMENT ELEVATIONS
Seq 82	FS-10	FOOD SERVICE EQUIPMENT DETAILS
Seq 97	DM9	HVAC DEMOLITION ENLARGED CENTRAL PLANT SECTIONS
Seq 101	DM13	HVAC DEMOLITION SCHEDULES
Seq 102	DP1	PLUMBING DEMOLITION
Seq 104	M0	HVAC SYMBOLS & ABBREVIATIONS
Seq 105	M1	HVAC DISTRIBUTION FIRST FLOOR PLAN AREA A PARTIAL
Seq 106	M2	HVAC DISTRIBUTION FIRST FLOOR PLAN AREA B PARTIAL
Seq 107	M3	HVAC DISTRIBUTION SECOND FLOOR AREAS A AND B PARTIAL
Seq 108	M4	HVAC DISTRIBUTION SECOND FLOOR PAN AREAS A, B, C, AND PARTIAL
Seq 109	M5	HVAC DISTRIBUTION SECOND FLOOR PLAN AREAS C AND D PARTIAL
Seq 110	M6	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS A AND B PARTIAL
Seq 111	M7	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS A, B, C, AND D PARTIAL
Seq 112	M8	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS C AND D PARTIAL
Seq 116	M12	HVAC ENLARGED SCALE MECHANICAL ROOM PLANS & SECTIONS
Seq 117	M13	HVAC PIPING FLOW DIAGRAM
Seq 124	M20	HVAC SCHEDULES
Seq 130	P1	PLUMBING - FIRST FLOOR PLAN AREA A PARTIAL
Seq 131	P2	PLUMBING - FIRST FLOOR PLAN AREA A PARTIAL
Seq 135	P6	PLUMBING - SECOND FLOOR PLAN AREA A & B PARTIAL
Seq 136	P7	PLUMBING - SECOND FLOOR PLAN AREAS A, B, C, & D PARTIAL
Seq 137	P8	PLUMBING - SECOND FLOOR PLAN AREAS C & D PARTIAL
Seq 138	P9	PLUMBING SOFTWATER RISER DIAGRAMS
Seq 140	P11	PLUMBING - THIRD FLOOR PLAN AREAS A & B PARTIAL
Seq 141	P12	PLUMBING - THIRD FLOOR PLAN AREAS A, B, C, & D PARTIAL
Seq 142	P13	PLUMBING - THIRD FLOOR PLAN AREAS C & D PARTIAL
Seq 143	P14	PLUMBING SCHEDULES
Seq 203	E-33	TELEPHONE RISER DIAGRAM & INTERIOR DETAILS
Seq 204	E-34	FIRE ALARM RISER DIAGRAM
Seq 205	E-35	ELECTRICAL RISER DIAGRAM
Seq 209	E-39	PANEL SCHEDULES IV
Seq 210	E-40	KITCHEN PANEL SCHEDULES

Sheet No.	Title

Bldg 09210

Seq 3	C-3	CRAWL SPACE GRADING PLAN AND SECTIONS
Seq 17	A-9	PARTIAL 2nd & 3rd FLR DEMOLITION PLAN - AREA "B"
Seq 19	A-11	PARTIAL 2nd & 3rd FLR DEMOLITION PLAN - AREA "D"
Seq 23	A-15	1st FLR MASTER PLAN - NEW WORK
Seq 25	A-17	DIMENSION PLAN - AREA "A"
Seq 26	A-18	KITCHEN & DINING ROOM FLOOR TILE LAYOUT - AREA "A"
Seq 35	A-27	PARTIAL 3nd FLR - NEW WORK AREA "A"
Seq 37	A-29	PARTIAL 3nd FLR - NEW WORK AREA "C"
Seq 38	A-30	PARTIAL 3nd FLR - NEW WORK AREA "D"
Seq 39	A-31	TYPICAL BATH PLANS & INTERIOR ELEVATIONS
Seq 42	A-34	INTERIOR ELEVATIONS
Seq 43	A-35	WALL SECTIONS
Seq 46	A-38	3rd FLR NEW WORK DOOR SCHEDULE & WINDOW DETAILS
Seq 47	A-39	MISCELLANEOUS DETAILS
Seq 49	A-41	1st FLR MASTER REFLECTED CEILING PLAN
Seq 58	A-50	1st FLR ROOM FINISH SCHEDULE
Seq 59	A-51	2nd FLR ROOM FINISH SCHEDULE
Seq 61	A-53	MASTER ROOF PLAN - NEW WORK
Seq 62	A-54	PARTIAL ROOF PLAN - AREA "A"
Seq 63	A-55	PARTIAL ROOF PLAN - AREA "B"

Seq 64	A-56	ROOF DETAILS
Seq 65	A-57	BUILDING ELEVATIONS A-D
Seq 67	A-59	BUILDING SECTIONS - NEW WORK
Seq 68	A-60	1st FLR LAUNDRY & LATRINE FLOOR PLANS & DETAILS
Seq 69	A-61	INTERIOR ELEVATIONS & DETAILS - CLASSROOMS
Seq 72	FS-1	FOOD SERVICE EQUIPMENT SCHEDULE - KITCHEN
Seq 77	FS-6	FOOD SERVICE EQUIPMENT ELEVATIONS
Seq 81	FS-10	FOOD SERVICE EQUIPMENT DETAILS
Seq 95	DM9	HVAC DEMOLITION ENLARGED CENTRAL PLANT SECTIONS
Seq 99	DM13	HVAC DEMOLITION SCHEDULES
Seq 100	DP1	PLUMBING DEMOLITION
Seq 102	M0	HVAC SYMBOLS & ABBREVIATIONS
Seq 103	M1	HVAC DISTRIBUTION FIRST FLOOR PLAN AREA A PARTIAL
Seq 104	M2	HVAC DISTRIBUTION FIRST FLOOR PLAN AREA B PARTIAL
Seq 105	M3	HVAC DISTRIBUTION SECOND FLOOR AREAS A AND B PARTIAL
Seq 106	M4	HVAC DISTRIBUTION SECOND FLOOR PAN AREAS A, B, C, AND PARTIAL
Seq 107	M5	HVAC DISTRIBUTION SECOND FLOOR PLAN AREAS C AND D PARTIAL
Seq 108	M6	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS A AND B PARTIAL
Seq 109	M7	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS A, B, C, AND D PARTIAL
Seq 110	M8	HVAC DISTRIBUTION THIRD FLOOR PLAN AREAS C AND D PARTIAL
Seq 114	M12	HVAC ENLARGED SCALE MECHANICAL ROOM PLANS & SECTIONS
Seq 122	M20	HVAC SCHEDULES
Seq 128	P1	PLUMBING - FIRST FLOOR PLAN AREA A PARTIAL
Seq 133	P6	PLUMBING - SECOND FLOOR PLAN AREA A & B PARTIAL
Seq 134	P7	PLUMBING - SECOND FLOOR PLAN AREAS A, B, C, & D PARTIAL
Seq 135	P8	PLUMBING - SECOND FLOOR PLAN AREAS C & D PARTIAL
Seq 136	P9	PLUMBING SOFTWATER RISER DIAGRAMS
Seq 138	P11	PLUMBING - THIRD FLOOR PLAN AREAS A & B PARTIAL
Seq 139	P12	PLUMBING - THIRD FLOOR PLAN AREAS A, B, C, & D PARTIAL
Seq 140	P13	PLUMBING - THIRD FLOOR PLAN AREAS C & D PARTIAL
Seq 141	P14	PLUMBING SCHEDULES
Seq 201	E-33	TELEPHONE RISER DIAGRAM & INTERIOR DETAILS
Seq 202	E-34	FIRE ALARM RISER DIAGRAM
Seq 203	E-35	ELECTRICAL RISER DIAGRAM
Seq 207	E-39	PANEL SCHEDULES IV
Seq 208	E-40	KITCHEN PANEL SCHEDULES

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

Upgrade Recruit Dorms, Buildings 9110 and 9210 (Title)
Lackland AFB, San Antonio, Texas (Location)

Solicitation No.DACA63-99-B-0004

BIDDING SCHEDULE
(To be attached to SF 1442)

BASE BID: All work required by the plans and specifications exclusive of work required by Option Bid Items.
[Amend #5] Each Option Bid Item applies to Building 9110 and 9210.

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
0001	**Additions/Alterations to Building 9110;** complete,including all utilities to the five-foot lines of the buildings; excluding all other work separately listed:	Job	Sum	***	**$**_____
0002	**Additions/Alterations Building 9210;** complete,including all utilities to the five-foot lines of the buildings; excluding all other work separately listed:	Job	Sum	***	**$**_____
0003	**Hazardous Material Abatement**	***	***	***	*********
0003AA	**Asbestos Abatement**	Job	Sum	***	**$**_____
0003AB	**Lead Base Paint Abatement**	Job	Sum	***	**$**_____
0003AC	**Polychlorinated Biphenyl Abatement**	Job	Sum	***	**$**_____
0003AD	**Mercury Abatement**	Job	Sum	***	**$**_____
0003AE	**Remove CDC's**	Job	Sum	***	**$**_____
0004	**Site Work/Supporting Facilities;** complete, including all utilities outside the buildings' five-foot lines, and all other work not separately listed:	Job	Sum	***	**$**_____

TOTAL BASE BID **$**_____

Solicitation No.DACA63-99-B-0004

BIDDING SCHEDULE (cont)

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
0005	**<u>Option NO.1</u> - Asbestos abatement by removal of floor tiles.**	Job	Sum	***	**$**_____
0006	**<u>Option NO.2</u> - Install new Water closets including trim And rough-in piping as specified.**	Job	Sum	***	**$**_____
0007	**<u>Option NO.3</u> - Install new Lavatories including trim and rough-in piping as specified.**	Job	Sum	***	$_____
0008	**<u>Option NO.4</u> - Install new Urinals including trim and rough-in piping as specified.**	Job	Sum	***	**$**_____
0009	**<u>Option NO.5</u> - New exterior windows and EIFS wall**	Job	Sum	***	**$**_____
0010	**<u>Option NO.6</u> - Metal Siding at 2nd & 3rd story exterior walls, facing Out over the lower roof.**	Job	Sum	***	**$**_____
0011	**<u>Option NO.7</u> - New outside Lighting in the Training Areas.**	Job	Sum	***	**$**_____
0012	**<u>Option NO.8</u> - New ceiling fans in the day rooms On the 2nd & 3rd floors.**	Job	Sum	***	**$**_____
0013	**<u>Option NO.9</u> - Exterior painting of exterior structural steel as specified.**	Job	Sum	***	**$**_____

Total For All Options $_____

TOTAL BASE BID and All Options $_____

BIDDING SCHEDULE (cont)

NOTES:

1. ARITHMETIC DISCREPANCIES (EFARS 14.406-2)

(a) For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by bidders:

(1) Obviously misplaced decimal points will be corrected;

(2) In case of discrepancy between unit price and extended price, the unit price will govern;

(3) Apparent errors in extension of unit prices will be corrected; and

(4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

(c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

2. If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.

3. Bidders must bid on all items.

4. Costs attributable to Division 01 - General Requirements are assumed to be prorated among bid items listed.

5. Responders are advised that this requirement may be delayed, cancelled or revised at any time during the solicitation, selection, evaluation, negotiation and/or final award process based on decisions related to DOD changes in force structure and disposition of the Armed Forces.

6. For the purpose of this solicitation, the word "item" shall be considered to mean "schedule" as used in Provision 52.214-0019, CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION, in Section 00100 INSTRUCTIONS, CONDITIONS, AND NOTICES TO BIDDERS, excluding additives, deductives, or optional items.

BIDDING SCHEDULE (cont)

NOTES: (cont)

7. EVALUATION OF OPTIONS (JUL 1990) (FAR 52.217-5)

Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

8. OPTION FOR INCREASED QUANTITY - SEPARATELY PRICED LINE ITEM (MAR 1989) (FAR 52.217-7)

The Government may require the completion of the numbered line item, identified in the Bidding Schedule as an option item, in the quantity and at the price stated in the Bidding Schedule. The Contracting Officer may exercise the option by written notice to the Contractor within the period specified in the Bidding Schedule. Completion of added items shall continue at the same schedule as the Base Bid unless otherwise noted in the SPECIAL CONTRACT REQUIREMENTS, paragraph 1 entitled COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK.

9. The Government reserves the right to exercise the option(s) either singularly or in any combination for up to 90 calendar days after award of the Base Bid without an increase in the Offeror's Bid Price.

SECTION 01000

CONSTRUCTION SCHEDULE
05/1998

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_
[Amend #2 & #4] (1) **All work for Buildings 9110 and 9210, including options.**	Within 10 days after receipt of Notice to Proceed	**750**	$ 850.00

[Amend #2 & #4]
NOTE: Building 9110 shall be completed first. After a 60 day period for moving personnel out of Building 9210, start work in Building 9210. The above 750 days includes the 60 days for moving.

[Amend #5]
Construction time will not start until Contractor recieves the Building sometimes between 1 July and 1 August 1999.

1.2 UTILITIES

1.2.1 Payment for Utility Services

See Section 00800 SPECIAL CONTRACT REQUIREMENTS.

1.2.2 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.

1.3 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. Two 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 --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 02050

DEMOLITION
09/91

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.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1992) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

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 01330SUBMITTAL PROCEDURES:

SD-18 Recordss

Work Plan; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent

the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, may be allowed to remain standing without additional bracing, shoring, of lateral support until demolished. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.2 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection From the Weather

The interior of buildings to remain and salvageable materials and equipment shall be protected from the weather at all times.

1.5.4 Protection of Trees

Trees within the project site which might be damaged during demolition and which are indicated to be left in place shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.5 Environmental Protection

The work shall comply with the requirements of Section 01510 ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.8 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available when the notice to proceed is issued.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed completely. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are specified in Section 0800 SPECIAL CLAUSES. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02225 EARTHWORK.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed

in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

[Amend #5]
3.4.1.2.1 Recovered Refrigerants:

All Refrigerants are the property of the government and shall be returned to the Base Civil Engineer as directed by the Contracting Officer.

3.5 Historical Items

Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.6 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off Government controlled property at the responsibility of the Contractor. Combustible material shall be disposed of off Government controlled property at the resposibility of the Contractor.

3.7 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES 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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

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-09 Reports

Field Density Tests; FIO. Testing of Backfill Materials; FIO.

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, GC, GM, SP, SM, SC, CL, and SW.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 3 inches, and materials classified in ASTM D 2487, as CH, ML, MH, PT, OH, and OL. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements will not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the l inch sieve. The maximum allowable aggregate size shall not be more

than 1 inch per foot of pipe diameter, or 3 inches maximum, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 6 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

AM#0005

2.1.9 Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility. **A No. 8 AWG tracer wire shall be installed with all plastic utility lines.** The continuous wire shall be taped to pipe at 20 foot intervals while being accessible above ground at all valves and building risers.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Excavation will be unclassified regardless of the nature of the materials encountered. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site and disposed of outside the limits of Government controlled property at the responsibility of the contractor, unless otherwise stated. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 5 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.1.6 Stockpiles

Stockpiles of satisfactory, unsatisfactory, and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways: Backfill shall be placed up to the elevation at which the requirements in Section 02225 EARTHWORK control or up to the bottom of the concrete backfill indicated for pavement replacement. Water flooding or jetting methods of compaction will not be permitted.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days], backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.2 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 3 feet from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.3 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection shall be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 100 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in accordance with ASTM D 1556or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 02660

WATER DISTRIBUTION SYSTEM
03/96

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 RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA MRE	(1994) Manual for Railway Engineering (Fixed Properties): Chapter 1, Roadway and Ballast

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM C 76	(1995) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM D 1599	(1988) Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(1993) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl

	Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1990) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1993) 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 2997	(1995) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe
ASTM D 3839	(1994a) Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B36.10M	(1985; R 1994) Welded and Seamless Wrought Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) 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	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1988) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994) Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids
AWWA C200	(1991) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C205	(1989) Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied
AWWA C207	(1994) Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
AWWA C208	(1983; C208a; R 1989) Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C300	(1989) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C301	(1992) Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
AWWA C303	(1987; Errata Jan 1988) Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C502	(1985) Dry-Barrel Fire Hydrants
AWWA C503	(1988) Wet-Barrel Fire Hydrants
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1990; C700a) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C702	(1992) Cold-Water Meters - Compound Type
AWWA C703	(1986) Cold-Water Meters - Fire Service Type
AWWA C704	(1992) Cold-Water Meters - Propeller Type for Main Line Applications
AWWA C706	(1991; C706a) Direct-Reading Remote-Registration Systems for Cold-Water Meters
AWWA C707	(1982; R 1992) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1988; Errata Apr 1988) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1988) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C950	(1988) Fiberglass Pressure Pipe
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA-01	(1988) Recommended Work Practices for A/C Pipe

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-01	(1992; Errata May 1993) Thrust Restraint Design for Ductile Iron Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1992) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1991) Hazardous Chemicals Data
NFPA 325M	(1991) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1990) Identification of the Fire Hazards of Materials
NFPA 1961	(1992) Fire Hose

NSF INTERNATIONAL (NSF)

NSF Std 14	(1965; Rev Nov 1990) Plastics Piping System Components and Related Materials

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

1.2 PIPING

This section covers water service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times. All piping and related products must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and must be certified by an organization accredited by ANSI.

1.2.1 Service Lines

Piping for water service lines for sizes 3 inches and larger shall be ductile iron, polyvinyl chloride (PVC) plastic through 12-inch nominal diameter, filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe or steel, unless otherwise shown or specified. All buried metallic piping and joints shall be protected with a factory applied 20 mil. thick coal-tar epoxy coating.

1.2.2 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 5-foot line.

1.2.3 Plastic Pipe

All plastic piping system components (PVC, polyethylene, thermosetting resin and reinforced plastic mortar pressure) intended for transportation of potable water shall comply with NSF-Std-14 and shall be legibly marked with their symbol.

1.2.4 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

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-06 Instructions

Installation; FIO.

The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; FIO.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Statement of Satisfactory Installation; FIO.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacteriological Disinfection; FIO.

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

PE, PB, RTRP, and/or RPMP Manufacturer's Representative*\; *FIO*\ Manufacturer's Representative; FIO.

The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified.

Contractor's Installation; FIO.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

1.4 HANDLING

Pipe and accessories shall be handled so as to ensure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Coated and Wrapped Steel Pipe

Coated and wrapped steel and/or metal pipe shall be handled in conformance with AWWA C203.

1.4.2 Polyethylene (PE) Pipe AND Polybutylene (PB) Pipe

PE pipe, fittings, and accessories shall be handled in conformance with AWWA C901. PB pipe, fittings, and accessories shall be handled in accordance with AWWA C902.

1.4.3 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP), and Reinforced Plastic Mortar Pressure (RPMP) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.2 Plastic Pipe

2.1.2.1 Polyethylene Plastic (PE)

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.2.2 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

Pipe 4-inch through 12-inch Diameter: Pipe, couplings and fittings 4-inch through 12-inch diameter shall conform to \AWWA C900-\, Class 150,

CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.1.2 Reinforced Plastic Mortar Pressure (RPMP) Pipe/AWWA C950_\.

2.1.3 Reinforced Thermosetting Resin Pipe (RTRP)

Pipe shall have a quick-burst strength greater than or equal to four times the normal working pressure of the pipe. The quick-burst strength test shall conform to the requirements of ASTM D 1599.

2.1.2.2.1 RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.2 RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.3 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 150 psi, unless otherwise shown or specified. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, all metalpiping, metal valves, and joints shall be protected with a factory applied 20 mil thick coal-tar epoxy coating. Piping shall be checked with a holiday tester prior to burial. Any flaws in the protective coating shall be repaired in accordance with the manufacturer's recommendations. Any pipe with flaws exceeding 2 square inches shall be replaced with new pipe or repaired at the factory.

2.4 Steel Pipe

2.4.1 Pipe 3 Inches and Larger, Not Galvanized

Steel pipe, not galvanized, shall conform to AWWA C200 with dimensional requirements as given in ASME B36.10M for pipe 6 inches in diameter and larger, and ASTM A 53 for smaller sizes. Pipe shall be welded or seamless with plain or shouldered and grooved ends in accordance with AWWA C606 for use with mechanical couplings or bell-and-spigot ends with rubber gaskets. Bell-and-spigot ends for sizes less than 6 inches diameter shall be as required by AWWA C200.

2.4.2 Galvanized-Steel Pipe

Galvanized-steel pipe shall conform to ASTM A 53, standard weight.

2.4.3 Protective Materials for Steel Pipe

Protective materials for steel pipe, except as otherwise specified, shall be mechanically applied in a factory or plant especially equipped for the purpose. The materials shall, unless otherwise indicated on the drawings, consist of one of the following for the indicated pipe

material and size:

Steel pipe 4 Inches or Larger, Not Galvanized:

(1) Cement-mortar coating and lining shall conform to and shall be applied in conformity with AWWA C205. Cement-mortar coating and linings shall not be used for pipe less than 4 inches in diameter.

(2) Coal-tar enamel lining, coating and wrapping shall conform to AWWA C203 for materials, method of application, tests and handling. Non-asbestos material shall be used for the outerwrap.

(3) Cement-mortar lining, in lieu of coal-tar enamel lining, may be used with coal-tar enamel coating and wrapping. Cement-mortar lining shall conform to and shall be applied in conformity with AWWA C205.

2.2 FITTINGS AND SPECIALS

2.4.3.2 Polyvinyl Chloride (PVC) Pipe

b. For pipe 4 inch diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or may be fittings and specials of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.4.3.3 RTRP and RPMP Pipe

Fittings and specials shall be compatible with the pipe supplied. Filament wound or molded fittings up to 6 inches shall conform to AWWA C950. Iron fittings shall be cement-mortar lined in accordance with AWWA C104 and shall conform to AWWA C110 and AWWA C111. Fittings shall be suitable for working and testing pressures specified for the pipe.

2.4.3.4 Ductile-Iron Pipe

Fittings and special shall be suitable for 150 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

When installed underground, fittings and specials shall have a protective coating as specified for ductile-iron pipe.

2.4.3.5

2.2.4 Steel Pipe

2.4.3.5.1 Steel Pipe Not Galvanized

Fittings and specials shall be made of the same material as the pipe. Specials and fittings may be made of standard steel tube turns or segmentally welded sections, with ends to accommodate the type of couplings or joints specified for the pipe. Dimensions of steel-pipe fittings shall be in accordance with AWWA C208. The thickness and pressure rating of pipe fittings and specials shall be not less than the thickness specified and the pressure rating calculated for the pipe with which they are used. Protective materials for fittings and specials shall be as specified for the pipe. Specials and fittings that cannot be mechanically lined, coated, and wrapped shall be lined, coated, and wrapped by hand, using the same material used for the pipe with the same number of applications of each material carefully and smoothly applied.

2.5 Galvanized-Steel Pipe

Steel fittings shall be galvanized. Screwed fittings shall conform to ASME B16.3. Flanged fittings shall conform to AWWA C207.

2.6 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

JOINTS

2.7 Plastic Pipe

2.7.1 Polyethylene (PE) and Polybutylene (PB) Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

2.7.2 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations as approved by the Contracting Officer.

2.8 RPMP Pipe

Joints shall be mechanical or bell and spigot type with elastomeric gasket.

2.9 RTRP

2.9.1 RTRP-I, Grade I and 2

Joints shall be bell and spigot with elastomeric gasket, mechanical coupling with elastomeric gasket, threaded and bonded coupling, or tapered bell and spigot with compatible adhesive. All RTRP-I materials shall be products of a single manufacturer.

2.9.2 RTRP-II, Grade 1 and 2

Joints shall be the bell and spigot type with elastomeric gasket, bell and spigot with adhesive, butt-jointed with adhesive bonded reinforced overlay, mechanical, flanged, threaded or commercially available proprietary joints, provided they are capable of conveying water at the pressure and temperature of the pipe.

2.10 Ductile-Iron Pipe

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricant shall conform to the applicable requirements of AWWA C111.

2.11 Steel Pipe

2.11.1 Steel Pipe, Not Galvanized

a. Mechanical couplings shall be as hereinafter specified.

b. Bell-and-spigot joints for use with rubber gaskets shall conform to AWWA C200, as appropriate for the type of pipe. Rubber gaskets shall conform to applicable requirements of AWWA C200.

c. Flanges shall conform to AWWA C207, and shall be used only in above ground installation or where shown on the drawings, or when approved.

2.11.2 Mechanical Couplings

Mechanical couplings for steel pipe shall be the sleeve type, or when approved, the split-sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.12 Bonded Joints

Where indicatedfor all ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.13 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to

the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

a. Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

b. Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.14 VALVES

AM#0005

2.15 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. **The operating nut shall have an arrow, cast in the metal, indicating the direction of opening.**

a. Valves 3 inches and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

b. Resilient-Seated Gate Valves: For valves 3 to 12 inches in size, resilient-seated gate valves shall conform to AWWA C509.

VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. A 2 ft. square concrete pad shall ne installed around all valve boxes at final grade. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

MISCELLANEOUS ITEMS

2.15.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.15.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.15.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.15.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi.

2.15.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable-iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.15.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.15.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.15.8 Meters

Meters shall conform to \-AWWA C700-\. Meter shall be positive displacement, oscillating piston, or nutating disc type; magnetic drive with magnetic shielding straight reading sealed register graduated in cubic feet, all bronze split case, integral strainer, accurately measuring and handling water at pressure, temperatures and flow rates to be encountered.

The pulse initiator shall provide the maximum number of pulses up to 500 per ;minute that is obtainable from the manufacturer. It shall not provide less than 1 pulse per 100 gallons.

2.9.9 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shut-off valve or service stop. Box height shall extend from invert of the meter to final grade at the meter location. Cover shall be cast iron with the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches

shall be maintained between pipes.

3.1.3 Joint Deflection

3.1.3.1 Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but in no case shall it exceed 5 degrees.

3.1.3.2 Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

3.1.3.3 Steel Pipe

For pipe with bell-and-spigot rubber-gasket joints, maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets shall be 5 degrees unless a lesser amount is recommended by the manufacturer. Short-radius curves and closures shall be formed by short lengths of pipe or fabricated specials specified.

3.1.4 Placing and Laying

Install pipe and appurtenances in a course and sand envelope, with a minimum thickness of the sand envelope being at least 6 inches.Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown. When non-metallic piping is installed underground and connected to metallic piping, a #8 HMWPF wire shall be thermit-welded to the existing metallic line and run the length of the new line to provide continuity of the cathodic protection system and to permit locating the pipe with a magnetic detector. Wire shall be continuous and accessible above ground at all valves and building risers.

3.1.5 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the recommendations of the manufacturer. PE and PB Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 *PE, PB, RTRP, AND/OR RPMP Manufacturera's Representative*\

The name and written qualifications of the manufacturer's field representative and written certification that the representative is technically qualified in all phases of PE, PB, RTRP, and/or RPMP pipe laying and jointing and experienced to supervise the work and train the Contractor's field installers shall be submitted to the Contracting Officer prior to commencing installation. The representative shall be present at the job site during the installation and testing to provide technical assistance and to verify that the materials are being installed in accordance with the manufacturer's prescribed prodecures. When the representative feels that the Contractor is installing and testing the PE, PB, RTRP, an/or RPMP pipe in a satisfactory manner, he shall certify this in writing and note which individuals employed by the Contractor are capable of properly installing the pipe. The field representative shall advise the Contractor of unsatisfactory conditions immediately when they occur. Such conditions include improper diameter of pipe ends, damaged interior liner, poorly prepared joints, improper curing of joints, moving pipe before joints are cured, bending pipe to follow abrupt changes in trench contours, leaving pipe ends open in trench overnight, not properly drying joints after rain storms, exceeding effective adhesive life, sharp objects in trench bed, backfill that could damage pipe, improper procedure for concrete encasement of pipe, omission of thrust blocks at changes in direction or any other conditions which could have an adverse effect on the satisfactory completion and operation of the piping system.

3.1.6 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA-01.

3.1.7 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic. Pipe shall be installed through the sleeve with a plastic insulator (PSI Products Inc. Model PE or approved equal) mounted on the pipe ;such that the total annular space between the casing insulator and the sleeve is 2 inches maximum.

3.1.8 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.2 Jointing

3.3 Polyethylene (PE) Pipe

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

3.4 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe 4 inch through 12 inch diameter: Joints shall be elastomeric-gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

3.5 RTRP I, RTRP II and RPMP Pipe

a. RTRP I: Assembly of the pipe shall be done in strict conformance with the manufacturer's written instruction and installation procedures. Field joints shall be prepared as specified by the pipe manufacturer. Several pipe joints having interference-fit type couplings may be field bonded and cured simultaneously. However, the pipe shall not be moved nor shall additional joints be made until the previously laid joints are completely cured. Joints not having interference-fit type coupling shall be fitted with a clamp which shall hold the joint rigidly in place until the joint cement has completely cured. The clamps shall have a protective material on the inner surface to prevent damage to the plastic pipe when the clamp is tightened in place. The pipe manufacturer shall provide a device or method to determine when the joint is pulled against the pipe stop. Additionally, the pipe manufacturer shall furnish a gauge to measure the diameter of the spigot ends to ensure the diameter conforms to the tolerances specified by the manufacturer. All pipe ends shall be gauged. Factory certified tests shall have been satisfactorily performed to verify that short-term rupture strength is 1,500 psior greater when carried out in accordance with ASTM D 1599. All field bonded epoxy-cemented joints, regardless of ambient temperature, shall be cured with a self-regulating thermostatically temperature controlled electrical heating blanket for the time and temperature recommended by the manufacturer for the applicable size and type of joint, or by an alternate heating method recommended by the manufacturer and approved by the Contracting Officer. The joint sections shall not be moved during heating or until the joint has cooled to ambient temperature.

b. RTRP II: A reinforced overlay joint shall be used to join sections together through a placement of layers of reinforcement fiberglass roving, mat, tape or fabric thoroughly saturated with compatible catalyzed resin.

c. Fittings and Specials for RTRP and RPMP Pipe: Metal to RTRP and RPMP pipe connections shall be made by bolting steel flanges to RTRP and RPMP pipe flanges. Cast-iron fitting with gasket bell or mechanical joint may be used with RTRP if pipe has cast iron outside diameter. Steel flanges shall be flat-faced type. Where raised-face steel flanges are used,

spacer rings shall be used to provide a flat-face seat for RTRP and RPMP pipe flanges. A full-face Buna "N" gasket 1/8 inch thick with a shore hardness of 50-60 shall be used between all flanged connections. The RTRP and RPMP pipe flange shall have raised sealing rings. Flat washers shall be used under all nuts and bolts on RTRP and RPMP pipe flanges. Bolts and nuts shall be of noncorrosive steel and torqued to not more than 100 foot pounds.Flanges shall not be buried. A concrete pit shall be provided for all flanged connections.

3.6 Ductile-Iron Pipe

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.7 Steel Pipe, Not Galvanized

a. Mechanical Couplings: Mechanical couplings shall be installed in accordance with the recommendations of the couplings manufacturer.

b. Rubber Gaskets: Rubber gaskets shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the pipe manufacturer.

3.8 Galvanized-Steel Pipe

Screw joints shall be made tight with a stiff mixture of graphite and oil, inert filler and oil, or with an approved graphite compound, applied with a brush to the male threads only. Compounds shall not contain lead.

3.9 Bonded Joints

Bonded joints shall be installed in accordance with details specified for joints in paragraph JOINTS.

3.10 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with details specified in paragraph JOINTS. Dielectric unions shall be encapsulated in a field-poured coal-tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.11 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.12 Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines

approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines Larger than 2 inches

Service lines larger than 2 inches shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter, and shall have a gate valve. Lines three-inches and larger may use rubber-seated butterfly valves as specified above, or gate valves.

3.12.2 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.13 Field Coating and Lining of Pipe

3.13.1 Steel Pipe 3 In. and Larger, Not Galvanized

a. Cement-mortar coating and lining: Field jointing shall conform to Appendix, AWWA C205. Any defective area found in the coating and/or lining of pipe and joints shall be removed to the pipe wall and repaired. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe. Steel reinforcement in the coating shall be repaired or replaced as necessary to assure a complete and soundly reinforced coating.

b. Coal-tar enamel coating, lining and wrapping: Field jointing shall conform to AWWA C203. The applied materials shall be tested by means of a spark-type electrical inspection device in accordance with the requirements of AWWA C203. Any flaws or holidays found in the coating and/or lining of pipe and joints shall be repaired by patching or other approved means. The repaired areas shall be at least equal in thickness to the minimum coating and/or lining required for the pipe.

3.13.2 Galvanized-Steel Pipe

Field joints shall be given one coat of coal-tar primer and two coats of coal-tar enamel conforming to AWWA C203. The tests of the coating shall conform to AWWA C203, and any flaws or holidays found in the coating of pipe and joints shall be repaired by patching or other approved means such that the repaired areas will be at least equal in thickness to the minimum coating required for the pipe.

3.14 Setting of Valves and Valve Boxes

3.15 Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet. Contractor shall furnish two (2) valve wrenches to the Contracting Officer.

3.16 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.17 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.18 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.18.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.18.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-01.

3.2 CATHODIC PROTECTION

Calthodic protection shall be provided for all metallic piping installed underground and shall be installed as specified in Section \=16640=\ CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.19 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.19.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be

subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02222EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.19.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 200 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 200 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 1/2 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.19.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks

necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.19.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.20 DISINFECTION

3.20.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651.. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.21 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 02685

GAS DISTRIBUTION SYSTEM
12/93

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 GAS ASSOCIATION (AGA)

AGA-01	(1989) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(1995) Line Pipe
API Spec 6D	(1994; Supple June 1996) Pipeline Valves, (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 181	(1995b) Forgings, Carbon Steel, for General-Purpose Piping
ASTM D 2513	(1995c) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2517	(1994) Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
ASTM D 2683	(1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 3261	(1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1991A) PTFE Resin Skived Tape
ASTM D 3350	(1993) Polyethylene Plastics Pipe and Fittings Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General

	Purpose (Inch)
ASME B16.5	(1988; Errata Oct 1988; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1988) Valves - Flanged, Threaded, and Welding End
ASME B16.40	(1985; R 1994) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPV VIII Div 1	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions

NACE INTERNATIONAL (NACE)

NACE RP0185	(1985) Extruded, Polyolefin Resin Coating Systems for Underground or Submerged Pipe
NACE RP0274	(1993) High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC Paint 101	(1991) Aluminum Alkyd Paint

SSPC Paint 104	(1991) White or Tinted Alkyd Paint
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL-06	(1996) Gas and Oil Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Welding Steel Piping

Welding and nondestructive testing procedures for pressure piping are specified in Section 15052 WELDING, PRESSURE PIPING. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

1.2.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.4 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION.

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-07 Schedules

Equipment and Materials; [FIO].

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

a. Dielectric Unions and Flange Kits.

b. Meters.

c. Pressure Reducing Valves.

d. Regulators.

Notification; [FIO].

Notification of the Contractor's schedule for making connections to existing gas lines, at least 10 days in advance.

SD-08 Statements

Welding Steel Piping; [FIO].

A copy of qualified welding procedures along with a list of names and identification symbols of performance qualified welders and welding operators.

Jointing Polyethylene and Fiberglass Piping; GA.

A copy of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors.

Connection and Abandonment Procedures; GA.

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME B31.8.

SD-13 Certificates

Utility Work; [FIO].

Certification from the Operating Agency/Utility Company that work for which the Utility is responsible has been completed.

Training; [FIO].

A copy of each inspector's and jointer's training certificate with respective test results.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

2.1.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Grade A or B, Type E or S, Schedule 40; or API Spec 5L seamless or electric resistance welded, Schedule 40, black steel pipe as specified in ASME B31.8. Furnace buttwelded pipe may be used in sizes 1-1/2 inches and smaller.

2.1.2 Small Fittings

Fittings 1-1/2 inches and smaller shall conform to ASME B16.11.

2.1.3 Fittings, 2 Inches and Larger

Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5, Class 150. Buttweld fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

2.1.4 Steel Forged Branch Connections

Connections shall conform to ASTM A 181, Class 60, carbon steel.

2.1.5 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluorethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.7 Sealants for Steel Pipe Threaded Joints

2.1.7.1 Sealing Compound

Joint sealing compound shall be as listed in UL-06, Class 20 or less.

2.1.7.2 Tape

Polytetrafluoroethylene tape shall conform to ASTM D 3308.

2.1.8 Identification

Pipe flow markings and metal tags for each valve, meter, and regulator shall be provided as required by the Contracting Officer.

2.1.9 Insulating Joint Materials

Insulating joint materials shall be provided between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.9.1 Threaded Joints

Joints for threaded pipe shall be steel body nut type dielectric type unions with insulating gaskets.

2.1.9.2 Flanged Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

2.1.10 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing steel and polyethylene or fiberglass pipe. Approved transition fittings are those that conform to AGA-01 requirements for transition fittings.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

AM#0005

2.2.1 Steel Valves

Steel valves 1-1/2 inches and smaller installed underground shall conform to ASME B16.34, carbon steel, socket weld ends, with square wrench operator adaptor. **Steel valves 1-1/2 inches and smaller installed aboveground shall conform to ASME B16.34, carbon steel, socket weld or threaded ends with wrench operator**. Steel valves 2 inches and larger installed underground shall conform to API Spec 6D, carbon steel, buttweld ends, Class 150 with square wrench operator adaptor. **Steel valves 2 inches and larger installed aboveground shall conform to API Spec 6D, carbon steel, buttweld or flanged ends, Class 150 with wrench operator**.

2.2.2 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow and vacuum protection, and shall be designed to meet the pressure, load and other service conditions.

2.2.2.1 Service Line Regulators

Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators shall be provided where gas will be distributed at pressures in excess of 10 inches of water column. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 2 inch size.

2.2.3 METERS

Meters shall conform to ANSI B109.2. Meters shall be pedestal mounted and be provided with a strainer immediately upstream. Meters shall be provided

with over-pressure protection as specified in ASME B31.8 tamper-proof protection, frost protection, and fungus-proof protection. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall provide not less than one pulse per 100 cubic feet of gas.

PART 3 EXECUTION

3.1 GAS LINES

Pipe for gas lines shall be steel. Steel pipe and fittings shall be coated with protective covering as specified. Service lines shall be constructed of materials specified and shall extend from the existing gas service line to and including the point of delivery as shown. The point of delivery is the meter set assembly. The service line shall be connected to the existing gas service line as indicated. Where indicated, service line shall be provided with an isolation valve of the same size as the service line. The service lines shall be as short and as straight as practicable between the point of delivery and the existing gas service line and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures.

3.1.1 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

3.1.2 PROTECTIVE COVERING

AM#0005
3.1.2.1 Protective Covering for Underground Steel Pipe

Except as otherwise specified, protective coverings shall be applied mechanically in a factory or field plant especially equipped for the purpose. Valves and fittings that cannot be coated and wrapped mechanically shall have the protective covering applied by hand, preferably at the plant that applies the covering to the pipe.

3.1.2.1.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer (same type paint as the shop primer). Surfaces that have not been shop primed shall be solvent-cleaned in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be mechanically cleaned by power wire brushing in accordance with SSPC SP 3 or brush-off blast cleaned in accordance with SSPC SP 7 and primed with ferrous metal primer in accordance with SSPC Paint 25. Primed surfaces shall be finished with two coats of exterior alkyd paint conforming to SSPC Paint 104.

3.2 Nonferrous Surfaces

Nonferrous surfaces shall not be painted.

3.2.1 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA-01 and 49 CFR 192. Abandoning existing gas piping shall be done in accordance with ASME B31.8. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. Cutting of plastic pipe shall be in accordance with AGA-01. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.2.1.1 Installing Pipe Aboveground

Aboveground piping shall be protected against dirt and other foreign matter as specified for underground piping. Joints in steel pipe shall be welded; however joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Flanges shall be of the weld neck type to match wall thickness of pipe.

3.2.2 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.2.2.1 Threaded Steel Joints

Threaded joints in steel pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.

3.2.2.2 Welded Steel Joints

Gas pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.8. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.2.2.3 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.2.3 PRESSURE REGULATOR INSTALLATION

3.2.3.1 Service Line Regulators

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building, 18 inches above the ground on the riser. An insulating joint shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.2.4 METER INSTALLATION

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

3.2.5 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8 using proper fittings to suit the actual conditions.

3.2.5.1 Connection to Government Owned/Operated Gas Lines

The Contractor shall provide connections to the existing gas lines in accordance with approved procedures. Deactivation of any portion of the existing system shall only be done at the valve location shown on the drawings. Reactivation of any existing gas lines will only be done by the Government. The Contractor's Connection Plan shall be submitted and approved prior to making any connections to existing gas lines. This plan shall include the Operating Agency's required procedures which may be obtained from the Base Civil Engineer's office. The Contractor shall notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

3.2.5.1.1 TESTS

3.3 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. The normal operating pressure for the system is 20 psig. The test pressure is 50 psig. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons

not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 09000

BUILDING COLOR AND FINISH SCHEDULE

PART 1 GENERAL

1.1 SUMMARY

This section covers colors, patterns, and textures of exterior and interior floor, wall, ceiling, and equipment finish materials, for the Upgrade Recruit Dormitory at Lackland A.F.B. Texas.

1.2 REFERENCES

The Federal Standard (FED-STD or FSN) listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by the basic designation only.

FED-STD 595B Colors

1.3 FEDERAL STANDARD COLOR REFERENCES

FED-STD 595 color references are on file in the Office of the Contracting Officer.

1.4 REFERENCES TO MANUFACTURERS AND PRODUCTS

The manufacturer's names and their products referenced in this section shall indicate the color, texture, and pattern required for the materials listed. The products furnished shall meet(be the same or an approved equal to) the color, texture, and pattern indicated as well as the material quality and performance specified in the applicable technical sections. The use of manufacturer's names and products do not preclude the use of other manufacturer's products of approved equal color, texture, or pattern finishes as long as all requirements are met.

1.5 ABBREVIATIONS: MANUFACTURERS AND MATERIALS

Abbreviation	Material	Manufacturer	Mfgr's No/Color
EC	Exposed Concrete		
EW	Existing Wood (Base) to match color P-2		
EVCT	Existing Vinyl Composition Tile		
GRT-1	Grout	Dal-tile	#380 Haystack
GRT-2	Grout	Dal-tile	#386 Oyster Gray #386

GSU-1	Glazed Structural Unit	Acme	Elgin Butler, shade 4159 Stoneware
EIFS	Exterior Insul. Finish System	Finestone	To match color of Bldg 9050
Miniblinds		Levolor	Dover 115
NCPT-1	New Carpet Tile	Interface	Libra Product #1629002500
NCT-1	New Ceramic Tile	Dal-Tile	Keystone Dk-325 Marble.
NCT-2	New Ceramic Tile	Dal-tile	#6416 Mink, Gloss
NCT-3	New Ceramic Tile	Dal-tile	#6510 Grape, Matte
NFRP-1	New Fiberglass Reinforced Panels	Kemlite	White smooth #85
NFRP-2	New Fiberglass Reinforced Panels	Kemlite	Soft Beige #70
NQT-1	New Quarry Tile	Metropolitan Ceramics	#105 Buckskin
NQT-2	New Quarry Tile	Metropolitan Ceramics	#507 Puritan Gray
NQT-3	New Quarry Tile	Quarry Tile Co.	Natural Hues Burgundy
NRF	Rubber Floor	Roppe	#540 Fawn
NRB-1	Rubber Base	Roppe	#540 Fawn
NSAU-1	New Suspended Acoustical Unit	Armstrong	High Performance Beveled, Tegular Cirrus in White
NSAU-2	New Suspended Acoustical Unit	Armstrong	Hi-LR Ultima RH90 in White
NVCT-1	New Vinyl Comp. Tile	Armstrong	Stonetex 52143 Sandstone
NVCT-2	New Vinyl Comp. Tile	Armstrong	Stonetetex 52132 Dusty Khaki
NVCT-3	Vinyl Comp. Tile	Armstrong	Stonetex 52122 Pebble Grey
NVCT-4	Vinyl Comp. Tile	Armstrong	Imperial Tex 51899 Cool Wht.
NVCT-5	Vinyl Comp. Tile	Azrock	VS 292 Burgundy

P-1	Paint	Sherwin Williams	#SW1032 City Loft
P-2	Paint	Sherwin Williams	#SW1034 Dolphin
P-3	Paint	Sherwin Williams	SW1294 cabernet
P-4	Paint	Hanley	#5375N Thrush
P-5	Paint	Sherwin Williams	#SW1057 Taupe
PL-1	Plastic Laminate	Formica	#1783-75 Firedust
PL-2	Plastic Laminate	Formica	#7022-42 Canvas
SF	Seamless Flooring	Rohalith	to match NRF
TP	Toilet Partition	Sanimetal	Stainless steel Finish
VWC-1	Vinyl Wallcovering	Gencorp	Tower Sherwood Moss T2-SW-23
VWC-2	Vinyl Wallcovering	Trikes	Essex mentmore Nimbus SP-26-04
VWC-3	Vinyl Wallcovering	Trikes	Essex mentmore Pebble SP-26-42
Wall Bumper	Boston Bumper		Color guard series 60 color 43 Clay 2-!/4" x 1-1/8"
WG-1	Wall Rail	C/S Group	Acrovyn Cordovan #875 Pebblette
WS-1	Wood Finish	Minwax	Natural Red Oak
Window Glazing		HGP or an approved equal	

1.6 EXTERIOR COLOR/FINISH INSTRUCTIONS

Note: Refer to paragraph "ABBREVIATIONS: MANUFACTURERS AND MATERIALS" for coordination of all color/pattern/texture finish abbreviation where indicated in this paragraph.

1.6.1 Exterior Wall: Brick, EIFS

1.6.1.1 Contractor to repair and replace brick as neccessary, and new brick shall match to existing brick in size, color and texture.

1.6.1.2 Contractor to repair and replace brick mortar, and to match existing building.

1.6.1.3 Exterior Insulation Finish System shall be in an integral color to match to building #9050 in a flat finish with texture in a sand pebble/fine. Paint stucco over the Mechanical room in clear epoxy paint finish, with a minimum of two coats for protection against moisture seepage into the inside of the walls.

1.6.1.4 Exterior new concrete screen wall to match to buildings #9050.

1.6.2 Doors, Door Frames: Metal

1.6.2.1 Steel: Frames shall be finish in color to match P-4 (on the exterior side of the building), and in P-2 in the interior side of rooms, unless otherwise indicated.

1.6.2.2 Steel: Doors shall be finish in color to match P-4 on the exterior side and in P-1 in the interior side of doors, in semigloss finish.

1.6.3 Glazing:

Glazing is specified in SECTION: 08810 - GLASS AND GLAZING. Glazing for the exterior windows shall come in a frosted finish, 1/4" laminated glass with the lamination at.030 thick in a white opaque film between the glass.

1.6.4 Handrails, Guardrails:

Handrail and guardrails components in steel, painted in color to match P-4, in semigloss finish.

1.6.5 Roofing Assembly: Built-up:

1.6.5.1 Coping: Metal, to match building #9050.

1.6.5.2 Roof Vents; to match building #9050.

1.6.5.3 Fascia: Metal, to match building #9050.
Hooded flashing metal over and up both sides of in-take vent on mechanical rooms, paint to match EIFS color.

1.6.5.4 Exposed Gutters and Downspouts- To match P-4 in a factory Kynar paint finish, semigloss.

1.6.5.5 Louvers, Grilles- Louvers in building 9110 shall match existing building #9050 in color finsh. Exterior metal plates over the exterior "old vents" shall be removed, and shall be replaced with new brick (to cover the opening)that match exising.Grilles colors to match Building #9050.

1.6.6 Windows: Metal

1.6.6.1 Aluminum: Manufacturer's standard medium anodized bronze finish.

1.6.6.2 Steel: Factory finished in color P-4, in semigloss finish.

1.6.6.3 Windows Sills: Metal.

1.6.6.3.1 Aluminum in anodized medium bronze finish.

1.6.6.3.2 Steel: Factory finished in color P-4, in semigloss finish.

1.6.7 Exterior Concrete floor

Provide a broom finish pattern over the exposed conc floor.

1.6.8 All miscellaneous metals, metal plates and shapes

To match adjacent finish.

1.6.9 **OPTION #9** Exposed structural steel components .

Paint to match building #9050 in color.

1.6.10 Existing Gas Pipe On Low Roof

Provide rust treatment (OSPRO or equal) and exterior metal paint for the existing gas pipe on low roof.

1.7.1 Pit Area - Walls shall be covered in factory pre-finish metal wall panels to match brick in color. Refer to the architectural drawings for location and other details.

1.7 INTERIOR COLOR/FINISH INSTRUCTIONS

Note: Refer to paragraph 1.5 for coordination of all color/pattern/texture finish abbreviation where indicated in this paragraph.

1.7.1 Exposed Ceiling

All exposed structural steel such as girder joists, joists, beams, underneath of metal decking, mechanical and electrical components shall match or be similar to paint color P-1 in a semigloss finish, unless otherwise indicated.

1.7.3 Ceiling and Suspended Ceiling Grid:

1.7.2.1 Gyp Board Ceiling for the dorm room units shall receive a semi-gloss enamel finish in color P-1 . Shower area in the toilets shall recive 2 coats of epoxy paint in color P-1. The drop/furred down ceiling above toilets to receive a semigloss alkyd enamel paint finish that matches the adjacent wall color. Other toilets and janitor closets shall receive semigloss alkyd enamel paint finish.

1.7.2.2 Suspended Ceiling Grid shall be provided in manufacturer's standard white color to match the adjacent ceiling panel in color. The suspended ceiling grid supporting NFRP and NSAU-2 ceiling tiles shall be of the environmental tee type, 90% RH resistance.The NFRP-1 shall have a smooth finish.

1.7.2.3 Plaster ceiling shall be painted in epoxy paint color to match P-1, in a semigloss finish.

1.7.2.4 NFRP Ceiling Panels:
NFRP-1 shall have a smooth finish in the indicated color. NFRP-2 shall have a texture finish in the indicated color.

1.7.4 Walls

1.7.3.1 All walls, unless otherwise indicated, shall be painted in a scrubable latex enamel paint in semigloss finish.

1.7.3.2 Exposed walls in the Kitchen area shall be painted in a semigloss finish, unless otherwise indicated.

1.7.3.3 Unless otherwise indicated, provide a trim finish over the top edge of the vinyl wall covering wainscot in the same color.

1.7.3.4 Laundry\Dryer area - Provide a 2 coat of epoxy paint finish 4 feet high wainscot on all walls.

1.7.3.5 In the Dining Room area - Red Oak trim with high polished mirrors, to match WS-1, covered in a clear polyurethane protective coating in a satin finish. The 4" accent stripe strip in color P-3, in a satin gloss finish. In the Dorm units, existing wood chair rail shall be removed, strip clean(and repair or replace as neccessary) refinished in P-2 semigloss, and reinstalled.

1.7.5 Wall ceramic Tiles and Grout finish:

1.7.4.1 New soap dishes, towel holders and other dispensers shall be integral part of same color ceramic walls in the latrines.

1.7.4.2 Ceramic tiles in size; 2x2 inches, in the indicated colors and pattern. Accent CT-3 shall be placed in a band at 4'h. see the architectural drawings for more information. Grout shall be GRT-1 for wall application, with epoxy grout for shower, dishwashing and can wash rooms.

1.7.4.3 In Janitors Closets in the first floors; 6ft.h ceramic tile wainscot with no NCT-3 pattern required. Paint gyp wall board above the wainscot in semigloss finish in the indicated color. Janitors' Closet in the 2nd and 3rd floors shall receive 2 coats of epoxy paint in color P-1 in a semigloss finish, at existing height wainscot.

1.7.4.4 Walls behind the water softeners in the main mechanical rooms, shall receive 2 tiers of GSU-1 at the base of the wall, and shall be covered with 2 coats of epoxy paint finish at 4ft.h. The GSU shall use epoxy grout in GRT-2.

1.7.6 Floors:

1.7.5.1 Unless indicated, exposed concrete shall receive a concrete harderner with a smooth surface finish. Provide a sealer in the exposed concrete floor in the main mechanical room . In the stairs and laundry/dryer rooms remove the existing cement skin coat and relace with the indicated new non-skid coat finish.

[AM #5]
1.7.5.2 In areas where NVCT is indicated, it shall be placed under Option #1, otherwise it shall be existing to remain (EVCT/EVAT)with NVCT installed over it. Contractor to clean and replace as required in areas where existing floor finish contains broken tiles and will require filling to support the new floor finish above it. Refer to the architectural drawing for placement of NVCT pattern for the Dining area. In the Dining Area, the

NVCT-5 shall be placed at each 90 degrees turn in the accent tile band.

1.7.5.3 Where EWB (existing wood base) is shown shall be stripped, repaired and refinished in paint P-2, unless otherwise indicated by the contracting officer.

1.7.5.4 Floor carpet molding shall be in a medium bronze annodized aluminum.

1.7.5.5 In stairs shall receive a rubber tile "NRF" over the landings. RB-1 on the walls. Thread, nosing, stringers, and risers shall be repaired to new condition in concrete and covered and finished in a troweled seamless synthetic coating material (SF)that matches in color to the rubber flooring "Fawn" with a abrasive finish.Underneath of stairs shall be painted in a semigloss paint finish.

1.7.5.6 Threshold in the following; where called out in the drawing, the metal shall have a mill finish annodized aluminum, the vinyl to match in color with the resilient base that is in the room. Threshold in the 2nd and 3rd floors between dorm units and corridors shall be removed for EVCT removal and NVCT installation (under Option #1), and shall be cleaned, repaired and reinstalled.

1.7.5.7 Toilet and shower areas, shall receive 2x2 inch ceramic tile flooring in an non-skid unglazed finish. Grout shall be epoxy type.

1.7.5.8 All quarry floor tiles shall be non-skid quarry tiles with a raised pattern, and shall use with epoxy grout.

1.7.7 Window Frames (Interior, Glazing)

1.7.6.1 Aluminum windows frames shall be in medium bronze anodized aluminum finish except for in the Dining, window type "B1" shall be painted in P-3 in a satin gloss finish.

1.7.6.2 Window sills inside of all rooms shall be in medium bronze anodized finish.

1.7.6.3 Steel, factory primed and painted in color to match P-4 in semigloss finish.

1.7.8 Doors, Door Frames:

1.7.7.1 Steel: Factory finished, in color P-2 in semigloss finish. Frames in color P-5 semigloss finish. In Laundry Rooms, paint door and frame in P-2, in semigloss finish.

1.7.7.2 Wood Doors shall be painted in P-2 in semigloss finish.

1.7.8 Door Hardware

Door hardware finish is specified in SECTION 08700 BUILDER'S HARDWARE.

1.7.10 HVAC Equipment

Paint all supply and return air mechanical grills or diffusers on gypsum board ceiling and walls to match adjacent color. Thermostat in manufacturer's color nearest to P-1.

1.7.11 Cabinets, Countertop, Vanity:

1.7.10.1 Unless otherwise indicated, interior and exterior sides of cabinets shall be stained to match WS-1, in a satin finish.

1.7.10.2 In Laundry room's counter top, lip and backsplash shall receive PL-1. Paint counter support in P-1 .

1.7.10.3 All Bathrooms with vanity counter top:
Top, lip, and backsplash shall be in plastic laminate finish in PL-2.

1.7.10.4 All face panels of food service equipment in servery/dining room extension in PL-1.

1.7.12 Shelving

Existing interior shelving shall be painted to match adjacent wall finish, unless otherwise indicated.

1.7.13 Mop Racks

Painted to match adjacent wall finish.

1.7.14 Equipment:

1.7.13.1 All toilet partitions shall be in #4 satin stainless steel finish.

1.7.13.2 White Boards - Similar to Greensteel's Claridge AXW Series wood framed pre-fab with marker board in white color, wood to match WS-1. Tackboards shall have a cork surface in color and size of 4feet square frame in chrome finish. Tackable surface for the displaycase in color cork finish. Provide 2 per dorm rooms.

1.7.13.3 Not used.

1.7.13.4 Drying room seats: new 2x4 redwood slats to match WS-1, on stainless steel frame brackets sanded smooth, sealed with 3 minimum clear polyurethane.

1.7.13.5 Existing Ceiling Fans shall be removed, cleaned and reinstalled. New ceiling fan shall be white enamel factory finish. Contractor to check existing ceiling fans for any defects or need for replacment.

1.7.13.6 All lockers shall be protected and repaired as necessary.

1.7.15 Corner Guards, Chair Rails, Wall Bumper:

Corner and Chair Rails shall be placed as indicated in the architectural drawings. Stainless steel corner guards shall be placed over the outside corners in the kitchen. Stainless steel corner guards shall be installed at floor level, not from the top of base. Chair rail in Acrovyn shall be mounted over the interior walls in the kitchen, dining rooms and shall be placed all around walls installed at approximately 34"AAF. The Red oak chair rails shall come in 2 inch thick by 4 inches wide by length to fit conditions, with miniwax #221 1pswich pine satin. It shall be mounted on all walls at 34"h as indicated in the room finish schedule drawing, and shall match WS-1 (in the Admin Offices) and painted in the dorm units in

color to match P-2. New and Existing Wood base to match P-2. Provide 2 corner guard at the edge corners in the dorm rooms units W1 thru W9. wall bumpers shall be installed in the kitchen area, and shall be an approved equal to Boston Bumper color Guard series 60, with rigid vinyl channel, insert, corner and end caps, 2-1/4" x 1-1/8".

1.7.16 Signage colors:

Building exterior signs and interior signs in are specified in SECTION: 10430 - EXTERIOR SIGNAGE and SECTION:10442 - INTERIOR SIGNAGE.

Interior signage shall be removed/reinstalled by the contractor before/after completion of construction. Placement shall be coordinated with the contracting officer.

1.7.17 Expansion Joint

I n a color that nearly matches adjacent wall and /or floor finish.

1.7.18

Not used.

1.7.19 Mirrors

Mirrors shall be manufactured to fit walls symetrically, with each of the mirrors in the same dimension in the largest possible size.

1.8 ROOM COLOR AND FINISH SCHEDULE

Note: Information ascribed in this schedule shall pertain to both building 9110 and 9210 in this contract. Since both building are alike, all room numbers and their finish applies to both. Except in a few cases where they differ, it will be noted with either a ***9110*** or ***9210*** along side of the room indicating that this particular room finish shall be an exclusive finish to the building the rooms is in. All material finish indicated includes Option #1 (NVCT in lieu of EVCT/EVAT).

The direction of the walls are keyed as alpha characters "A,B,C,D" with the architectural floor plan orientation. WALL ORIENTATION: A=NORTH B=EAST C=SOUTH D=WEST

FIRST FLOOR

Area: Dry Clean Rm 001

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-2

Area: Classrooms Rms 037, 042, 045, 053, 054, 055

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Classrooms (TI Lounge) Rm 049

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	CPT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Closet Rms 001A, 001B, 037A, 037B, 042A, 042B, 045A, 045B, 049A, 049B, 053A, 053B, 054A, 054B, 055A, 055B, 066A, 066B.

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Dishwashing (Clipper) Rm 002, 039

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-2	NQT-2	NCT-2	NCT-2	NCT-2	NCT-2	P-1

Area: Dining Entry/Exit West Rm 003 and East Rm 038,

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-1	P-1	P-1	P-1	P-1	NSAU-2
		NVCT-2					

NOTE: Accent tile NVCT-2 used as the border, with NVCT-1 as the in-field.

Area: Storage Rm 004, 050, 064A

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	EC	P-1	P-1	P-1	P-1	P-1

Area: Mail Room Lobby Rm 005 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: PC Supply Office Rm 005***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Mail Room Rm 006 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: PC Supply Rm 006 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Closet Rm 007

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	--	EC	P-1	P-1	P-1	P-1	P-1

Area: Stair Rm 008, 035, 044, 051, 064, 086

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NRF/SF	P-1	P-1	P-1	P-1	P-1
	SF						

Area: Kitchen Office Rm 010

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	NSAU-2
			VWC-2	VWC-2	VWC-2	VWC-2	

NOTE: VWC-2 wainscot height at 34" high AAF, with chair rail in WS-1 above.

Area: Expendable Storage Rm 011

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Training Rm 012

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Janitor Closet Rm 013

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	P-1	P-1	P-1	P-1	P-1
			CT-2	CT-2	CT-2	CT-2	

Area: Men's Lockers Rm 014

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	P-1

Area: Vestibule Rm 014A

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls.

Area: Men's Restroom/Shower Rm 014B

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls.

Area: Women's Lockers Rm 015

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-1	P-1	P-1	P-1	P-1	P-1

Area: Women's Restroom/Shower Rm 015A

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls. Paint shall be smooth in semigloss finish.

Area: Can Wash Rm 016

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NCT-2	NCT-2	NCT-2	NCT-2	P-1

Area: Vestibule Rm 017

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Hall Rm 018, 020

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Pot & Pan Wash Rm 019

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Kitchen Rm 021

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Note: Wall metal liner in stainless steel.

Area: Vegetable Prep Rm 022

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Cooler Rm 023, 024

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	P-1(White Enamel)

Area: Receiving 025

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Dry Goods Stor Area Rm 026

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Cooler Rm 027

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	P-1(White Enamel)

Area: Cooler Rm 028

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	P-1(White Enamel)

Area: Carb-Bev Pump & Bottle storage Rm 029

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	NFRP-1

Area: Janitor Closet Rm 030

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	P-1 NCT-2	P-1 NCT-2	P-1 NCT-2	P-1 NCT-2	P-1

Area: Receiving Off Rm 031

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-1	P-1	P-1	P-1	P-1	P-1

Area: Thaw Box Rm 032

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	P-1(White Enamel)

Area: Freezer Rm 033

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-1	NQT-1	NFRP-2	NFRP-2	NFRP-2	NFRP-2	P-1(White Enamel)

Area: Closet (Crawl Space Access) Rm 009, 034, 052, 065

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	--	EC	P-1	P-1	P-1	P-1	P-1

Area: Closet Rm 036

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	EC	P-1	P-1	P-1	P-1	P-1

Area: Serving Area 040

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NQT-2	NQT-2	P-1	P-1	NFRP-2	P-1	NFRP-1
		NQT-3					

Note: NQT-2 under the serving line floor. See Arch. drawings.

Area: Dining East Rm 041E and West Rm 041W,

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-1	P-1	P-1	P-1	P-1	NSAU-2
	NQT-1	NVCT-2	P-3	P-3	P-3	P-3	
	NQT-2	NVCT-5					
		NQT-2					
		NQT-3					

Note: Acrovyn chair rail installed at 34". height, over the joint in the almost middle of the walls in these rooms. On the floor NVCT-1 as the field tiles color, and NVCT-2 as the border, and NVCT-5 as the accent tiles. Refer to the arch drawings for the placement location of the accent and field tiles. The portion of the rooms between the serving lines to be done in quarry tile. NQT-2 as the field, NQT-3 as the accent tiles.
P-3 shall be placed as an accent wall border, see architectural drawings.

Area: Hall Rm 043, 087

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-2	P-1	P-1	P-1	P-1	NSAU-2

Area: Restroom Rm 046

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls. Paint shall be smooth in semigloss finish.

Area: Janitor Rm 047

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	

Area: Corridor Rms 048, 048A, 048B

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Office Rms 056, 057, 058, 059, 060, 061, 062, 063, 076, 077, 078, 079, 080, 081

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	VWC-2	VWC-2	VWC-2	VWC-2	NSAU-1

Note: Wood chair rail installed at 34" height.

Area: Closet Rm 056A, 057A, 058A, 060A, 061A, 062A, 063A, 077A, 079A, 080A

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Classroom H Rm 066 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Counseling Rms 066D ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Weight Training Rm 066 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Weight Counseling Rms 066D ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Storage Rms 066C

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Toilet Rm 067 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls. Paint above wainscot in a semigloss finish.

Area: Womens Rm 067 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls. Paint above wainscot in a semigloss finish.

Area: Mens Rm 068 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	P-1	P-1	P-1	P-1	P-1
			NCT-2	NCT-2	NCT-2	NCT-2	
			NCT-3	NCT-3	NCT-3	NCT-3	

Note: Accent NCT-3 band at 4'h all around walls. Paint above wainscot in a semigloss finish.

Area: Bench Rm 068 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	-	P-1	P-1	P-1	NSAU-1

Area: Training Lab Rms 069 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	VWC-1	VWC-1	VWC-1	VWC-1	NSAU-1

Area: Reception/Waiting Area Rm 069***BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Comm Rm 070

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Office Rm 071 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	VWC-2	VWC-2	VWC-2	VWC-2	NSAU-1

Area: Treatment Rms 071 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	VCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Closet Rm 072 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Closet Rm 072 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Office Rm 073 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	VCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Office Rm 073 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	VWC-2	VWC-2	VWC-2	VWC-2	NSAU-1

Area:
Closet Rm 074 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Closet Rm 074 ***(BLDG. 9120)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-1	P-1	P-1	P-1	P-1	NSAU-1

Area: Office Rm 075 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	VWC-1	VWC-1	VWC-1	VWC-1	P-1

Area: Closet Rm 075A ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NCPT-1	P-1	P-1	P-1	P-1	P-1

Area: Mech Rm 085

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	EC	EC	P-1	P-1	P-1	P-1	EC
	GSU-1						

Area: Laundry West Rm 098, Laundry East Rm 099

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	-	EC	P-1	P-1	P-1	P-1	P-1

Note: Paint in a semigloss finish.

Area: Dryer Service Rms 098A, 099A

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	-	EC	P-1	P-1	P-1	P-1	P-1

Note: Paint in a semigloss finish.

Area: Covered Training Area Rms 088, 089, 090, 091, 092, 093, 094, 095, 096, 097

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:		EC - - - -					P-1
		Asphalt					

NOTE: Fill all cracks and seal existing asphalt.

Area: Closet Rms 082, 084 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Storage Rm 083 ***(BLDG. 9210)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Area: Rooms 075, 082, 083, 084-NOT USED ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling

Area: Closet Rms 100A, 100B ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-3	P-1	P-1	P-1	P-1	NSAU-1

Area: Storage Rm 100 ***(BLDG. 9110)***

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

2ND & 3RD FLOOR

Area: Dorm Unit's W1, W2, W3, W4, W5, W6, W7, W8, W9, W10 (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	EW/NW	NVCT-4	P-1	P-1	P-1	P-1	P-1

Note: Replace existing wood base (EW) with new wood base (NW) where required.

Area: Team Instructor Rooms (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NW	NVCT-4	P-1	P-1	P-1	P-1	P-1

Area: Toilet Rooms (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	NCT-2	NCT-2	NCT-2	NCT-2	P-1
			NCT-3	NCT-3	NCT-3	NCT-3	
			P-1	P-1	P-1	P-1	

Ceiling and wall paint in epoxy semigloss finish. NCT-3 accent band at 4'h AFF on all walls.

Area: Shower(s) (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	NCT-2	NCT-2	NCT-2	NCT-2	P-1
			NCT-3	NCT-3	NCT-3	NCT-3	

Ceiling paint in epoxy semigloss finish. NCT-3 accent band at 4'h AFF on all walls.

Area: Drying Rooms (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NCT-1	NCT-1	NCT-2	NCT-2	NCT-2	NCT-2	P-1
			NCT-3	NCT-3	NCT-3	NCT-3	

Ceiling paint in epoxy semigloss finish. NCT-3 accent band at 4'h AFF on all walls.

Area: Dayrooms (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	NSAU-1

Ceiling fans in the manufacturer's standard white paint finish.

Area: Closet (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	P-1

Area: Mechanical Room (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	EC	P-1	P-1	P-1	P-1	P-1

Area: Janitor Closet (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	EC	P-1	P-1	P-1	P-1	P-1

Ceiling and wall paint in epoxy semigloss finish.

Area: Storage Rm - (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	P-1

Area: Stairs - (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NRF/SF	P-1	P-1	P-1	P-1	P-1
	SF						

Area: Vestibule Rms - (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	P-1

Area: Corridors (Typical)

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NRB-1	NVCT-4	P-1	P-1	P-1	P-1	P-1

PART 2 PRODUCTS (NOT USED)

PART 3 NOT USED

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 11400

FOOD SERVICE EQUIPMENT
02/97

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 CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-01	(1995) Industrial Ventilation: A Manual of Recommended Practice

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL-01	(1996) Directory of AGA & CGA Certified Appliances and Accessories

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)Org

ANSI Z21.15	(1992) Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
ANSI Z21.41	(1989; Z21.41a; Z21.41b) Quick-Disconnect Devices for Use With Gas Fuel.
ANSI Z21.45	(1992) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances.
ANSI Z21.69	(1992; Z21.69a) Connectors for Movable Gas Appliances.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 53	(1993) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
ASTM A 123	(1989a) 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 240	(1996) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM B 43	(1991) Seamless Red Brass Pipe, Standard Sizes.
ASTM B 75	(1992a) Seamless Copper Tube.
ASTM B 88	(1993) Seamless Copper Water Tube.

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-72	(1992) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

17A	(1990) Wet Chemical Extinguishing Systems.
NFPA 54	(1992) National Fuel Gas Code
NFPA 70	(1996) National Electrical Code
NFPA 96	(1994) Ventilation Control and Fire Protection of Commercial Cooking Equipment

NATIONAL SANITATION FOUNDATION (NSF)

NSF-01	(1994) Listings of Food Equipment and Related Products, Components, and Materials
NSF-02	(1968; Rev Feb 1989) Manual on Sanitation Aspects of Installation of Food Service Equipment
NSF Std 2	(1952; Rev May 1992) Food Equipment

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION

(SMACNA)

SMACNA-06	(1995) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL-02	(1996; Supple) Electrical Appliance and Utilization Equipment Directory
UL 197	(1993; Rev thru Aug 1996) Commercial Electric Cooking Appliances
UL 710	(1995) Exhaust Hoods for Commercial Cooking Equipment
UL 1046	(1979) Grease Filters for Exhaust Ducts

1.2 GENERAL REQUIREMENTS

Food service equipment shall be of the sizes and types shown. Equipment, materials, and fixtures required for use in conjunction with the items to be furnished by the Government shall be furnished and installed by the Contractor. Equipment, materials, and fixtures indicated on the drawings and schedules shown as Contractor furnished and installed, shall be furnished and installed by the Contractor.

1.2.1 Mechanical, Electrical, and Plumbing Work

Roughing-in and final connection of mechanical, electrical and plumbing systems to fixed and movable food service equipment and cold storage assemblies shall be as specified in SECTION: 15400 - PLUMBING, GENERAL PURPOSE; AND SECTION: 16415 - ELECTRICAL WORK, INTEROR; and SECION: 15488 - GAS PIPING SYSTEMS.

1.2.1.1 and Shut-Off Valves

Strainers, and shut-Off valves furnished under this section shall be as specified under SECTION: 15400 - PLUMBING, GENERAL PURPOSE.

1.2.1.2 Control Valves and Pressure Regulators

Control valves, apppliance pressure regulators for water, gas, steam, and vacuum breakers, wherever required on food service equipment (chrome-plated where exposed) shall be furnished under this section.

1.2.1.3 Plumbing Electrical work, and Gas Piping

Plumbing, electrical work, and gas piping specified, but not shown, shall be provided in accordance with SECTION: 15400 - PLUMBING, GENERAL PURPOSE; and SECTION: 16415 - ELECTRICAL WORK, INTERIOR; and SECTION: 15488 - GAS PIPING SYSTEMS.

1.2.2 National Sanitation Foundation Standards

Food service equipment shall meet the requirements set forth by the

National Sanitation Foundation (NSF-01). Acceptable evidence of meeting the requirements of the applicable NSF standards shall be anyone of the following:

a. A listing of the equipment in the NSF Food Service Equipment Listingand display of the NSF seal on the equipment for the year the equipment was manufactured.

b. A certification issued for special or specific food service equipment by NSF under their special one time contract evaluation and certification.

c. A certified test report from an independent testing laboratory, approved by the Office of the Surgeon General, indicating that the specific food service equipment has been tested and conforms to the applicable NSF standards.

1.2.3 Verification of Dimensions and Coordination of Project Data

The Contractor shall become familiar with all details of the work and shall advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall perform the following:

a. Horizontal and vertical dimensions shall be field verified.

b. Contract drawings and submittal data shall be reviewed for accuracy and completeness.

c. The installed utility capacity and location shall be field checked.

d. Critical systems/components shall be reviewed for application and capacities such as for exhaust hoods, refrigeration systems, fire suppression systems, gas, water, and steam/condensate line sizes and manifold configurations.

e. Delivery shall be coordinated for access through finished openings and vertical handling limitation within the building.

1.2.4 Standard Products

Materials and equipment shall be the standard products of manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satifactory use for at least 2 years priop to bid opening. The experience used shall include applications of equipment and materials under similar circumstances and of simiar size. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.5 WASTE PULPING PRODUCTS

a. Manufacturer regularly and presently manufactures food waste pulping systems as one of their principal products.

b. Installer has the technical qualifications, experience, trained personnel, and facilities to install specified items.

c. There is a permanent service organizaton, maintained or trained by the equipment supplier, which will respond to a service call within 24 hours with a fully equipped service vehicle and trained service person. Submit

name and address of service organization.

d. Manufacturer has equivalent product presently installed in three installations similar to this project for three years, and has been in satisfactory and efficient operation for that periond of time. Submit list of installations.

1.2.6 Equipment Nameplates and Identification Plates

Each item of equipment shall bear a stainless steel, aluminum, or engraved polyester nameplate, as standard with the manufacturer, located in a conspicuous position and permanently fastened to the equipment. Nameplates or identification plates shall be of the size standard with the manufacturer for the particular piece of equipment provided and shall be of the approximate size in the referenced specification. Nameplates or indentification plates shall reflect the following:

a. Name of the manufacturer/trade name.

b. Serial number, make, and model number.

c. Pertinent ratings, operating characteristics, and other information as standard with the manufacturer.

d. Date of manufacture.

e. Electrical characteristics.

f. Other applicable data, such as flow rate, temperature, pressure, capacity, and material of construction.

Separate equipment identification plates with the contract number marked thereon, shall be securely fastened to the surface of each piece of equipment. The identification plate and information imprinted thereon shall be as permanent as the life expectancy of the equipment to which they are affixed.

1.2.7 American Gas Association Laboratories Standards

Gas-burning equipment shall be designed for operation with the type of gas specified and shall be approved by AGAL. Acceptable evidence of meeting the requirements of the applicable AGAL-01 standards shall be one of the following:

a. A photostatic copy of the AGAL appliance certificate

b. A listing of the specific food service equipment or appliance in the AGAL Directory of Certified Appliances and Accessories

c. A certified test report from a nationally recognized independent testing laboratory, indicating that the specified equipment has been tested and conforms to the requirements of the applicable AGAL standards.

1.2.8 Underwriters Laboratories Standards

Electrically operated equipment shall be in accordance with applicable UL standards such as UL 197. Evidence of meeting the requirements shall be any one of the following:

a. Display of UL label on the equipment.

b. A UL listing mark per UL-02

c. A certified test report from a nationally recognized independent testing laboratory indicating that the specific food service equipment has been tested and conforms to the applicable UL standards.

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 Detail Drawings

Food Service Equipment; [___GA__].

Detail drawings consisting of a complete list of equipment and materials,including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructionsd. Detail drawings showing complete wiring, piping, 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 and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.

Brochures shall have front and rear protective covers with labeled project name and include:

a. Index indicating item number, quantity, description, and manufacturer.

b. Fly sheet for each component indicating itme number, name, quantity, manufacturer, optional equipment, mondification, special intruction, and utility requirements.

c. Catalog specifications sheets and manufacturer's drawings.

d. Detail drawings by Contractor shall be separate drawings and shall be the contractor's standard sheet size, but not smaller than the contract drawings, and shall indicate:

e. Food service equipment and cold storage assemblies with itemized schedule.

f. Special conditions drawings indicating size and location of slab depressions, cores, wall openings, blockouts, ceiling pockets, blocking grounds, [ceiling,] [wall,] access panels, and above ceiling hanger assemblies.

g. Plumbing/mechanical rough-in drawings.

h. Electrical rough-in drawings. Detail drawings by manufacturer shall be separate drawings; sheet size shall be manufacturer's standard

size and indicate:

1. Item number, name, and quantity
2. Construction details, sections, and elevations
3. Adjacent walls, columns, and equipment
4. Plumbing and electrical schematics, and fabricated fixtures with single electrical or plumbing connection.
5. Service access panels required for maintenance or replacement of mechanical or electrical components.

SD-09 Reports

Testing; [____FIO_].

Test reports in booklet format showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-19 Operation and Maintenance Manuals

Food Service Equipment; [___GA__].

[Six] complete copies of the service manual,after approval of the detail drawings not later than [3] months prior to the date of beneficial occupancy, with data for each different item of material and equipment specified. Service manuals shall include:

a. Front and rear protective covers with labeled project name.

b. Index indicating item number, quantity, description, manufacturer's name, and model number.

c. Maintenance instructions for stainless steel and plastic laminate.

d. Manufacturer's catalog specification sheets and manufacturer's detail drawings.

e. Manufacturer's operation manual outlining the step-by-step procedures for equipment installation, startup, basic operation features, and operation shutdown.

f. Manufacturer's maintenance manual listing routine maintenance procedures, possible breakdowns, repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.

g. Manufacturer's list of parts and supplies with current unit price and address of manufacturer's parts supply warehouse.

1.4 DELIVERY AND STORAGE

1.4.1 Delivery

Unless otherwise directed, the following procedures shall apply:

a. Field assembled fixed equipment integrated into structure shall be sent to jobsite when required.

b. Fixed equipment not integrated into structure shall be sent to the jobsite after completion of finished ceilings, lighting, and acidizing of the finished floor and wall systems, including painting.

c. Major movable equipment shall be delivered to inventory in a secured area for interim jobsite storage, or if secured area is not available, when fixed equipment installation/clean-up has been completed.

d. Minor appliances and loose items shall be delivered to the jobsite when the Contracting Officer is prepared to receive and inventory such items.

1.4.2 Storage

All Items delivered and placed into storage shall be stored with protection from weather, humidity, and temperature variation, dirt and dust, or other contaminants.

1.4.3 Protection of Fixed/Fabricated Manufactured Equipment

Fiberboard or plywood shall be taped to surfaces as required by equipment shape and installation access requirements.

1.4.4 Prohibited Use of Equipment

Food service equipment shall not be used as tool and material storage, work bench, scaffold, or stacking area.

1.4.5 Damaged Equipment

Contractor shall immediately submit documentation to the Contracting Officer with a recommendation of action for repair or replacement and the impact on project schedule.

1.5 SUBSTITUTIONS

1.5.1 Equipment items or components specified are intended to be typical manufacturers. All other brands, including any additional names which may be listed as "alternates" or "Approved Equal" must conform to the specifications, size, accessories, etc. of the first named brand and be subject to paragraph 1.5.2, this Specification.

1.5.2 Provide all design engineering services required to make adjustments in space, systems, utilities, etc. and pay all additional costs for utilities, construction or professional services that may be incurred due to the acceptance of any substitution.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following:

2.1.1 Black Iron Pipe

ASTM A 53

2.1.2 Brass Pipe

ASTM B 43

2.1.3 Chromium Plating of Brass Pipe, Valves, and Fittings

FS WW-P-541/GEN and FS WW-P-541/8

2.1.4 Copper Tubing

ASTM B 88, Type K or L, or ASTM B 75, as required to suit application.

2.1.5 Stainless Steel, Nonmagnetic

ASTM A 167 or ASTM A 240: 18-8, 302 polished to No. 4 finish on exposed surfaces.

2.1.6 Stainless Steel Pipe and Tubing

ASTM A 269. Pipe and tubing shall be seamless or welded, of the gauge specified, of true roundness, and of material as specified for stainless steel. Seamless tubing shall be thoroughly annealed, pickled, and ground smooth. Welded tubing shall be thoroughly heat-treated, quenched to eliminate carbide precipitation and then drawn true to size and roundness, and ground. Tubing shall be given a No. 3 or 4 finish when exposed to view.

2.1.7 Fittings for Copper Tubing

Fittings on tubing shall be of solder-joint type. Flared joint fittings may be used in specific applications when approved. Cast-bronze solder joint fiitings shall conform to ASME B16.22. Cast-bronze fittings for flared joints shall conform to ASME B16.26.

2.1.8 Fittings for Brass Pipe

FS WW-P-460, Class A or B, shall be as required for application.

2.1.9 Galvanizing Repair Compound

MS MIL-P-21035

2.1.10 Solder Material

ASTM B 32, Sn96.

2.1.11 Steel Structural Shapes for Framing

ASTM A 36. Structural shapes shall be uniform, ductile in quality, and shall be free of hard spots, runs, checks, cracks and other surface defects. Sections shall be galvanized by the hot-dip process, conforming to ASTM A 123.

2.1.12 Paint and Coatings

Coatings shall be of a durable, nontoxic, nondusting, nonflaking, and mildew-resistant type, suitable for use with food service equipment and in conformance with NSF Std 2. Application shall be in accordance with the

recommendations of the manufacturer.

2.1.13 Parts

Exterior, galvanized parts, exposed members of framework, and wrought steel pipe, where specified to be painted, shall be cleaned, degreased with mineral spirits, and primed with rust inhibiting primer, and primed with rust inhibiting prime and finshised with two coats of epoxy-based gray hammertone paint in accordance with Section 09900 PAINTING, GENERAL, unless otherwise specified.

2.2 CONSTRUCTION OF FABRICATED EQUIPMENT

2.2.1 Welding

2.2.1.1 Welding Rods

Welding shall be done with welding rods of the same composition as the sheets or parts welded.

2.2.1.2 Weld Quality

Welds shall be strong and ductile. Welds shall be free of imperfections such as pits, runs, spatter, cracks, and shall be finished to have the same color as the adjoining surfaces. Butt welds made by welding straps under seams, or by filling in with solder, or by grinding will not be acceptable. Welded joints shall be homogeneous with the sheet metal. Spot welding shall not be substituted for continous welding. Joints in tops of counters, tables, drainboards, exposed shelving, and sinks shall be joined bby heli-arc welding or a process other than carbon-arc welding or one that will permit carbon pick-up. Joints shall be fully welded. Counter tops shall be factory welded into lengths as long as practical in order to reduce field welded joints to a minimum. All welds shall be ground smooth and fee of burrs and sharp edges. Wherever welds occur on nonfood contact surfaces not suitable for grinding or polishing, such welds and the accompanying discoloration shall be sandblasted and coated inn the factory with a nontoxic metallic-base paint. Bolts and screws shall be welded by a process that will minimize the possibity of carbide precipitation. Welds in galvanized steel made after galvanizing, and the adjacent areas where galvanizing is damaged, shall be cleanded and coated with galvanizing repair compound.

2.2.2 Soldering

Soldering shall serve only as a filler to prevent leakage and shall be made with tin-antimony solder, conforming to FS QQ-S-571. Stainless steel requiring soldering shall first be cleaned of discoloration and then have a soldering flux applied. Excess or remaining flux shall be washed clean after the soldering has been completed, and the entire soldered joint and adjacent metallic surfaces shall be cleaned with a liquid alkaline or neutralizing agent to prevent any attack on the surronding metallic surfaces by the soldering flux.

2.2.3 Brazing

Brazing shall be accomplished with silver solder. Brazing shall be used only on copper tubing to brass and bronze connection fittings. Steam coils requiring dip-tinning shall first be brazed with all surplus flux removed so that metal is exposed and then tinned.

2.2.4 Grinding, Polishing, and Finishing

Exposed welded joints shall be ground smooth and finished to match the adjoining material. Whereever materials have been depressed or sunken by welding operation, such depressions shall be hammered and peened flush with the adjoining surface, and again ground to eliminat e highspots. Ground surfaces shall then be polished or buffed to match adjoining surfaces. Care shall be exercised in the gringing operations to avoid excessive heating of the metal and metal discoloration. Abrasives, wheels, and belts used in gringing shallbe free of iron and shall not havev been used on carbon steel. In all cases, the grain of rough grinding shall be removed by several successively finer polishing peration. The texture of the final polishing operation shall b e uniform, smooth, and consistent. The grain direction of horizontal stainless steel surface shall be longitudinal, including the splash back. Polishing at right angle corners shall provide a mitered appearance. Butt and contact joints shall be close fitting and not require solder as a filler. Wherever brake bends occur, the bends shall be free of open texture or orange peel appearance. Where brake work does mar the uniform appearance of the material, such marks shallbe removed by grinding, projections, and fins. Where miters or bullnosed corners occur, such miters and corners shall be finished with the underage of the material and ground to a uniform condition. Overlapping of material is not accptable. Exposed stainless steel surfaces shall have a No. 3 or 4 finish. Finishes of materials, other than stainless steel, shall be comarable in appearance to commercial mill finish. Exposed surfaces shall include:

a. Exterior surfaces exposed to view.

b. Interior surfaces exposed to view in doorless cabinets.

c. Undersides of shelves shall have a ground finish of No. 90 grit of finer

2.2.5 Chromium Plating

Chromium Plating, where used, shall be applied over nickel plating.

2.2.6 Fastening Devices

Fastening devices shall be of the same material as the metal being joined when joint pieces are of similar metal. Fastening devices shall be shtainless steel when stainless steel is joined to dissimilar metal. Stud bolts shall be 1/4-20 stainless steel with length necessary to accept washers, lock washers, and required nuts, and shall be welded 9" on center maximum. Exposed surfaces of equipment shall be free of bolts, screws, and rivet heads. Stainless steel stud bolts shall be used to fasten tops of counters or tables to angle framiing and trim to other surfaces. Such bolts shall be of the concealed type. Threads of stud bolts which are on the inside of fixtures and are either visible of might ocme in contact with a wipiong cloth, whall be capped with chrome plated washers, lock washers, and chromium-plated brass cap nuts. Wherever bolts are welded to the underside of trim of tops, the reverse side of the welds shall be finished uniform with the adjoining surface of the trim of the top. Dimples at

these points will not be acceptable.

2.3 COUNTERS

Counters shall be constructed in accordance with applicable portions of NSF Std 2.

2.3.1 Counter Tops

Counter tops shall be constructed of 14 gaugestainless steel with all seams and corners welded, ground smooth, and polished.

2.3.2 Cafeteria Counters

Cafeteria counters shall be constructed and sound deadened as indicated and as specified for counters.

2.3.3 Pitch and Drainage of Equipment Surfaces

Wherever a fixture has a waste or drain outlet, the surface shall have a distinct pitch toward such outlet. Corners shall be coved on mm3/4 inch radius and sloped 1/8 inch per footmaintaining level crown at front edges of rolled rims, marine edges, and backsplashes, when tops are sloped to drains.

2.3.4 Drip Gutter

Drip gutter shall be an integral part of the counter top and located where indicated. Drip gutter shall be provided with a 1 inch brass drain tube centered in the bottom of the gutter. Bottom shall be pitched to the drain. The drip gutter shall be 4 inches wide, 1 inch deep, and the length indicated. The drip gutter shall be provided with a 4 inchwide, 1 inch high, removable, nonsplash, stainless steel, wire mesh strainer with frame.

2.3.5 Counter Edges and Backsplashes

2.3.5.1 Counter Edges

Counter edges shall be as shown in drawings and the four profiles as shown in STANDARD DETAILS 1.02:

a. Inverted V: 3 inches at 90 degrees, 1/4 inch 45 degrees ("V"), with 3/4 inch tight hem at bottom.

a. Turned Down: Two inches at 9O degrees with 3/4 inch tight hem at bottom. Free Corners shall be rounded on 3/4 inch radius.

b. Marine Edge: Turned up [1/2 inch] [and] [mm1-1/2 inches] at 45-degree angle and turned down 2 inchesat 135 degree angle with 3/4 inch tight hem at bottom.

c. Raised Rolled Rim: Coved up 3 inches with 1-1/2 inch wide rim rolled 180 degrees and turned down to table top; hem edges, and bullnose corners.

2.3.5.2 Counter Backsplash

Counter backsplash, as shown in draqings and STANDARD DETAILS 1.04, shall be coved up and sloped backas indicated with dimensions, and turned down 1 inch at 135 degrees at teh rear of the splash with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 4 inch long, 12 gauge stainless steel "zee" clips anchored to wall, 3 feeton center.

2.3.6 Counter Top Support Angles and Hat Channels:

Counter top support angles shall be of 1-1/2 by 1-1/2 by 1/8 inch and hat channels 1 by 4 by 1/16 inch - 14 gauge painted galvanized steel angles with all corners mitered, welded, and ground smooth at perimeter. Angle cross members shall be provided on 24 inches centers maximum. A 4 by 4 inch, 12 gauge stainless steel triangular pad shall be provided where leg gussets are welded to the frame. Angle frame shall be stud bolted to counter top.

2.3.7 Sound Deadening of Counters

Counter tops shall be sound deadened with 1/2 inchwide rope sealant positioned continuously between all contact surfaces of the frame-members and the underside of counter top, overshelves and undershelves. Stud bolts shall be tightened for maximum compression and the excess sealant trimmed.

2.4 COUNTER BASES

Counter bases shall be [open] [or] [closed] as indicated or required to accomodate the scheduled equipment.

2.4.1 Closed Bases

Closed bases shall be constructed with 1-1/2 inch by 1-1/2 inch, 1/8 inch galvanized steel angle with all corners mitered, welded, and ground smooth. Horizontal and vertical angles shall be provided on 24 inches centers or less. Horizontal hat channels, 1 inch by 4 inch by 1/16 (14 gauge), shall be provided as shown in drawings where undershelving and back/side panels are detailed. The enclosure panels on closed bases shall be of [18 gauge stainless steel] . Joint trim on enclosed bases shall be 2 inch wide, 14 gauge stainless steel, attached with concealed stud bolts and sealed to interior partition. Enclosed bases shall be double walled on interior, exposed ends, and at interior exposed partitions. Service access shall be provided for utilities supplying equipment designed to fit atop the counter.

2.4.2 Open Bases

Open bases shall be constructed of 1-5/8 inch outside diameter, 1/16 inch 16 gauge stainless steel rails welded 360 degrees to the legs.

2.4.3 Gussets

Gussets shall be stainless steel, fully enclosed, a minimum of mm3 inches in diameter at the top, reinforced with a bushing, and shall be continuously welded to channel or angle.

2.4.4 Legs

Legs shall be of 16 gauge, 1-5/8 inch outside diameter stainless steel tubing. Legs shall be continuously welded to gussets, channel, or angle as

specified.

2.4.5 Feet

Feet shall be sanitary, die-stamped stainless steel bullet-shaped, fully enclosed and shall provide for a 1 inch adjustment . The bottom of the legs shall be finished off smoothly and the stem overlapped to provide a sanitary closed fitting. Feet for free-standing fixtures requiring utility connections shall be as above except with a flanged plate at the bottom which shall be anchored to the floor with noncorrosive bolts.

2.4.6 Undercounter Shelving

2.4.6.1 Open Base Shelves

Open base shelves shall be constructed of 16 gauge stainless steel with all edges turned down 1-1/2 inches at 90 degrees with a 3/4 inch tight hem at bottom. Corners shall be notched a full 90 degrees and welded from underside to completely fill the gap, ground and polished. Undershelf shall be braced with 1 inch by 4 inch, 14 gauge stainless steel channel at longitudinal center line and between each intermediate pair of legs.

2.4.6.2 Closed Base Shelves

Interior shelves on closed bases shall be constructed of 16 gauge stainless steel. Side edges of the shelf shall be turned up 2 inches at 90 degrees on a 1/4 inchradius and sealed to the side walls. Rear of the shelf shall be coved up at 90 degrees on a 5/8 inch radius to shelf above or counter top, flanged out for attachment with no open space at interior. Vertical joints shall be sealed. Front edge shall be turned down 2 inches at 9O degrees with a 3/4 inch tight hem. The vertical seam of shelf turn down/turn up shall be welded to the face of body partition. Shelves shall be reinforced with 1 inch by 4 inch, 14 gauge stainless steel closed hat channel. Shelf slides, where indicated, shall be 14 gauge stainless steel, 1-1/2 inch by 1-1/2 inch angles, and shall have front and back corners rounded and finished smooth.

2.4.7 Tray Slides

Tray slides shall be [solid type]. The width of the tray slides shall not be less than 14 inches. The mounting height of the tray slides shall be as shown in drawings. Tray slides shall be installed true and level. Tray slide shall be designed and installed to preclude tray spillage.

2.4.7.1 Solid Type Slide

Solid type slide shall be constructed of 14 gaugestainless steel with the front edge rolled 1-3/4 inches at 180 degrees. The top edge of the roll shall be 3/8 inch above the flat surface of the slide. Two inverted "V" forms, approximately 3/8 inch high, shall be provided in the flat surface of the slide as the running surface for trays. The back edge of the slide shall be turned up 1 inch at 90 degrees behind counter top turn down. Ends of the slide shall be closed to eliminate sharp edges.

2.4.7.2 Support Brackets

Support brackets for tray slides shall be [stainless steel] and shall be

secured to the trim strip of the counter with stainless steel truss head bolts. Brackets shall not be spaced more than 48 inches, center to center.

2.4.8 Protector Shelf (or noted as Breath Protector)

Protector shelf shall be installed on the serving line counters and shall be located over the equipment as indicated. All sides and shall be supported on stainless steel uprights, at front. All free corners shall be rounded on a 3/4 inch radius.

2.4.8.1 Fluorescent Display Light Modules

Fluorescent display light modules shall be in 18 inch and 36 inch increments, each with warm white lamps. [lamps as indicated on the drawings.] Display lamps shall be connected together and wired to a single recessed mounted switch on table face. All wiring shall be installed in flexible tubing, concealed under shelving or run inside supports or otherwise installed in a manner that results in being concealed from view. Furnish juction boxes at switch location and as needed to install conduit. Light fixtures shall have light shields and will be mounted at the front of the shelf with the sheild rotated to allow light to shine toward rear of display.

2.4.8.2 Protector Glass

Protector glass sheet shall be no less than 1/4 inch thick in transparent, tempered plate glass or heat- and mar-resistant clear acrylic framed in an all welded stainless steel channel edging and shall be installed under the protector shelf and in front of the food display. At the top and bottom of the installed glass shall be a 1 inchspace for vapor venting. The protector glass or clear acrylic shall be pivoted for easy cleaning. Design shall be such that glass or clear acrylic can be replaced in the event of breakage.

2.4.8.3 Breath Protector

Breath protector/self serve shall be constructed of 16 gauge stainless steel, with a minimum width of at least 12 inches and shall have a full 1 inch skirt with 3/4 inch tight hem on all sides and shall be supported on stainless steel uprights at front. All free corners shall be rounded on 3/4 inch radius.

a. Adjustable louver brackets below the top shall be fitted with 1/4 inch polished, tempered plate glass or heat and mar-resistant clear acrylic framed in an all welded stainless steel channel and shall be installed with a 7 inch clearance above counter top.

b. Fluorescent light fixtures shall be installed the full length of the undershelf with warm white lamps. Display light wiring shall be concealed in a corner post. Fixtures shall be prewired to a single recess-mounted master switch. Switch to be mounted in a junction box mounted in counter front.

2.5 DISH COUNTERS (SINK VEGETABLE PREP, SINK POT AND PAN, SOIL TRAY TABLE, DISHTABLE)

Dish counters shall be constructed and sound deadened in addition to what is detailed and as specified for counters. Where applicable, dish counters shall be fitted and flanged into the dishwashing machine with a water-tight joint.

2.5.1 Dish Counter Support Channels

Dish counter tubularsupport channels shall be 1 inch by 4 inch by 1 inch, 12 gauge stainless steel. Tubes shall be provided under dish counter top between each pair of legs and as detailed in drawings. Cross members, on the centerline, shall be provided between legs. Channels shall be provided under dish counter top between each pair of legs and shall have closed ends. Channels shall be stud-bolted to counter top at 6 inches on center, maximum.

2.5.2 Dish Counter Components

2.5.2.1 Scupper Drain

Scupper drain shall be provided the full width of dish counter with all corners coved, 6 inches wide by 2 inches deep, and integrally welded to the soiled/clean dish counter top at the entrance/exit of a rack-type dishwash machine. Bottom of the scupper drain shall be scored and sloped to 1-1/2 inch brass drain with tailpiece. Removable strainer shall be 16 gaugestainless steel, flush-mounted, pan-formed, perforated top, shall have 1/2 inch holes punched 1-1/2 inches on center, and shall be installed in the scupper opening on 1/2 inchdiameter stainless steel legs with closed ends.

2.5.2.2 Prewash Sink

Integral prewash sink shall be as indicated with a vertical top flange welded to the dish counter top with the corners rounded on 1/2 inch radius. The sink body shall be tapered from the bottom edge of the flange to 6 inch below dish counter surface and shall be provided with a disposer throat flange 1-1/2 inch brass drain. Removable rack support/slide assembly shall be a 20 1/2 inch square 16 guage guage frame with two cross members. Two 1 inch by 1/8 inch stainless steel angle rack guides shall be welded on top of the frame at 20 inches apart with ends flared at 45 degrees.

2.5.2.3 Prerinse Spray

A prerinse spray assembly shall be mounted on the backsplash of the dish counter with vertical tubing, wall bracket, flexible gooseneck hose, and self closing squeeze-type valve and spray.

2.5.2.4 Hose Bib Faucet

A hose bib faucet shall be mounted on a 12 gauge stainless steel flange or inverted gusset below top of counter, which shall be ground and polished to match counter top.

2.5.2.5 Undershelves

Undershelves shall be the solid type, and shall be constructed as specified for open base shelves.

2.5.2.6 Scraping Trough

Scraping trough in the soiled dish counter shall be 14 gauge stainless steel with all corners (3/4 inch coved, and shall be integrally welded to the dish counter. Trough shall be 8 inches wide minimum and shall be sloped 1/8 inch per foot or from mm4 inch depth to a waste disposer system. . Long sides of trough shall be formed on a 60 degree angle with a 1/2 inch by 1/2 inch recessed shoulder at juncture of the dish counter. Removable trough covers shall be 7-7/8 inch by 20 inch, 16 gauge stainless steel, pan formed, and the top shall be perforated (1/2 inch diameter holes punched 1-1/2 inches on center). One trough cover shall be provided for each 36 inches of trough. One inlet fitting shall be installed at the shallow end of the scraping trough, and intermediate inlet fittings shall be installed at 48 inches on center. Inlet fittings shall be piped to a blending valve, vacuum breaker, solenoid valve, and shall have a ball valve at each intermediate inlet. A solenoid valve shall be interconnected with the disposer delay-relay control to initiate the blended water flow when the disposer is activated. All inlet fittings shall have 1/2 inch [copper] [stainless steel] tubing from blending valve to inlet fittings. Exposed fittings shall be chrome plated.

2.5.3 Glass/Cup Rack Overshelf

Glass/cup rack overshelf shall be 14 gauge stainless steel with an open tube design shall be provided.

A horizontal rack rest of 1-5/8 inch outside diameter stainless steel tubing shall be provided shall be wall mounted.

2.5.4 Dish/Tray Return Shelf (Conveyor with Soil Tray Table)

Dish/tray return shelf shall be sized as indicated on the drawings. Shelf shall extend through opening in wall to be flush with the wall at the deposit side. Shelf shall be turned down 1 inch at 90 degrees at the front with 3/4 inch return at bottom. Rear long side shall be turned down 1 inch at 90 degrees, and shall be integral with [conveyor slider pan] whenever adjacent.

2.5.4.1 Window Frame

Window frame shall be of 18 gauge stainless steel and shall have the perimeter flange channel-formed, 1 inch by 3/4 inch at both sides of the wall. All corners of the frame shall be welded. The frame shall be installed with concealed attachments. The jamb of frame shall be aligned/abutted with the end splash of [conveyor slider pan] , whenever adjacent.

2.6 CONVEYORS

Conveyor shall be roller assemblies as noted in "DESCRIPTION" column in 11400, gravity operated, soiled dish type, to transport standard 14 inch by 18 inch cafeteria trays constructed in accordance with NSF Std 2 in two areas and dish racks in others, and shall be sized with configuration as indicated in drawings.

2.6.1 Trough

The conveyor shall have a one-piece seamless pan constructed of 14 gauge stainless steel. All horizontal and vertical corners shall be reinforced with 12 gaugestainless steel closed end channels. Conveyor pan edges shall be turned up 3 inches with 3/4 inch at 90 degrees to form rolled rim. Pan shall be sized to transport standard 14 inch by 18 inch cafeteria trays. Slider pan shall be mounted on "U" shaped supports of 12 gauge stainless steel, at 60 inches on center. Legs shall be provided as specified for gussets, legs, and feet.

2.6.2 Roller Assemblies

Roller sections shall be (stainless steel, tubing style, with stainless steel ball bearings. Rollers shall be mounted on stainless steel 12 gauge stainless steel side rails formed to maintain trays in proper alignment, top and bottom hemmed for added rigidity. Each section end of frame shall be fitted with stainless steel plate notched for easy removal. Roller section shall be mounted in trough to allow for free movement of trays without drag.

2.6.3 Waste Pulping System

All components, excluding piping, of the waste pulping system shall be supplied by a single manufacturer. The system shall be capable of processing 410 kg of waste per hour.

2.6.3.1 Extractor

1. Press assembley fabricated of corrosion resisting stainless steel including housing, screw assembly, discharge assembly and other components in contact with slurry or extracted pulp.

2. Automatic wash-down of screen with fresh water.

3. Controlled moisture content of extracting pulp.

4. Totally enclosed fan cooled motor mounted to gear reducer.

5. Extracted waste return pump to pulpers for re-use, pump with fresh water flushed mechanical seal to protect drive shaft.

6. Diaphram actuated additive injector pump(s) with 19 liter additive tank for defoamer, deodorizer, disinfectant and cleanser.

7. Wall mounted NEMA 4 enclosure pre-wired control panels magnetic circuit breakers interlocked with door handle, low voltage and three leg thermal overload protection.

8. Chemical treatment for vermin and odor control.

2.6.3.2 Waste Pulping Disposer and Waste Pulping Unit

1. Housing: Cast iron, corrosion resisting stainless steel, or

corrosion resisting aluminum alloy with water connection into grind chamber.

2. Grind Ring: Rust resistant steel alloy with cutting teeth hardened and precision ground. Replaceable without replacing housing.

3. Rotor: Rust resistant alloy with hardened steel impellers, connected directly to motor shaft and dynamically balanced. Replaceable without replacing other components.

4. Motor: Continuous duty, splashproof, permanently lubricated, vertical shaft, with water seal.

5. Control Center: Prefabricated, containing:

6. On-Off Switch: Push buttons in corrosion resisting stainless steel NEMA 4 enclosure mounted on table near disposer.

7. Floor stand.

8. Silver trap.

9. Accssories: Corrosion resisting stainless steel cone and cover.

2.7 SINKS

Sink shall be of the dimensions indicated and conform to the applicable requirements of NSF Std 2. Sinks shall be constructed of a minimum of 14 gauge stainless steel. Vertical and horizontal corners shall be rounded to a radius of not less than mm3/4 inch with double walls at partitions. Continuous 14 gauge stainless steel exterior filler panels shall be provided between compartments of multiple-compartment sinks and shall be ground and polished to match the adjacent surfaces. The sink bottom shall be scored and sloped to assure drainage to the waste outlet. Sinks shall be equipped with waste and overflow fittings, drain plugs with quick-opening valves, and faucets of the type specified. Faucet and drain plug, and overflow fitting shall be required for each sink compartment, unless otherwise indicated. Spout outlet of faucets shall be a minimum of 5 inches above the rim of the sink. Sink legs shall be as specified for counters, except that closed gussets shall be welded to the support channels. Sinks installed adjacent to walls or enclosures shall be anchored and sealed thereto. Sinks shall be sound-deadened as specified for counters.

2.7.1 Plumbing/Trim Requirements

2.7.1.1 Drain Plug and Overflow Fittings

Drain shall consist of a 1-1/2 inch quick opening brass body valve with side outlet overflow connection with a stainless steel twist lever handle. Removable perforated stainless steel strainer plate shall be not less than 3 inches in diameter. Overflow fittings shall consist of 1-1/4 inch diameter chrome-plated brass tubing of not less than 0.036 inch thickness connected to an overflow head in the back of the sink compartment. Overflow head shall have a removable perforated chrome-plated brass or stainless steel strainer plate of not less than 1-1/2 inch diameter. Overflow head shall be installed in die-stamped opening 1 inch below counter top.

2.7.1.2 Backsplash-Mounted Faucets

Backsplash-mounted faucets shall be combination fitting-type with an exposed body and concealed supply connections at the back of the sink. Fitting shall have a swinging spout of approximately 8 inches in length and inlets with 3/4 inch pipe thread. Faucets shall have adjustable flanges. Valves shall have indexed metal lever handles and replaceable seats.

2.7.1.3 Counter Top or Ledge-Mounted Faucets

Counter top or ledge-mounted faucets shall be combination fitting-type with a concealed body and with the supply connections under the sink ledge or counter top. The faucets shall have replaceable valve seats, swinging spout elevated to clear valve handle, and wrist blade metal handles. Chrome-plated copper alloy or stainless steel escutcheons for valves and spout, locknuts and washers or lock-nut type escutcheons together with coupling nuts, and 1/2 inch pipe size union-tailpieces shall be provided.

2.7.1.4 Backflow Preventers

Backflow preventers shall be provided at each item of food service equipment having a water supply and waste connections, where the water inlet is connected below the flood level of the equipment. Backflow preventer shall
be supplied of a size and proportion that will allow an ample flow of water to the equipment, but will prevent the backflow of waste or polluted water into the water supply system. Backflow preventers shall be as specified in SECTION 15400 - PLUMBING, GENERAL PURPOSE.

2.7.1.5 Connected Overflows

Faucets, and drains with connected overflows, unless otherwise indicated, shall be provided for all sinks.

2.7.1.6 Water-Fill Faucets

Specialty food service water-fill faucets or hose assemblies shall be provided as indicated in drawings/specifications.

2.7.1.7 Water Hammer Arresters

Water hammer arresters shall be provided for food service equipment with quick-opening or solenoid-operated water valves. Each unit shall be installed in a vertical position.

2.7.1.8 Control Valve Mountings

Gusset-shaped 14 gauge stainless steel panel for the control valves shall be mounted on open base fixtures with mm3-1/2 inch setback from the countertop edge/rim to the valve handle.

2.7.2 Pot Washing Sinks

2.7.2.1 Final Rinse Compartment

The final rinse compartment of the pot washing sink shall be equipped with a booster heater for sanitizing, using a sanitizing sink heater mounted in

bottom of sink compartment. Sink heater to have stainless steel body and base, and a rinse teperature monitor with indicator light.

2.7.2.2 Temperature Gauge

Temperature gauge shall have a 3 inch diameter face with stainless steel flange.

2.7.2.3 Valves, Temperature Gauge, and Controls Mounting

Valves, temperature gauge, and controls shall be installed in a stainless steel recessed panel, ready for final connections. A perforated stainless steel casing shall be provided over the temperature bulb.

2.7.2.4 False Bottom

False bottom shall be constructed of 14 gauge stainless steel, 1/2 inch deep pan formed with a perforated top (1/2 inch holes punched 1-1/2 inches on center), and shall have welded corners and finger rings. False bottom shall be fitted with 2 inch high by 1-1/4 inchoutside diameter tubular stainless steel feet with closed ends.

2.8 DRAIN TRENCH LINER/GRATING (FLOOR TROUGH w/ GRATE)

DRAIN TRENCH LINER/GRATING SHALL BE OF (14 GAUGE) STAINLESS STEEL IN SIZES AS INDICATED WITH A 1 INCH WIDE PERIMETER SHOULDER AT THE TOP, TURNED UP FLUSH AND LEVEL WITH FINISHED FLOOR, TIGHT-HEMMED BACK DOWN TO THE SHOULDER LEVEL AND FLANGED OUT 2 INCHS FOR ATTACHMENT TO THE SLAB.

2.8.1 Interior of the Liner

Interior of the liner shall have corners coved on 3/4 inch radius; sloped and scored 1 inch to an integrally welded box pattern drain (drain housing oly). Drains shall be at 1200 mm on center maximum and shall be fitted with 6 inches long welded tailpiece. Drain shall be stainless steel basket type and shall include a removable scrap basket. A safety chain shall be connected to the basket strainer assembley and the top of the liner wall. Underside of sloping portion of liner shall have 2 inch long "zee" clips.

2.8.2 Stainless Steel Grating

Stainless Steel grating shall be fabricated of all welded stainless steel, sahll be removable without the use of tools, having 1 inch by 3/16 inch bearing bars. Section quantities and sizes shall be as indicated on the drawings.

2.9 HOODS

Design, fabrication, air flow rate and installation of hoods and duct systems shall conform to ACGIH-01, UL 710 and NFPA 96, where applicable to automatic washdown hood systems, and UL 1046 where applicable to filter hood systems. These standards represent only the minimum requirements; subsequent subsections of this clause may require construction that exceeds these minimum requirements. Hood duct systems, grease in the hood or duct, shall be protected with fixed pipe systems and provided with portable fire extinguishing equipment in accordance with NFPA 96, NFPA 17A, and as

specified. Unless otherwise specified, ducts and hoods shall be secured to building so as to be level and free from vibration under all conditions of operations.

2.9.1 Hood Connections Provisions

2.9.1.1 Exhaust Duct for Canopy or Noncanopy Hoods

Exhaust duct for canopy or noncanopy hoods shall be constructed of [18 gauge stainless steel] and shall have external seams welded continuously, liquid tight. Duct size shall be based on a minimum air velocity of 1500 fpm and maximum of 2500 fpm. Duct shall be continuously welded, liquid tight, to hood duct collar as required by NFPA 96.

2.9.1.2 Hood Support

Wall mounted or island type hoods shall be supported from the structure with stainless steel mounting brackets provided with hoods. Hanger rods shall be 1/2 inch diameter stainless steel, threaded at the bottom and designed at the top to fit into inserts in building slats above or shall have hanger attachments fastened to structural steel members. Hanger rods shall be spaced 48 inches on center, maximum.

2.9.1.3 Make-up Air Tempered and/ or Untempered

The air volume which is exhauseted from a kitchen shall be replaced as required by NFPA 96. A fire activated damper of at least the same gauge as the hood shall be installed in the supply plenum at the same plane as the external weld. Air supplied upstream of the hood suction opening does not qualify as make-up air. The exhaust air flow rate for ventilation of cooking equipment shall be drawn through the open area between cooking surfaces and the perimeter entrance of the hood. Make-up air diffusers shall be provided at the front panel, the exterior length of the hood producing a low velocity discharge. The supply air plenum shall have 1 inch thick foil-faced fiberglass insulation at interior of plenum. The temperature differential between make-up air and the air in the conditioned space shall not exceed 5 degrees C, except air that is part of the air conditioning system or air that does not decrease comfort conditions of the occupied space.

2.9.1.4 Hood Lights and Wiring

This section shall provide recess mounted vapor-proof, grease-proof, and heat-proof fluorescent fixtures as shown on the plans for the length of hood. Cut-out of 25 inches by 8 inches in the canopy is required for the installation of each hood light fixture. The light fixtures shall be prewired to junction box at a rear free corner of the canopy. The light switch for each fixture in the hood will be pre-wired and mounted to the hood. The bottom of the switch box will be flush with hte bottom of the hood canopy, on the outside of the canopy.

2.9.1.5 Closure Panels

Vertical corner mullions, at removable closure panels, shall be 2 inch by 2 inch wide, 16 gauge stainless steel, and shall be welded integrally to the furring and head channel. Exhaust hood closure panels shall be 1/2 inch pan-formed, 18 gauge stainless steel. Upper edge of panels shall be retained in 1 inch by 2 inch continuous 16 gauge stainless steel head channel secured to the hood superstructure. Lower edge of panels shall be

mounted on perimeter furring cap, and shall be turned back 1 inch and flanged up 1 inch for "zee" clip retention.

2.9.1.6 Wall Panels

Double pan-formed wall panels shall be 18 gauge stainless steel, 1/2 inch thick with internal stiffener members. The panels shall be filled with a "USDA Approved" thermal insulation the full height and width of panels, and shall be attached to the interior with mastic. Maximum allowable temperature at rear side of panel shall be 120 degrees F.

a. Lower edge and sides shall be leveled and squared.

b. Panels shall have butt joints.

2.10 Noncanopy Hoods

Noncanopy hoods shall be located a maximum of 36 inches above the cooking surface and sized as scheduled; Exhaust air volume for the hood shall be as scheduled. Test data or performance acceptable to the Contracting Officer shall be provided and displayed.

2.10.1 Grease Extracting Exhaust Hoods Over Cooking Equipment

Grease extracting exhaust hoods shall be pre-engineered, factory fabricated and assembled with built-in washdown systems. Grease extracting exhaust hoods shall be UL listed as a grease extractor for exhaust ducts in accordance with UL 710. Hoods shall conform to the requirements of NFPA 96. Grease extracting exhaust hoods shall be of the size and type as indicated and shall be welded as required by NFPA 96 to the exhaust ductwork.

2.10.2 Construction

Construction shall be entirely of stainless steel. Grease extraction chamber and exhaust capture chamber shall be not less than 18 gauge stainless steel. All seams or joints that direct and capture grease laden vapors shall be continuously welded, with the weld ground and polished to match the adjacent finish . The vertical joint where the front outside face of the hood meets the end panel of the hood shall be continuously welded, with the weld ground and polished to match the adjacent finish. All other joints or seams shall be mechanically sound in accordance with the hood manufacturer's listing procedure and NFPA 96. Hoods over 12 feet in length shall be provided in multiple, equal-length sections for mounting end to end; no section shall be less than 6 feet in length. Hoods comprised of multiple sections shall be factory preassembled and provided with predrilled mounting holes and stainless steel fasteners. F ield joints inside the capture area and exposed to view shall be, ground and polished to match the adjacent finish. Hoods shall be factory preplumbed and prewired and shall have a single connection point. Hoods built in multiple sections shall be furnished with unions and junction boxes for field connections. Canopy-typegrease extracting exhaust hoods shall be of the overhead type suitable for [wall mounting] . Exhaust hoods shall be designed for installation over griddle, fryers, and ranges. Stainless steel wall or equipment mounting brackets shall be provided by the manufacturer.

2.10.3 Automatic Washdown System

Automatic washdown system shall be provided for each grease extracting exhaust hood or group of hoods served by a common exhaust fan and shall be controlled by a pushbutton control station. The washdown system shall remove accumulations of grease and other cooking process contaminants from the internal hood surfaces using a hot-water and detergent solution. The washdown system shall operate using water at a temperature of not less than 140 degress F, at a flow pressure of 40.0 psig \ minimum. A pressure reducing valve, when supply line pressure exceeds 50.0 psigshall be provided ahead of the hood control panel. The hood shall have within the grease extraction chamber a full length stainless steel tube header with brass spray nozzles, located to remove accumulated grease deposits during the hood wash cycle. Plumbing of associated components for the hood washdown system, shall include a 1/4 turn ball-type shut-off valve conforming to FS WW-V-35, temperature/pressure gauge, water hammer arrester, line strainer, solenoid valve, flow check valve, detergent inlet fitting with check valve, detergent pump, detergent tank, and pump test switch. Plumbing and detergent components shall be located within a factory prewired control enclosure. All hot-water piping within control enclosure shall be copper tubing. All electrical components shall be factory prewired to common terminal blocks. A vacuum breaker shall be furnished for the hot-water/detergent supply line from the control enclosure to the hood connection point. The control enclosure shall be mounted as indicated. The wash water and grease shall be collected within the hoods, piped to the outside of the hoods, and interconnected to the building plumbing system through an air-gap hub assembly. Operation shall be by a control system, including indicator lights, timing relay adjustable from a minimum of 1 to 10 minutes, control relays and terminal blocks. "START" button shall start the exhaust fan and "STOP" button shall stop the exhaust fan and activate the timed wash cycle. The pushbutton control station shall be mounted as indicated.

2.10.4 Internal Hood Fire Protection

Each grease extracting hood or group of hoods served by a common exhaust fan shall be provided with an internal fire protection system as required by NFPA 96 and local fire marshall regulations. In the event of a fire or overheat situation in excess of 286 degrees F, fusible links located in the exhaust duct collars shall melt and automatically release a self closing, stainless steel fire damper, sealing the exhaust ducts. Exhaust fan shall continue to operate after the extinguishing system has been activated unless fan shut down is required by a listed component of the ventilation system or by design of the extinguishing system. Each damper shall have a manual control device for the purpose of resetting the damper to its normal position after activation. The reset level shall not be located greater than 7 feet above the finished floor. Once the temperature reaches a safe level, the damper control shall be used to manually raise the fire damper without the removal of any inspection doors or use of tools. Each fire protection system shall be provided with a remote pull station mounted as indicated. Grease extracting hoods shall be furnished prepiped by hood manufacturer at the factory with piping and nozzles for a fire protection system providing coverage of the cooking surfaces below the hood. All exposed piping and fittings shall be chrome-plated or stainless steel sleeved. Exposed pipe threads in/above the food zone shall not be acceptable. Field installation shall be limited to detection lines with

chrome sleeves where exposed, remote pull station, and connecting piping from the container holding the fire extinguishing agent. Hand held fire extinguishers shall be located at each exhaust hood, suitable for gas, electric and grease fires. Fire protection system shall be installed in accordance with manufacturer's recommendations, NFPA 17A and applicable codes or standards. An installation certification form shall be submitted to the Contracting Officer, at the completion of the installation.

2.11 CONDENSATE HOODS

Design, fabrication, air flow rate and installation of hood and duct systems shall conform to ACGIH-01, SMACNA-06, and NFPA 96. Unless otherwise specified, ducts and hoods shall be secured to building so as to be level and free from vibrations under all conditions of operation.

2.11.1 Condensate Exhaust Hood Connection Provisions

2.11.1.1 Exhaust Duct for Canopy or Noncanopy Condensate Hoods

Ducts shall be constructed of 18 gauge stainless steel. External seams shall be welded and liquid-tight. Duct size shall be based on a minimum air velocity of 800 fpm. Duct shall be continuously welded, liquid tight, to hood duct collar as required by NFPA 96.

2.11.1.2 Hood Support

Wall mounted or island type hoods shall be supported from the ceiling structure with stainless steel mounting brackets provided with the hoods. Hanger rods shall be 1/2 inch diameter stainless steel, threaded at the bottom and designed at the top to fit into inserts in building slats above or hanger attachments fastened to structural steel members. Hanger rods shall be spaced 48 inches on center, maximum.

2.11.1.3 Hood Lights and Wiring

This section shall provide recess mounted vapor-proof, grease-proof, and heat-proof fluorescent fixtures as shown on the plans for the length of hood., Cut-out of 25 by 8 inches in the canopy is required for the installation of each hood light fixture. The light fixtures shall be prewired to junction box at a rear free corner of the canopy, on the outside of the canopy.

2.11.1.4 Closure Panels

Vertical corner mullions shall be provided at removable closure panels, 2 inch wide by 2 inch wide, 16 gauge stainless steel, and shall be welded integrally to furring and head channel. Exhaust hood closure panels shall be 1/2 inch 18 gauge stainless steel. The upper edge of the panel shall be retained in a 1 inch by 2 inch continuous 16 gauge stainless steel head channel secured to the hood superstructure. The lower edge of the panels shall be mounted on perimeter furring cap, and shall be turned back 1 inch for "zee" clip retention.

2.11.2 Ducts at Dishwashing Machines

Ducts at dishwashing machines shall consist of two vertical ducts, one at each end of the dishwasher. Exposed, seamless, ducts shall be constructed

of not less than 18 gauge stainless steel and shall be sized to accommodate the machine exhaust vent. The intake of each duct shall be at the top edge of the dishwasher and the ducts shall extend to 6 inches above the finished ceiling for final connection. The duct shall be trimmed at the ceiling with a 16 gauge stainless steel angle flange with corners welded. The exhaust outlet shall be connected to the exhaust system.

2.11.3 Condensate Exhaust Hoods

Hoods, exposed ducts, and enclosures over dishwashing machines and the rinse compartment of pot washing sinks shall be constructed of 16 gauge stainless steel with seams welded, ground, and polished.

2.11.3.1 Condensate Gutter

Hood shall be fabricated so as to form a condensate gutter 3 inches wide by 1 inch high at the perimeter and shall be provided with a condensate drain terminating at a floor sink location.

2.11.3.2 Duct Openings

Duct openings with collars shall be of quantity/size as indicated, with a stainless steel louvered grille at the openings. Penetrations of the dishwashing machine duct risers through the hood body shall be trimmed and sealed.

2.12 PREFABRICATED WALK-IN REFRIGERATORS

Refrigerators shall be prefabricated, commercial, walk-in type suitable for the intended use in dining facilities. Units shall conform to UL 207, UL 471, NSF-02 and NSF Std 7 design type and size as indicated, and the following:

2.12.1 General Requirements

2.12.1.1 Closure Panels

Closure panels and/or trim strips to the building walls and ceiling shall be installed with concealed attachments. Closure/trim shall be of the same material as the wall panels unless otherwise noted.

2.12.1.2 I-Beam Supports

Wherever compartment dimension exceeds the clear-span ability of ceiling panels, I-beam supports shall be provided on the exterior of the ceiling or supported by spline-hangers. Half inchdiameter steel rods shall be installed through beam/hangers and secured to the structure above. Beams or posts within compartments will not be acceptable.

2.12.1.3 Identification Signs

Engraved phenolic plastic compartment identification signs 12 inches by 2 inches high in selected color with 1 inch high letters shall be mounted on door above view window.

2.12.1.4 Door Stops

Door stops shall be provided, where necessary, to prevent walk-in refrigerator doors from striking adjacent walls, plumbing fixtures or food service equipment when door is open.

2.12.2 Panels

Compartment shall be factory pre-fabricated modular panel construction assembled in the field. Panels shall be 4 inches thick, consisting of an inner skin of .040 ga stucco aluminum with baked white finish and an outer skin of .040 ga stucco aluminum, unpainted. The space between the inner and outer skin will be foamed-in-place urethane which binds to the metal skin and creates a rigid 4 inches thick insulated panel. Panel edges shall be double tongue and groove with a flexible vinyl gasket along the interior and exterior perimeter of each male edge. Panels shall be assembled in the field using a cam action locking device which positions and locks the panels together, creating a positive joint. Not less than three (3) cam locking devices shall be installed at each panel joint. The cam lock shall be located in the tongue of panel edge and shall engage a steel rod which is firmly anchored in the groove edge. The locking device shall be bonded in urethane foam and both locking arms and steel rod shall be housed in steel pockets, which are foamed-in-place. Attachment of panel section shall be from interior of compartment using hex wrench furnished by manufacturer. Wrench holes shall be recessed and covered with stainless steel plugs, which are flush with the metal skin of the building.

2.12.3 Insulation

Urethane shall be foamed-in-place and shall have a thermal conductivity factor (K) not exceeding 0.118. Overall coefficient of heat transfer (U factor) shall not exceed .029. Insulation shall have 97% closed cell structures and an average in place density of 2.31 lbs/cubic foot.

2.12.4 Doors [am #5]

a. Swing doors as indicated on drawings.

b. Defrost heater: thermostatically controlled and replaceable at fullperimeter of all doors (in addition to door jambs). Defrost heaters to be wired for continuous service.

c. 12" high x full-length 16 gauge stainless steel kick plates at front and rear of all hinged doors.

d. 12" x 2" engraved phenolic plastic compartment identification sign in Contracting Officer's color selection with 1" letters, mounted above door window.

e. 14" x 22" four-panel glass view window with heater and molded nonmetallic inner and outer frame. Heater to be wired for continuous ~ervice.

f. Padlock and key provisions in door latch with interior safety release .

g. Refrigerator/Freezer door: Stainless steel interior and exterior. Doors shall be 3 foot x 7 foot flush mounted, having a (14) ga steel "C" channel style construction. Each door leaf shall consist of a heavy 4 inch wide x 1/32 inch thick thermally fused and polished PVC perimeter which

secures the metal edges and creates a thermal break between metal facings. Doors shall be equipped with magnetic gasket.

h. Freezer door shall have an anti-condensate heater which is concealed behind the stainless steel edge of the door jamb on all sides of the opening to prevent condensation and frost formation. Heater shall be easily accessible for replacement or service.

2.12.5 [am#5] Floors

2.12.5.1 Prefabricated Floor Panels (Freezers Only)

Prefabricated floor panels shall be of the same construction as wall/ceiling except with 14 gauge galvanized skin, sealed watertight. [One hard-alloy aluminum tread plate, mm3/16 inch thick, with all joints caulked, shall be field applied.] [Nonskid floor strips shall be 4 by 36 inches and shall be field applied at 12 inch spacing in all aisles.] Prefabricated floor panels which are [layed on] [sloping interior floor ramps at exterior entrance doors]. Two sets of erection tools, compatible with fasteners, shall be furnished with each unit.

2.12.6 Thermometer

A digital type thermometer mounted on the strike side of the door, having a range of -40 F to 98.96 F and shall be accurate to plus or minus one degree.

2.12.7 Threshold

Thresholds shall be 12 gauge stainless steel and must be an integral part of the door section. Threshold will be factory installed and shall be a universal design which allows the door section to be moved.

2.12.8 Door Hardware

Door hinges shall be of cane lift design and shall be heavy duty chrome plated with steel pins and nylon bushings. Hinges shall have a 8 inch minimum strap of sufficient number to carry weight of door. Door latch shall be constructed of chrome plated steel. Provide an inside safety release which will open the door from the inside, meeting OSHA standards. Provide a metal placard describing emergency release procedures and attach to inside of compartment in a readily visible location.

2.12.8.1 Refrigeration Systems

Remote installation and type of system for prefabricated refrigerators shall be as specified under SECTION: 15652 - COLD STORAGE REFRIGERATION SYSTEM and the following:

2.12.8.1.1 Unit Coolers

Unit coolers shall be of specified quantity and model numbers and shall be ceiling-hung by 1/2 inch outside diameter nylon bolts with stainless steel washers and nuts. Hanger bolts shall be inserted through plastic

sleeve with the penetrations sealed airtight.

2.13 Drain Fittings

Unit cooler drain fittings shall be positioned as indicated on the drawings. Cast tee-fittings shall be installed on drain pan outlet with union and cleanout plug and shall have a 1 inch copper drainline extended through a wall panel to an air-gap fitting or floor drain.

a. Drainline shall be sloped 1/4 inch per ft, and extended to trap at exterior of the assembly, and shall turn down into drain. Drainlines of adjacent compartments shall be manifolded wherever possible.

b. Plastic sleeve shall be installed through the compartment wall, and sealed around the drainline. A stainless steel escutcheon shall be installed with set screws at the exterior of the wall.

c. Electric drainline heater cable shall be provided with a minimum rating of 100 watt per lineal meter, 208 volts, single phase. The drainline shall be wrapped with a maximum 2 inch loop spacing and interwired to the unit cooler for continuous operation.

2.14 Rack-Mounted Condensing Unit Assemblies

Rack-mounted condensing unit assemblies shall be air-cooled units. Each unit shall be fitted with a prewired control panel.

a. Oil separator shall be provided for all compressors that are positioned higher than the coil, 2.238 kW (3 hp) or larger, located more than 15.2 m from coil, and all freezer systems. The separator shall be piped to compressor crankcase with a shut-off valve in return line.

b. Condensing units installed in an area subject to weather conditions or low ambient temperatures shall be furnished with stainless steel enclosure.

c. A 1 Foot by 2 inch engraved phenolic plastic condenser identification sign shall be mount on the rack below each condenser in Contracting Officer's selection of color with 1 inch letters.

2.15 Electrical Conduit

EMT conduit with pull-wire and wide-sweep bends shall be installed for refrigerant piping to remote food service equipment refrigeration systems and shall be sealed at both ends with silicone foam.

2.16 System Start Up

Evacuation and charging after completion of pressure test shall be as specified under SECTION: 15652 - COLD STORAGE REFRIGERATION SYSTEM.

2.17 GAS-BURNING EQUIPMENT

2.17.1 General Description

Gas-burning equipment shall comply with the applicable requirements of AGAL and ANSI.

2.17.2 Quick-Disconnect and Flexible Connections

Each gas-burning appliance shall be connected to the building piping by means of a quick-disconnect device and flexible connector. A manual shut-off valve shall be installed on the building piping, ahead of the supply side of each quick-disconnect device. The quick-disconnect device shall conform to ANSI Z21.41 and the flexible connector to ANSI Z21.45. The length of the flexible connector shall be as required but shall not exceed 6 feet. Flexible connector shall not be concealed and shall not extend from one room to another. The flexible connector and quick-disconnect diameter shall be sized as recommended by the appliance or equipment manufacturer. Dust caps and plugs shall be provided for quick-disconnect fittings for use when fittings are uncoupled.

2.17.3 Restraining Device for Mobile Gas Equipment

A heavy duty steel cable, 3 inch by 6 inch shorter than the equipment connector shall be fastened to the equipment and the walls.

2.18 ELECTRICAL WORK

Electrical systems, components and accessories shall be certified to be in accordance with NFPA 70 and the following:

2.18.1 Installed Equipment Load

Should equipment differ from that specified, be approved for use and such equipment have different load requirements from that specified, the Contractor shall provide electrical service compatible with the installed equipment loads.

2.18.2 Electrical Equipment and Components

Food service equipment furnished under this section shall have loads, voltages, and phases compatible with building system, and shall conform to existing equipment requirements .

2.18.3 Cords and Caps

Food service equipment cord/caps shall be coordinated with related receptacles. All 120/208 volt "plug-in" equipment shall have Type SO or SJO cord and a plug with ground, fastened to frame/body of item. Mobile equipment shall have a strain-relief assembly at the cord connection of the appliance. Mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutter, toaster, coffee makers, microwave ovens, etc.) shall have cord/cap assembly with cord-hanger strap secured to rear of equipment.

2.18.4 Switches and Controls

Each motor-driven appliance or electrically-heated unit shall be equipped with control switch or starter per Underwriters Laboratories, and shall have low-voltage and overload protection . Disposer controls recess-mounted in the wall shall have external fittings and accessories removed from enclosure and shall be furnished with a (16 gauge) stainless steel perimeter angle flange with welded corners. Controls shall be installed at 4 feet above finished floor to bottom of enclosure. Disposer controls recess-mounted in the counter-splash risers shall have external fittings and accessories removed from a NEMA Type 4 watertight enclosure and shall be furnished with a (16 gauge) stainless steel perimeter angle

flange with welded corners. Control shall be installed at 900 mm above finished floor to bottom of enclosure. The panel shall be provided with a 3 feet long coil of waterproof electrical conduit from the bottom of the control panel. Remote manual starters, magnetic contactors, starters, and push-button stations shall have a NEMA Type 4 waterproof enclosure as defined by NEMA 250. A NEMA Type 1 enclosure shall be used only when installed in a closed base body, as defined by NEMA 250. Equipment or devices at 208/240 volts shall have integral, prewired step-down transformer to provide 120 volt control circuit.

2.18.5 Motors

Motors at 120 volts shall have manual tumbler type starter with thermal overload protection and interchangeable heating elements. Motors at 208/240 volts shall have magnetic starter with low-voltage protection and one interchangeable overload relay per phase.

2.18.6 Heating Elements

Electrically-heated equipment shall have thermostatic controls. Water heating equipment shall be equipped with a positive low-water shut-off.

2.18.7 Receptacles and Switches

Receptacles which are located in vertical panels of closed base bodies shall be installed in 12 inch by 8-1/2 inch by 3 inch deep recessed mounting panel sloped on a 60-degree angle and turned up to the top of the opening. Receptacles which are located in closed base fixtures shall be prewired to a junction box located within 6 inches from the bottom of the utility compartment. Receptacles which are installed in/on fabricated equipment shall be horizontally-mounted in a metal box with a stainless steel cover plate. If the box is placed a damp or wet location, the box and all other accesories shall conform to NEMA Type 4.

2.18.8 Light Fixtures

Light fixtures with lamps which are installed in/on fabricated or field-assembled equipment shall be prewired to a junction box for final connection (fixtures shall be continuous run when indicated). Fluorescent display light shall be installed the full-length of the display stand and serving shelf with stud bolts or as indicated, and shall be prewired through a support post to a recess-mounted switch. Cold storage light fixtures shall be electrically connected through the hub fitting located on the top of the fixture. All horizontal conduit shall be above the ceiling panels. Plastic sleeves shall be installed through ceiling panels for electrical conduit and the penetrations shall be sealed airtight at both sides of panel.

2.18.9 Final Electrical Connection Provisions

Final electrical connection points of equipment shall be tagged with item number, name of devices on the circuit, total electrical load, voltage, and phase. Fabricated equipment containing electrically-operated components or fittings, indicated on utility connections drawings to be direct-connected, shall have each component, fitting, or group thereof prewired to a junction box for final connection. Refer to the drawings for circuit loading. Field-assembled equipment (example, prefabricated cold storage assemblies,

conveyor systems, exhaust hoods) shall have electrical components completely interconnected by this section for final connection as indicated on utility connection drawing. The following groups of cold storage assembly electrical devices shall be prewired to a top-mounted junction box for final connection per compartment grouping, unless otherwise indicated.

a. Light fixtures, switches, and heated pressure-relief vent.

b. Door/jamb heater and temperature monitors/alarms.

c. Evaporator fans, defrost elements, freezer fan door switch, and drain line heaters.

2.18.10 Lamps

Food service equipment containing light fixtures shall have standard appliance type bulbs. Exposed fluorescent lamps above or within a food zone shall have plastic coated lamps or standard lamps, sleeved in plastic tube with end caps, unless specified elsewhere.

2.19 PLUMBING WORK

Plumbing final connection points of equipment shall be tagged, indicating item number, name of devices or components, and type of utility (water, gas, steam, drain).

2.19.1 Plumbing Connection Provisions

Extensions of indirect waste fittings shall be provided to open-sight hub drain, floor sink or floor drains from food service equipment. Drains shall have diameter as required, or 25 mm minimum, stainless steel. All drain lines subject to condensation shall have 25 mm thick fiberglass insulation 48 kg per cubic meter with factory-applied fire retardant jacket and vapor barrier and shall be wrapped with 1.0 mm (20 gauge) stainless steel. Fabricated equipment containing components, fitting and/or devices indicated on food service connections drawings to be connected to the building systems shall have each component, fitting, or group thereof prepiped to a utility compartment for final connection. Piping brackets and supports shall be provided beneath/within fabricated equipment. Field assembled equipment (for example, prefabricated walk-in refrigerator/freezers, conveyor systems, exhaust hoods, dishwashing machines, convection ovens) shall have plumbing components completely interconnected under this section for final connection as indicated on utility connection drawings.

2.19.2 Integral floor panels Am #5(Freezers only):

a. Sandwich panels, same as walls/ceiling except with 14 gauge galvanized skin, sealed watertight.

b. Swing doors as indicated on drawings.

c. Defrost heater: thermostatically controlled and replaceable at fullperimeter of all doors (in addition to door jambs). Defrost heaters to be wired for continuous service.

d. 12" high x full-length 16 gauge stainless steel kick plates at front and rear of all hinged doors.

e. 12" x 2" engraved phenolic plastic compartment identification sign in Contracting Officer's color selection with 1" letters, mounted above door window.

f. 14" x 22" four-panel glass view window with heater and molded nonmetallic inner and outer frame. Heater to be wired for continuous service.

g. Padlock and key provisions in door latch with interior safety release.

h. Refrigerator/Freezer door: Stainless steel interior and exterior.

i. Freezer fan switch connected to solenoid (for compressor pump down cycle) at each freezer entrance door jamb, pre-wired to top-mounted junction box and freezer evaporator fans with temperature activated override control. Refrigerator/Freezer door: Stainless steel interior and exterior servlce.

j. Heated pressure relief ports in freezers to be wired for continuous service.

2.20 COLD STORAGE REFRIGERATION SYSTEMS

2.16.1 Unit Coolers: specified quantity and model, ceiling-hung by 1/2" o.d. nylon bolts with stainless steel washers and nuts. Insert hanger bolts through plastic sleeve and seal penetration air tight.

a. Unit cooler drain fittings: positioned as indicated on drawings. Install cast tee-fittings on drain pan outlet with union and cleanout plug and extend 1" type "K" copper drainline through wall panel to air gap fitting or floor drain at exterior of assembly.

b. Slope drainline 1/2" per foot, trap at exterior of assembly and turn down into drain. Manifold drain lines of adjacent compartments wherever possible.

c. Install plastic sleeve through compartment wall, seal around drainline and install stainless steel escutcheon with set screws.

d. Electric drainline heater cable: on all unit coolers operating below 36., ingtalled from coil drainline fitting to wall penetration. He~ter cables: minimum rating of 30 watts/lineal foot, 208 volts, single pha~e. Wrap drainline with maximum 2~ loop spacing and interwire to unit cooler for continuous operation.

e. Mounted, prepiped and prewired evaporator components:

1. Sporlan thermostatic expan8ion valve with external equalizer.
2. Shut-off valve at evaporator suction and liquid line~.
3. Sporlan "Catch-all~ refrigerant filter/dehydrator on liquid line.
4. White Rogers 1609-101 adjustable thermostat with remote bulb positioned in return air stream of evaporator.
5. Manual lift stem solenoid valve.
6. Electrical disconnect switch in NEMA 4 enclosure.

2.20.2 Multi-circuited condenser: Dyess Refrigeration Design Air-cooled units, each fitted with a 80-0 1 prewired control panel and:

a. Suction and discharge line vibration eliminators.

b. Shut-off valve at condensing unit inlet and outlet.

c. Sporlan "Catch-all" refrigerant filter/dehydrator at condensing unit outlet with "See-all" sight glass and cover.

d. Suction line filter/dryer.

e. Crankcase pressure regulating valve on low-temperature units.

f. Oil separator all compressors that are:

1. Positioned higher than the coil.
2. 3 hp or larger.
3. Located more than 50' from coil.
4. All freezer systems.
5. Pipe the separator to compressor crankcase with shut-off valve in return line.

g. 12" x 2" engraved phenolic plastic condenser identification signs in Contracting Officer's selection of color with 1" letters mounted on rack below each compressor unit.

h. EJS monitor panel mounted on rack assembly.

2.20.3 Refrigerant System Installation

a. Refrigerant lines: Type "L" copper tubing. Fittings: wrought copper or brass designed for use with high temperature solder. Piping joints: made with silver solder (Sil-Fos). Piping: properly suspended from and anchored to the structure with adjustable hangers 6' o.c. maximum. Suction lines: sized to give maximum pressure drop of two pounds in medium temperature systems; one pound in low temperature systems. Liquid lines: sized to give maximum pregsure to prevent trapping of oil. Rigid insulation on all ~uction lines: Armaflex insulation by Armstrong. 1" thick at medium temperature and 1-1/2" thick at low temperature. Refrigerant lines in EMT conduit: sealed at both ends with Dow Corning 3-6548 silicone RTV foam.

2.20.4 Evacuation and Charging

a. After completion of the pressure test, the system shall be evacuated using an approved auxiliary vacuum pump. Connections for evacuation: in accordance with manufacturer's recommendations.

b. Charging subsequent to the initial charge which is contained in the condensing unit: given through the charging valve in the high side passing all the liquid refrigerant through a charging dehydrator. All charging lines and gauges: purged of air prior to connection with the system. Refrigerant: unused and shall be delivered in clean containers. After the system is fully charged: start and place in full operation.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed at locations shown in drawings and in accordance with NSF-02 and the manufacturer's written instructions. The Contractor shall make provision for the plumbing, heating, and electrical connections and for equipment indicated as being furnished and installed by the Government.

3.1 Pulpers, Extractor(s)

Pulpers, extractor(s), pump, controls, and accessory equipment shall be suitable for installation in available space; arranged for safe and convenient operation and maintenance.

3.2 Equipment Connections

Equipment connections shall be complete for all utilities. Unless otherwise specified, exposed piping shall be [chromium-plated copper alloy] .

3.3 TESTING

All equipment shall be inspected and tested under operating conditions after installation. If inspection or test shows defects, such defects shall be corrected, and inspection and test shall be repeated. Refrigerator tests shall include the following:

3.3.1 Performance Tests

A detail written test procedure shall be submitted prior to performance of tests. The Contractor shall furnish all instruments, test equipment, and personnel required for the tests. Utilities for testing shall be provided as specified in the SPECIAL CLAUSES. Evidence shall be submitted that the instruments have been properly calibrated by an independent laboratory at the Contractor's expense. Performance tests for refrigeration system shall

be in accordance with Section 15652 COLD STORAGE REFRIGERATION SYSTEMS.

3.3.2 Operating Tests

An operating test shall be performed on all items after complete installation and adjustment. The failed test item shall be corrected and the test shall be rerun.

3.3.3 Clean and Adjust

Debris resulting from this work, as the installation progresses, shall be removed from the jobsite. All food service equipment, prior to demonstration, shall be cleaned and polished, both interior/exterior. Drawer slides and casters shall be lubricated and adjusted. All Pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, and exhaust hood grilles shall be adjusted, as required, for proper operation. Faucet aerators and line strainers shall be cleaned or replaced. Damage to painted finishes shall be touched up.

3.3.4 Equipment Start-Up/Demonstration

The Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the start-up, adjustment, and testing of the equipment, prior to the demonstration. Equipment shall be carefully tested, adjusted, and regulated in accordance with the manufacturer's instructions and shall be so certified in writing to the Contracting Officer. A thorough operational demonstration shall be provided of all equipment and instructions furnished for general and specific care and maintenance. Selected items of equipment and attendees shall be scheduled, with the Contracting Officer, at least 2 weeks in advance of demonstration periods.

3.3.5 Item Specifications and Schedule of Equipment

All items listed on the contract drawings under the heading "Food Service Equipment Schedule" shall be provided in strict accordance with the foregoing specification requirements and with the following detailed item specifications. Also included as a part of these specification requirements is the "Schedule of Standard Details" which accompanies this Section, and follows the "Item Specifications and Schedule of Equipment.

3.4 INSTALLATION

Performed by manufacturer of custom fabricated fixtures.

a. Assemble, square, level and make ready all items for the final utilities connections.

b. Cut neatly around obstructions to provide sanitary conditions.

c. Where gaps of 1/4" or less occur adjacent to or between equipment, insert rope backing and smoothly-applied General Electric construction sealant Series SE-1200 silicone mastic (white color). Mask both sides of gap for neat application of sealant and remove excess. If space exceeds 1/4", neatly install 18 gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "zees" clips wherever possible to secure stainless steel trim. Exposed edges or corners

of trim: eased and smooth.

a. Fabricated fixtures: Fiberboard or plywood taped to tops and exposed body panels/components.

b. Manufactured equipment: Fiberboard or plywood taped as required by equipment shape and installation-access requirements.

c. Prohibited use of equipment: tool and materials storage, workbench, scaffold, stacking area, etc.

d. Damaged equipment: immediately documented and submitted to Contracting Officer.

3.5 CLEAN AND ADJUST

3.5.1 Thoroughly clean and polish interior/exterior of all food service equipment, prior to demonstration and final observation, ready for use.

3.5.2 Lubricate and adjust drawer slides, hinges, casters.

3.5.3 Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.

3.5.4 Clean or replace faucet aerators, line strainers.

3.5.5 Touch-up damage to painted finishes.

3.5.6 Start up and check operation of all refrigeration systems for at least 72 hours prior to acceptance.

3.6 EQUIPMENT START-UP/DEMONSTRATION

3.6.1 Carefully test, adjust and regulate all equipment in accordance with the manufacturer's instructions and certify in writing to the Contracting Officer that the installation, adjustments and performance are in full compliance. Coordinate and schedule selected items of equipment and attendees with Contracting Officer at least two weeks in advance of demonstration periods.

3.7 FINAL OBSERVATION

3.4.1 Final observation will be made when the Contractor will certify that he has completed his work, made a thorough review of the installation/operation of each item in the contract and found it to be in compliance.

PART 4 3.7.1 SCHEDULE

REGULARLY - MANUFACTURED EQUIPMENT/COMPONENTS: Standard finishes and accessories unless specifically deleted.

4.1 FABRICATED AND FIELD ASSEMBLED EQUIPMENT

Arrangement and configuration as shown on Plans, Elevations and Detail Drawings.

4.2 REFER TO DRAWINGS

Refer to Drawings for unit quantities and electrical or mechanical provisions required, including munufacturer's optional voltages, wattages, burner capacities, etc.

4.3 REFER TO PART 2 - PRODUCTS FOR ACCESSORIES, FITTINGS, REQUIREMENTS AND PROCEDURES RELATED TO THE LISTED BUY-OUT AND FABRICATED EQUIPMENT.

4.4 FOOD SERVICE EQUIPMENT

CAN WASH AREA

Item No. CW lOl - Can Washer Quantity: One Manufacturer/Model: Aervoid Model No. 5B can washer. Utilities: Refer to Drawings. Equipment:
- o One Fountain Brush Attachment No. FB-i.
- o One Faucet Cleaner Attachment No. FC-i.
- o One Roto Table Attachment No. RT-i Special Instructions:
- o Anchor to floor with non-corrosive bolts.

Item No. CW 102 - Drain Trench Liner/Grate
Quantity: One
Manufacturer/Model: Custom Fabricated
Utilities: Refer to drawings
Unit Sizes: 2'-0" x 2'-0"
Constructlon: Refer to drawings and Part 2 - Products.
Equipment:
- o One section.

Special Instructions:
- o Maximum grate size 2'-0" x 2~_0".
- o Installation in Division 15.

Item No. CW 103 - Spray Unit
Quantity: One
Manufacturer/Model: Custom Fabricated.
Utilities: Refer to drawings.
Unit Sizes: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
- o 14 gauge stainless steel recessed enclosure.
- o One Economic Laboratory Inc. Model No. C3 Spray Unit.
- o One Chicago Model No. 305-VBR Hose Bibb.
- o Two Strahman Model No. HR-100 Hose Racks.
- o One Strabraan Model No. "E" - 50~-0" Hose and Spray Nozzle.

Special Instructions:
- o Mount spray unit at 48", hose bibb at 42" aff.
- o Install In wall with concealed fasteners.
- o Seal perimeter to wall.
- o Install at 36" aff to bottom of recessed enclosure.

RECEIVING STORAGE AREA

Item No. RS lO1 - Receiving Scale
Quantity: One
Manufacturer/Model: Toledo Model No. 1105DG receiving scale.
Special Instruction: Verify chart requirements with Contracting Officer.

Item No. RS 102 - High Density Storage Shelving
Quantity: One Lot
Manufacturer/Model: Metro Super Erecta shelving sections. (AMCO)

o Shelf material/type: chrome plated wire
o Post material/size: Stainless steel/86" fixed. Stainless steel/74" mobile.

Quantity	Size	Posts
Four (4) Fixed	48n x 24"	4 per assembly
Eight (8) Mobile	48" x 24"	4 per assembly

o Configuration: 5 tiers, lower shelf adjusted to 8" aff, 2nd shelf @ 29" clear balance at 14" clear.
o Four stationary end unit kits Model No. TTE5S with flanged feet.
o Two track sets.
o Seven mobile unit kits Model No. TTM5AS with flanged feet.

Special Instruction:
o Anchor flanged feet of stationary end unit kits to floor with non-corrosive bolts.

Item No. RS 103 - Dry Storage Shelving
Quantity: One Lot
Manufacturer/Model: Super Erecta shelving sections. (AMCO)
Equipment:
o Shelf material/type: chrome plated wire
o Post material/size: stainless steel/86"
o Complete shelf assemblies indicated.

Quantity	Size	Posts
Two (2)	24" x 48"	4 per assembly

o Configuration: 5 tiers, lower shelf adjusted to 8" aff, 2nd shelf @ 29 clear balance at 14" clear.

Special Instruction:
Wall clamps, installed on all back-to-back shelf units.

Item No. RS 104 - Cold Storage Shelving
Quantity: One Lot
Manufacturer/Model: Metro Super Erecta shelving sections. (AMCO)
Equipment:
o Shelf material/type: stainless steel Louvered/embossed.
o Post material/size: stainless steel/74"
o Complete shelf assemblies indicated:

Quantity	Size	Posts
Three (3)	21" x 42"	4 per assembly
Thirty-Two(32)	21" x 48"	4 per assembly

o Configuration: 5 tiers, lower shelf adjusted to 8" aff; balance at 14" clear.
o Four (4) dunnage racks.

Item No. RS 105 - Mobile Shelving Unit
Quantity: One
Manufacturer/Model: Metro Mode No. PR48ES mobile shelving unit. (Serv-O-lift/Eastern)

Item No. RS 106 - Recessed Hose Bib
Quantity: One
Manufacturer/Model: Custom Fabricated
Utilities Sizes: Refer to drawings.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o 14 gauge stainless steel recessed enclosure.
o One Chicago Model No. 305-VBR Hose Bibb.
o One Strahman Model No. HR-100 Hose Rack.
o One Strahman Model No. "E" 50'-0" Hose and Spray Nozzle.

Special Instructions:
- o Install in wall with concealed fasteners.
- o Seal perimeter to wall.
- o Install at 36" aff to bottom of recessed enclosure.
- o Final connection in Division 15.

Item No. RS 107 - Can Storage Racks
Quantity: Four
Manufacturer/Model: Cres-Cor Model Number - 20 DAC-FEI17 can storage racks. (New Age)
Special Instructions:
- o Anchor to floor with non-corrosive bolts.

BEVERAGE EQUIPMENT AREA

Item No. B lOl - Beverage Equipment Stands
Quantity: Two
Manufacturer/Model: Perfection Model No. PE10-BIB-TS beverage equipment stands. (Metro)(Serv-O-Lift/Eastern)
Utilities: Refer to drawings.
Equipment:
- o Automatic switch over system, dual C02 shut-off and alarm.
- o Equipment stand for bag-in-box, PE10-BIB-TS.
- o Instrument/panel for mounting gages, etc.
- o Safety chain.
- o Bag-in-box shelf kit with pumps.
- o Two Perfection Model No. GR-3F-WC Beverage Systems - Vendor Furnished.

Special Instructions:
- o Interconnection to bag-n-box units.
- o Provide all necessary tubing, fittings, and pumps, etc. by Vendor.
- o Seal PVC drink line conduit with expanding urethane foam insulation when installation has been completed and pressure tested.
- o Interconnection to Item No. S123 - Ice/Beverage Dispenser with all necessary components and fittings in Section 11400.
- o Verify with Contracting Officer that bag-n-box will be used.

Item No. B 102 - Water Filter System/Cabinet
Quantity: One
Manufacturer/Model:Ultra Flo Model No. System 4 water filter cabinet. (Filtrine) Utilities: Refer to drawings.
Equipment: Two replacement filters.
- o One replacement pre-filter.
- o One stainless steel recessed cabinet 36" wide x 36" high x 10" deep; with 2n perimeter flange;

Special Instructions:
- o Install cabinet at 5~-O" aff to bottom with concealed fasteners.
- o Installation and interconnection to Beverage System - Item Nos. BlOl and for final connection in Division 15.

COLD STORAGE AREA EQUIPMENT

Item No. CS lOl Cold storage Assembly
Quantity: One
Manufacturer/Model: Chrysler & Koppin (Refrigeration Manufacturers, Inc.) (Thermo-Kool) (Master-Bilt)
Unit Sizes Size/configuration as shown on drawings x 8'-6" aff to top of compartment.
Utilities: Refer to drawings.
Equipment: Refer to drawings and Part 2 - Products.

Compartments:
- o One Thaw Refrigerator: Two light fixtures.
- o One Freezer: Four light fixtures.
- o One EJS compartment monitor (CS104) per compartment installed as indicated on drawings.

Special Instructions:
- o Monitor panels installed by EJS Limited
- o Verify color monitor face plates with Contracting Officer. Interconnection of monitor to CS105 Master Monitor by EJS Limited, conduit in Division 16.

Item No. CS 102 - Cold Storage Assembly
Quantity: One
Manufacturer/Model: Chrysler & Koppin (Refrigerator Manufacturers, Inc.) (Thermo-Kool) (Master-Bilt) cold storage assembly
Unit Sizes: Size/configuration as shown on drawings x 8'-6" aff to top of compartment.
Utilities: Refer to drawings.
Equipment:
Refer to drawings and Part 2 - Products.
Compartments:
- o One (B) Dairy Refrigerator: Two light fixtures.
- o One (C) Cook's Refrigerator: One light fixture.
- o One (D) Vegetable Refrigerator: Three light fixtures.
- o One EJS compartment monitor (CS104) per compartment - installed as indicated on drawings.

Special Instructions:
- o Monitor panels installed by EJS Limited.
- o Verify color monitor face plates with Contracting Officer.
- o Interconnection of monitor to CS105 Master Monitor by EJS Limited, conduit in Division 16.

Item No. CS 103 - Refrigeration Systems Quantity: One Lot
Manufacturer/Model: Dyess Refrigerated Designs, Inc. (Omnitemp) (Airdyne) air-cooled refrigeration systems.
Utilities: Refer to drawings.
Equipment: drawings and Part 2 - Products.
- o "A" Thaw Refrigerator:
  One Model No. LET-1201 coil; adjust to +38 F
  One Model No. 150 M condensing unit.
- o "B" Dairy Refrigerator:
  One Model No. ADT 1400 coil; adjust to +38 F
  One Model No. 100 M condensing unit.
- o "C" Cook's Refrigerator
  One Model No. ADT 901 coil; adjusted to +38 F
  One Model No. 100 M condensing unit.
- o "D" Vegetable Refrigerator:
  One Model No. ADT-130 coil; adjust to +38 F
  One Model No. 150 M Condensing unit.
- o "E" Freezer:
  One Model No. LET-1601 coil; adjust to -lO F
  One Model No. 300 L condensing unit.
  One EJS master monitor - installed on condenser rack.

Special Instructions:
- o Mount condensing units on common condenser rack.
- o Low temperature coils: insulate all drain lines.
- o Install on 4" high platform, refer to architectural drawings for location. Interconnection of monitor by EJS - conduit in Divi~ion 16.

Item No. PR lOl - Dry/Storage Shelving
Quantity: One Lot
Manufacturer/Model: Metro Super Erecta shelving sections. (United Wire)(AMCO) Equipment:
- o Shelf material/type: Stainless steel/wire.
- o Post material/size: Stainless steel/86"
- o Complete shelf assemblies indicated.
- o Quantity
  Seven (7) 24" x 48~ 4 per assembly
- o Configuration: 5 tiers, lower shelf ad~usted to 8" aff, 2nd shelf at 29" clear, balance at 14n clear.
- o Wall-clamps installed on all rear posts adjacent to walls.

Item No. PR 102 - Number Not Used

Item No. PR 103 - Exhaust Hood
Quantity: One
Manufacturer/Model: Gaylord Model No. BDL-MA (modified) exhaust hood. (Ventmaster)
Unit Sizes: 23'-0" long x 5~-O" x 24" high.
Utilities: Refer to drawings.
Equipment:
- o Full length fluorescent light fixtures.
- o Insulate make up air plenum with 1" insulation.
- o Exhaust hood fully welded/liquid tight interior, all welded exposed exterior panels.
- o Phenolic identification plates at exhaust hood and control panel Item No. PR 104.
- o Insulated wall panels: Maximum allowable temperature at rear of panel 120 F.
- o Stainless Steel top cap on wall, turn down

Special Instructions:
- o Installed at 6'-10" aff to bottom of hood.
- o Modify hood as indicated on drawings.
- o Bottom of wall panel secured to wall with oval head moly bolts.
- o Operation controlled from Item No. PR 104 - Exhaust Hood Control Panel.
- o Support from structure above ceiling with 1/2" o.d. stainless steel rods at 48" o.c. maximum.
- o Verify color of phenolic plates with Contracting Officer.

Item No. PR 104 - Exhaust Hood Control Panel
Quantity: One
Manufacturer/Model: Gaylord Model No. GPC-3000S exhaust hood control panel. (Ventmaster) Utilities: Refer to drawings.
Equipment:
- o Stainless steel perimeter frame.
- o Hot water pressure regulator and vacuum breaker a~ required.
- o Phenolic identification plates at control panel and hoods Item Nos. PR 103, and PR 124.

Special Instructions
- o Unit to operate Items Nos. PR 103 and PR 124 - Exhaust hoods.
- o Mount at 4'-0" aff to bottom.
- o Verify color of phenolic plates with Contracting Officer.

Item No. PR 105 - Exhaust Hood Fire Extinguishing System
Quantity: One
Manufacturer/Model: Ansul Model No. R 102 exhaust hood fire extinguishing system.

Utilities: 20 amps; 120 volts, single phase.
Equipment:
o Refer to drawings and Part 2 - Products.
o Stainless steel recess cabinet and perimeter frame.
o Two remote fire pulls - refer to drawing for locations.
o Phenolic identification plates at Exhaust Hood Nos. PR 103 and PR 124 and Remote Pulls.
o Two recessed stainless steel hand held extinguisher cabinets.
Special Instructions:
o Provide hood/duct protection for Item Nos. PR 103 and PR 124 - Exhaust Hoods. o Provide surface protection for cooling equipment.
o Install at 7'-0" aff to bottom.
o Verify color of phenolic plates with Contracting Officer.
o Install hand held extinguisher as indicated on drawings.

#2 Item NO. PR 106 - Number Not Used.

#2 Item No. PR 107 - Exhaust hood (Refer to PR 103).

Item No. PR 108 - Number Not Used.

Item No. PR 109 - Number Not Used.

Item No. PR 110 - Steamer
Quantity: two
Manufacturer/Model: Steam 'n' Hold, model 240D8 by Accutemp Products, Inc.
Utilities: 240 volts, three phase, 19.2 amps.
Equipment: stainless steel floor stand (stacked).

Item No. PR 112 - Drain Trench Liner/Grate Quantity: One
Manufacturer/Model: Custom Fabricated. Unit Sizes 1'-6" x 3'-0"
Utilities: Refer to drawings. Construction: Refer to drawings and Part 2 - Product~. Equipment:
o Equally sized grating sections. Special Instruction~:
o Maximum width/length 2'-0".
o Installation in Division 15.

Item No. PR 113 - Tilt Kettles
Quantity: three
Manufacturer/Model: Cleveland Model No. KEL-25-T tilt kettles. (Groen) (Legion) Utilities: 14.8 kw; 480 volts, 3 phase.
Equipment:
o 2" tangent draw-off.
o H&C fill faucet.
o Tri basket strainer.
o Kettle brush kit.
o Type 316 stainless steel interior.
o High wattage option.
o Flanged Feet. Special Instructions:
o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 114 - Drain Trench Liner/Grates
Quantity: Five
Manufacturer/Model: Custom Fabricated.
Unit Sizes: 2'-0" x 4'-0"
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Equally sized grating sections.
Special Instructions:
o Maximum width/length 2'-0" x 2'-0".
o Installation in Division 15.

Item No. PR 115 - Work Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Sizes: Refer to drawings x 3'-0" deep x 2'-11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - products.
Equipment:
o Top: square turn down at free side.
o Open base construction.
o Edland Model No. 1 can opener anchored to top with non-corrosive bolts.

o Undershelf .
o One Drawer.
o Flanged feet.
o Can opener pad shall be fabricated onto counter surface per Detail 11/FS-11. Provide Edlund Model #1 operator.
Special Instruction:
o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 116 - Ceiling Mounted Utensil Rack
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Sizes: 1/4" thick X 2" high X 20'-0" long.
Utilities: Refer to drawings.
Construction: Refer to drawing and Part 2 - Products.
Equipment:
o Two NEMA-5-20R; 120 volts, single phase; duplex receptacles.
Special Instructions:
o Install at 7'-0" aff to top of bar.
o Verify mounting height with Contracting Officer.
o Provide Standard-Keil Model 1577-1010-1251 sliding hooks @ 8" o.c..

Item No. PR 117 - Number Not Used

Item No. PR 118 - Work Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 3~-0" deep x 2'-11" high to table surface.
Utilities: Refer to drawing.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Top: square turn down at free sides.
o Open base construction:
o One 18" x 21" x 10" deep sink.
o One Chicago Faucet Model No. 50-E3-SWG gooseneck faucet.
o Undershelf.

o One drawer
o Utility enclosure.
o Verify mounting height with Contracting Officer.
o One NEMA-6-20R; 208 volt; three phase receptacle mounted on side of utility compartment for Item No. PR 131-Mixer.
o Provide water proof junction box for hard wire connection of PR-131 in lieu of NEMA-6-20R receptacle.
o Fill Faucet Chicago Model No. 512GC mounted in utility compartment in recessed compartment.

Special Instructions:
o Install utility compartment on 4" high finished platform.
o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 119 - Ceiling Mounted Utensil Rack
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: 1/4" thick X 2" high X 8'-0" long.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Two NEMA-5-20R; 120 volts, ~ingle pha~e; duplex receptaclec.

Special Instructions:
o Install at 7'-0" a.f.f. to top of bar.
o Verify mounting height with Contracting Officer.
o Provide Standard-Keil Model 1577-1010-1251 sliding hooks @ 8" o.c.

Item No. Item No. PR 120 - Tilt Fry Pans
Quantity: Two
Manufacturer/Model: Groen Model No. NHFP-3 tilt fry pans. (Cleveland) (Legion) (Vulcan)
Utilities: 104 mBTU; 5.0 amps; 120 volt, single phase.
Equipment:
o Flanged rear feet.
o 9" deep pan.
o Type 316 stainless steel interior.
o H&C faucet with swing spout.
o Electronic ignition.
o Dormont Model No. SSC-U(PFS) Series flexible gas line with quick disconnect fitting.

Special Instruction:
o Anchor flanged feet to floor with non-corrosive boltc.

Item No. PR 121 - Depression/Drain Trench Liner/Grate Assembly
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Equally sized grating sections.
o Depression liner 3'-6" x 7'-2".
o Trench liner/grate 2'-0" x 7'-4".

Special Instruction~:
o Maximum width/length 2'-0" x 2'-0~.
o Installation in Division 15.

Item No. PR 122 - Fryer/Filter Assembly
Quantity: One Lot
Manufacturer/Model: Pitco Model No. 18-SS fryer/filter asssembly,

electronic ignition. (Kenting) (Anets)
Utilities: Refer to drawings.
Equipment:
- o Three Pitco Model No. 18-SS fryers.
- o Stainless steel back guard assembly.
- o Stainless steel front and exposed sides.
- o Single point rear gas connection.
- o Dormont Quick Disconnect.
- o Stainless steel tank and cover.
- o One Pitco built-in filter with top drainers.
- o 8" stainless steel legs in lieu of standard.
- o One Pitco model Fat Vat mobile waste shortening container.

Special Instructions:
- o Install Fat Vat in janitor's closet.
- o Install fry/filter assembly in floor recess.

Item No. PR 123 - Convection Ovens
Quantity: six
Manufacturer/Model: Garland, convection Ovens (Vulcan) (Blodgett DFG 402 Model No. UCO-G20)
Utilities: 2 @ 6.2 amps; 120 volts, single phase; 80 BTU natural gas.
Equipment:
- o Stainless steel top and exposed sides/back.
- o Two speed motor.
- o Five additional oven racks.
- o Install casters with brakes.
- o Cook-N-Hold option.
- o Five hour timer.
- o Solid doors.
- o Interior light.
- o Dormont quick disconnects. Special Instruction:

Item No. PR 124 - Exhaust Hood
Quantity: One
Manufacturer/Model: Gaylord Model No. BDL-60 (modified) exhaust hood. (Ventmaster)
Unit Size: 21'-0" long x 5'-0" X 24" high.
Utilities: Refer to drawings.
Equipment:
- o Full length fluorescent light fixtures.
- o Exhaust hood fully welded/liquid tight; all welded exposed exterior panels.
- o Phenolic identification plates at exhaust hood and control panel - Item No. PR 104.
- o Insulated wall panels; Maximum allowable temperature at rear of panel 120 F.
- o Stainless steel top cap on top of wall, turn down 2" on free sides.

Special Instructions:
- o Installed at 6'-10" aff to bottom of hood.
- o Modify hood as indicated on drawings.
- o Bottom of wall panel secured to wall with oval head moly bolts.
- o Operation controlled from Item No. PR 104 - Exhaust Hood Control Panel.
- o Support from structure above ceiling with 1/2~ dia. stainless steel rods at 48" o.c. maximum.
- o Verify color of phenolic plates with Contracting Officer.

Item No. PR 125

Quantity: Three
Manufacturer/Model: Cres-Cor Model No. 110-1841 mobile food transport carts. (Serv-O-Lift) (Jero) Equipment:

- o Model No. CMP-1405-27 perimeter bumper kit.

Item No. PR 126 - Reach-In Freezer
Quantity: One
Manufacturer/Model: Traulsen model No. ALT232WWREFHS reach-in freezer. (Hobart) (Victory)
Utilities: 16.0 amps; 120 volts, single phase.
Equipment:
- o Half length doors in both sections, hinged as indicated.
- o Four extra chrome plated shelves.

- o Floor Lock Kit CMP-1430.

Special Instructions:
- o Install on 4" high finished platform.
- o Seal perimeter of cabinet to pad/walls with butyl sealant.

Item No. PR 127 - Reach-In Refrigerator
Quantity: One
Manufacturer/Model: Traulsen Model No. AHT132WREFHS reach-in refrigerator. (Hobart) (Victory)
Utilities: 7.0 amps; 120 volts, single phase.
Equipment:
- o Half length doors in both sections hinged as indicated.
- o Eight extra chrome plated shelves.

Special Instructions:
- o Install on 4" high finished platform.
- o Seal perimeter of cabinet platform/wall~ with butyl sealant.

Item No. PR 128 - Mobile Utensil Racks
Quantity: Four
Manufacturer/Model: Metro Model No. PR48ES mobile utensil rack~ (Market Forge)
(Serv-O-Lift/Eastern)

Item No. PR 129 - Number Not Used

Item No. PR 130 - Work Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Sizes: Refer to drawings x 2'-6" deep x 2'-11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
- o Top: square turn down at free sides.
- o Open base construction.
- o One drawer.
- o Undershelf
- o Wall mounted overshell at 18~ above counter top.

Special Instruction:
- o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 131 - 80 Quart Mixer
Quantity: One
Manufacturer/Model: Hobart Model No. L-800-D. (Varimixer)
Utilities: 2 hp, 208 volts, 3 phase.

Equipment:
- o 80 quart stainless steel bowl.
- o Bowl truck.
- o Flat beater/wire whip/dough hook.
- o 12 quart stainless steel bowl.
- o Flat beater/wire whip/dough hook.

Special Instruction:
- o Anchor to floor with non-corrosive bolts.

Item No. PR 132 - Preparation Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 2'-6" deep x 2' -11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products
Equipment: Top with marine edge at free sides; 10" high splash at balance.
- o Open base construction with leg/bracket support at rear side.
- o Omit front cross rail at roll-under pocket.
- o Omit rear cross rail at sinks.
- o One 24" x 26" x 12" deep sink.
- o One PolyBrite sink cover.
- o One Chicago Faucet Model No. 540-LD-L12 swing faucet.
- o One Chicago Faucet Model No. 305-VBR hose bibb and rack.
- o One drawer.
- o One undershelf.
- o One Strahan Model "E" 50'-0" hose and spray nozzle.

Special Instructions:
- o Secure wall mounted equipment/components to in-wall ground or anchor plates.
- o Anchor flanged feet of floor with non-corrosive bolt.

- o Can opener pad shall be fabricated onto counter surface per Detail 11/FS-11. Provide Edlund Model #1 operator.

Item No. PR 133 - Food Cutter/Mobile Stand
Quantity: One
Manufacturer/Model: Hobart Model No. 84186-U food cutter/mobile stand. (Berkel) Utilities: 1.0 hp, 208 volts, single phase.
Equipment:
- o Cord/cap with cord hanger attached securely to machine.
- o Mobile Stand 36" x 24~ x 24" high; 14 gauge stainless steel, top reinforced, with marine edge at all sides, 1-5/8" diameter stainless steel legs with undershelf.

Special Instructions
- o Install stand on Jarvis and Jarvis Castora Model No. 5-405-113P-NSF swivel casters. Two casters with Model No. E-75 Vertilok brakes.
- o Provide all casters with 7" diameter rolling bumpers with stainless steel top disc.

Item No. PR 134 - Worktable
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 1-1/6 deep x 2'-11" high to table surface.
Utilities: Refer to drawings.
Construction:
- o One drawer.
- o Edlund Model No. l can opener enclosed to top with non corrosive bolts.
- o Undershelf.
- o Flanged feet. Special Instructions:

o Anchor flanged feet to floor non-corrosive bolts.
o Can opener pad shall be fabricated onto counter surface per Detail 11/FS-11.

Item No. PR 135 - Number Not Used

Item No. PR 136 - Meat Tenderizer
Quantity: One
Manufacturer/Model: Hobart Model No. 403 meat tenderizer. (Berkel)
Utilities: 1/2 hp, 120 volts, single phase.
Equipment:
o Cord set

Item No. PR 137 - Slicer
Quantity: One
Manufacturer/Model: Hobart Model No. 1712E- slicer/mobile stand. (Berkel) (Globe)
Utilities: 1/3 hp; 120 volts, single phase.
Equipment:
o Tubular food chute assembly (high and low).
o Adjustable fence assembly (high and low).
o Cord/cap with cord hanger attached securely to rear of machine

Item No. PR 138 - Number Not Used

Item No. PR 139 - Drain Trench Liner/Grate
Quantity: Two
Manufacturer/Model: Custom Fabricated.
Unit Sizes: 1-6" x 4'-0"
Utilities: Refer to drawings.
Construction: Refer to drawings andPart 2 - Products
Equipment:
o Equally sized grating sections.
Special Instructions:
o Maximum width/length 2'-0".
o Installation in Division 15.

Item No. PR 140 - Number Not Used

Item No. PR 141 - Water Filter System/Cabinet
Quantity: One
Manufacturer/Model: Ultra Flo Model No. "4" water filter/cabinet with stainless steel door and latch. (Filtrine)
Utilities: Refer to drawings.
Equipment:
o Two replacement filters.
o One replacement pre-filter.
o Four replacement filters.
o One stainless steel recessed cabinet 36" wide x 36" high x 10~ deep; with 2" perimeter flange.
Special Instructions:
o Install cabinet at 5~-0~ aff to bottom with concealed fasteners.
o Installation and interconnection ice machines - Item No. PR 142 and final connection in Division 15.

Item No. PR 142 - Ice Machine/Bin
Quantity: Two
Manufacturer/Model: Vogt Model No. HEC30S ice machine. (Refer to Article 1.6) Utilities: 2.0 hp, 208 volts, three phase.

Equipment:
o Vogt HE30CS Ice Machines, air-cooled.
o Follett Model No. 1175-48 stainless steel bin with stainless steel legs.
o Stainless steel top.
o Remote air-cooled condenser.
o Secure inspection door with stainless steel screw.
o Install remote condenser above CS-101-Cold Storage Refrigeration System, interwiring by Division 16.

Item No. PR 143 - Vegetable Preparation Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 2'-6" deep x 2'\11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Can opener pad shall be fabricated onto counter surface per Detail 11/FS-11. Provide Edlund Model #1 operator.
o Top with marine edge at free sides; 10" high splash at balance.
o Open base construction with leg/bracket support at rear side.
o Edlund Model No. 1 can opener anchored to top with non-corrosive bolts.
o Item No. PR144 - Disposer installed in top. 01 Integrally-welded disposer cone. 02 Notch and punch splash turnback for vacuum breaker. 03 Extend splash to enclose disposer control panel.
o One Chicago Faucet Model No. 923 GC spray rinse unit. Secure riser pipe bracket to wall.
o Omit front cross rail at disposer, roll-under equipment, trash bin.
o Omit rear cro~s rail at sinks.
o Two 24" x 26" x 12" deep sinks.
o One Chicago Faucet Model No. 540-LD-L12 swing faucet.
o One Chicago Faucet Model No. 305-VBR hose bibb and rack.
o One PolyBrite sink cover.
o One drawer.
o 12" deep single overshelf post mounted at 18" above table top, punched to accommodate spray riser.
o 18 gauge stainless steel butt joint wall panels from back splash to underside of overshelf.
o Post mounted utensil rack: extend 1-5/8" Qtainless steel posts from backsplash, turn forward 12" and weld full length x 2" x 1/4" stainless steel bar with Standard-Keil Model No. 1577-1010-1251 sliding hooks at 8" o.c. Verify mounting height with Contracting Officer.
Special Instructions:
o Secure wall mounted eguipment/components to in-wall ground or anchor plates. o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 144 - Disposer
Quantity: One
Manufacturer/Model: In-sink-erator disposer, (Salvajor) (Master Model No. B3-O-SXBC-CCR-MS-PF).
Utilities: 3.0 hp; 208 volts, 3 phase.
Equipment:
o Stainless steel leg assembly.
o Neoprene silver trap.
o Disposer controls recess-mounted in splash risers: external fittings and accessories removed from enclosure and furnished with 16 gauge stainless steel perimeter angle flange with welded corners. Install NEMA Type 4X stainless steel control enclosure at 35-1/2~ aff. Provide panel with 48" long coil of Seal-Tire electrical conduit from bottom of

control panel.
o Remote on/off switch.
Special Instructions:
o Install in Item No. PR 143 - Vegetable preparation Table.
o Anchor to floor with non-corrosive bolts.
o Adjust time-delay relay for 45 second

Item No. PR 145 - Vegetable peeler/Disposer
Quantity: One
Manufacturer/Model: Hobart Model No. 6460 vegetable peeler/disposer. (Blakeslee) Utilities: 1.0 hp; 208 volt, three phase, peeler; 1/2 hp, 208 volt, single phase, disposer.
Equipment:
o One disposer stand.
o One Hobart Disposer Model No. FD2-50 with long hopper housing.
Special Instructions:
o Install disposer on stand.
o Anchor flanged feet to floor with non-corrosive bolts.

Item No. PR 146 - Foodcutter
Quantity: One
Manufacturer/Model: Hobart Model No. FP100 foodcutter. (Robot Coup)
Utilities: 3.5 amps, 120 volt, single phase.
Equipment:
o Two slicer plates,
o two julienne plates, four shredder plates, four dicer grinder and plate holders.
o Cord/cap with cord hanger sttached securely to rear of machine
o Two - three peg wall racks. Special Instructions:
o Install on Item PR 144 Vegetable Preparation Table.
o Verify size of plates with contracting officer.

Item No. PR 147 - Work Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 2'-6" deep x 2'-11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawinga and Part 2 - Products.
Equipment:
Top: square turn down at free sides; 10" high splash at balance.
o Open base construction.
o One slicer recess 12" deep.
o Undershelf.
o Two NEMA 5-20R; 120 volts; single phase; two duplex receptacles mounted on brackets.
o One drawer.
o Flange feet.
Special Instruction:
o Anchor flanged feet to floor with non-corrosive bolts.

UTENSIL WASH AREA

Item No. W lOl - Mobile Utensil Rack
Quantity: Four
Manufacturer/Model: Metro Model No., PR48ES mobile utensil rack.

Item No. W 102 - Utensil Wash Table
Quantity: One
Manufacturer/Model: Custom Fabricated.

Unit Size: Refer to drawings x 2'-6" deep x 2'-10" high to table surface.
Utilities: Refer to drawings.
Equipment:
- o Top:
- o Open base structure with leg/bracket support at rear side.
- o Item No. 103 - Disposer, installed in top.
  - 01 Integrally welded disposer cone.
  - 02 Notch and punch splash turnback for vacuum breaker.
  - 03 Extend splash to enclose disposer control panel.
- o One Chicago Faucet, Model No. 923 GC spray rinse unit. Secure riser pipe bracket to wall.
- o Omit front cross rail at disposer, roll-under dquipment and trash bin.
- o Omit rear cross rail at sinks.
- o One 30" x 26" x 15" deep sink.
- o Two 36" x 26" x 15" deep electrically heated sinks.
- o One Wells Model No. PW-106 hydro surge unit: 1/3 hp; 120 volts, single phase; installed in heated sink with remote on/off switch.
- o Two T&S Model No. B-290/EE swing faucets for 3/4" hot and cold water connections
- o One Chicago Faucet, Model No. 305-VBR hose bib and rack.
- o 12" deep single overshell post mounted at 18" above table top, punched to accomodate spray riser
- o 18 gauge stainless steel butt-joint wall panels form backsplash to under side of overshelf.
- o Post mounted utensil rack: extend 1 5/8" stainless steel posts from backsplash, turn forward 12" and weld full length x 2" x 1/4" stainless steel barwith Standard-Keil Model No. 1577-1919-1251 sliding hooks at 8"o.c. Verify mounting height with Contracting Officer.

Special Instructions:
- o Secure wall mounted equipment/components to in-wall ground or anchor plates.
- o Anchor flanged feet to sloor with non-corrosive bolts.

Item No. W 103 - Disposer
Quantity: One
Manufacturer/Model: In-sink-erator disposer, (Salvajor) (Master Model No. B-5-OBC-CRR-MS-PF)
Utilities: 3.0 hp, 208 volts, 3 phase.
Equipment:
- o Stainless steel leg assembly.
- o Neoprene silver trap.
- o Disposer control recess-mounted in splash riser: external fittings and accessories removed and furnished with 16 gauge stainless steel perimeter angle flange with welded corners. Install NEMA Type 4X stainless steel control enclosure at 35-1/2" art. Provide panel with 48" long coil of Seal-Tite electrical conduit from bottom of control panel.
- o Remote on/off switch.

Special Instructions:
- o Install in Item No. W102 - Utensil Wash Table.
- o Anchor to floor with non-corrosive bolts.
- o Adjust time-delay relay for 45 second run-on.

Item No. W 104 - Condensate Exhaust Hood
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: Refer to drawings x 18" high at interior.
Utilities: Refer to drawings.
Construction: Refer to drawings and part 2 - Products.

Equipment:
- o Full length fluorescent light fixtures.
- o Fully welded exhaust hood interior/exposed exterior.
- o 18 gauge stainless steel double paneled front and end panels with interior stiffener members. Panels extended from bottom edge of hood to ceiling and are secure with concealed attachment.

Special Instructions:
- o Mount at 8'-0" aff to bottom of hood.
- o Support from structure above ceiling with 1/2" o.d. stainless steel rods at 48" o.c. maximum.

Item No. W lO5 - Utensil Wash Machine
Quantity: two
Manufacturer/Model: C-64 (Hobart). Utilities: Refer to drawings.
Equipment:
- o Left to Right operation. 120 Volt control circuit.
- o Regulated electric tank heater, each at 15 kw.
- o Auto-timer control package.

- o Stainless steel closure panel and legs.
- o Three (3) assorted stainless steel racks (std).
- o Five (5) additional racks.
- o Automatic tank fill with manual by-pass.

Item No. W 106 - Booster Heater
Quantity: One
Manufacturer/Model: Hatco Model No. S-15 booster beater. (Merco)
Utilities: 15 kw, 480 volts; three phase.
Special Instructions:
- o Mount on 14 gauge stainless steel, wall mounted booster heater rack assembly.

Item No. W 107 - Condensate Exhaust Hood
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Size: 5'-0" x 4'-6" x 18" high.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2-Products.
Equipment:
- o Full length fluorescent light fixture.
- o Fully welded exhaust hood interior/exterior.

Special Instructions:
- o Unit installed at 8'-0" aff to bottom of hood.
- o Support from structure above ceiling with 1/2" o.d. stainless steel rods at 48" O.C. maximum.

Item No. W 108 - Clean Dish Table
Quantity: One
Manufacturer/Model: Custom Fabricated.
Unit Sizes: Refer to drawings x 2'-6" deep x 2'-10" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
- o Top with rolled rim at free sides; 10" high splash at balance.
- o Open base structure with leg/bracket support at rear side.
- o Scupper drain at exit of utensil wash machine.
- o Undershelf.

Special Instructions:
- o Secure wall mounted equipment/components to in-wall grounds or anchor

plates. o Anchor flanged feet to floor with non-corrosive bolts.

SERVERY AREA

Item No. S 103 - Pass-Thru Refrigerators
Quantity: Two
Manufacturer/Model: Traulsen Model No. RHT-1-32WP pass-thru refrigerators. (Hobart) (Delfield)
Utilities: 7.3 amps; 120 volts; single phase.
Equipment:
o Half length doors both sections on kitchen/servery side, hinged as indicated.
o Four extra chrome plated shelves.
o Stainless steel trim both sides of wall.
o Cord Set.
Special Instructions:
o Install on 4" high finished concrete platform.
o Trim seal perimeter of cabinet to pad/wall with butyl sealant.

Item No. S 104 - Pass-Thru Heated Cabinets
Quantity: Two
Manufacturer/Model: Traulsen Model No. RHF-I-32WP pass-thru heated cabinets. (Hobart) (Delfield) (Victory)
Utilities: 7.8 amps; 120 volts, single phase.
Equipment:
o Half length doors both sections on kitchen/servery side, hinged as indicated. o Four extra chrome plated shelves.
o Stainless steel trim both sides of wall.
o Cord set.
Special Instructions:
o Install on 4" high finished concrete platform.
o Seal perimeter of cabinet to pad/walls with butyl sealant.

Item No. S 105 - Back Counters
Quantity: Two
Manufacturer/Model: Custom Fabricated.
Unit Sizes: Refer to drawings x 2'-6" deep x 2'-11" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
Top with square turn down at free sides; 6" high splash at balance.
o Closed base construction.
o One 15" x 18" x 10" deep sink.
o One Chicago Faucet Model No. 50-E3-SWG gooseneck faucet.
o Utility Compartment
o Undershelves.
Special Instructions:
o Install on 4n high finished platform.

Item No. S 106 -Main Serving Line Counters
Quantity: Two
Manufacturer/Model: Custom Fabricated.
Unit Sizes: Refer to drawings x 3'-0" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.

Equipment:

o Top with square turn down at free sides; 4" high splash at balance.

o Serving counter base construction.

o Cut-out serving counter top/body for mobile plate dispenser and mobile cooking equipment.

o Cut-out serving counter top/body for mobile yogurt machine Item No. Sll9.

o Fully lined dispenser/cooking equipment pockets.

o Ten NEMA 5-20R; 120 volts, single phase; duplex receptacles mounted in recessed panels for general use, as indicated or required, maximum of 2 receptacles per circuit.

o Provide NEMA 5-20R; 120 volts, single phase, duplex receptacles mounted under top for beverage/counter/mobile equipment as required.

o One NEMA 6-20R; 208 volts, single phase, single purpose receptacle mounted under top for Item No. S102 toaster. Confirm plug configuration.

o Three NEMA 5-20R; 120 volts; single phase duplex receptacles recessed mounted in body panel under top; two for Item No. S109 - Griddle, One for Item No. S 111 Broiler. Confirm plug requirements.

o Compressor compartments.

o Utility compartments.

o Six hot food wells, drain to floor sink.

o Plate shelf; control panel in plate shelf with hot food well/heat lamp/display light controls.

o One refrigerated condiment unit sized to accommodate 1/4 sised 6" deep pans.

o One two door custom fabricated compressor installed at left.

o Provide stainless steel food pans and adaptor bars, as required.

o Removable section cover

o One two-door custom fabricated refrigerated base, with 1/2 hp air cooled compressor, installed at left.

o One electrical load center compartment with two Square ~D" Model No. Q0430L200 circuit breaker load centers with Model No. QOC430LS cover and doors, Model No. PK18GTA ground bar kits, and Visi-Trip breaker (rated to 200 amps; 208 volt, three phase, 4 wire; 30 space~). Breakers shall be provided/installed with ~mp rating and number of poles a8 required for all equipment served by the load center.

o Raised built-in bread platform with four Serv-O-Lift Model No. TDB bread dispensers.

o Two Serv-O-Lift Model NO. AT3 - bread plate disposers.

o Item No. S 118 Novelty Ice Cream Cabinet installed in top of counter.

o Two Jero Model No. P120570 - Bowl Dispenser. Verify bowl size with Contracting Officer.

o One refrigerated cold pan 4'-0" x 21" provide plexiglass riser three sides; with 1/2 hp air cooled compressors installed under counter top.

o Three Drain Troughs: refer to drawing for sizes.

o Item No. S123 - Ice/Soda Disenser; Installed in top of counter.

o One Ultra Flo Model No. System 4 in-line water filter installed in utility compartment, pre-piped water lines with-in counter body to beverage equipment complete with shut-off valves to single point connection in utility compartment for final connection in Division 15.

o One chilled water dispenser with drip pan - refer to drawings.

01 One Perfection Model No. R34W water chiller. 20.0 amps; 208 volts; single phase.

02 Two stainless steel towers with four (4) electric push button fast flow valves.

o Breath Protector/Serving Shelf: length as indicated on drawing x 6" wide at mobile cooking equipment; 9" wide at hot food wells; 1'-0" wide at sandwich board.

o Three Hatco Model No. GPA-24-24" heat lamps; 350 watts each; 208

volts, single phase; consolidated chassis of longest possible length for multiple sections. Pilot light and remote infinite control for each Section. Secure to underside of shelf, provide 1/2" thick USDA approved thermal breaker between heat lamp and shelf. Conceal wiring in post.

o Eleven Capitol Model No. 1105-40-3/4" fluorescent light fixtures; remote Ballasts Model No. 907; T-8 slimline warm white fluorescent bulbs, 30 watts each; 120 volts; single phase; satin aluminum finish. Secure to underside of overshell. Conceal wiring in post.

o Four (4) compartment plexiglass cereal dispenser mounted on overshell.

o Three (3) Cambro Model No. 8R8 Condiment and Dispenser - verify color with Contracting Officers.

o Tray Slide: full length.

o Front Panels: full length plastic laminate removable panels, painted metal louvers/access doors where required for ventilation/service.

o Chromed plastic grommets in top for electric, and drain lines. Grommets sealed watertight to counter top (die stamp opening).

o Water service penetrations shall be terminated chrome-plated fittings sealed watertight to counter top (die stamp opening)

o Stainless steel flexible hoses, no less than 18 inches in length, shall be used to connect water service line to any unit requiring water service.

Special Instructions:

o Install on 4" high finished platform.

o Verify color/pattern of plastic laminate with Contracting Officer.

o Verify color of phenolic plates with Contracting Officer.

o Cold waterline and Chicago faucet model no. 349 at hot food well location

Item No. S 107 - Number Not Used

Item No S 108 Mobile Heated Dish Dispensers
Quantity: Six
Manufacturer/Model: Jero Model No. P/ME2H mobile heated dish dispensers (Delfield) (Sety-O-Lift).
Utilities: 6.3 amps, 120 volts, single phase.
Equipment:

o Cord set.

o Wrap around bumpers.

o Casters with polyurethane tires.

Special Instructions:

o Verify plate size/shape/weight with Contracting Officer.

Item No. S 109 - Griddles/Mobile Stands
Quantity: Four
Manufacturer/Model: Vulcan Model No. 900 A-36 series griddles/mobile stands (Garland) (Wolf) (Lang).
Utilities: 90 mBTU; 1.0 amps; 120 volts; swingle phase
Equipment:

o Electronic ignition

o Cord/cap with cord hanger attached securely to rear of griddle~.

o Stainless steel sides and base splash.

o Dormont quick disconnects.

o Mobile stand; Manufacturers stand with stainless steel shelf & stainless steel legs.

Special Instructions:

o Install stand on Jarvis and Jarvis Castors Model No. 5-405-113P-NSF Swivel Caster, two with Model No. E75 Vertilok Brakes.

Item No. S 110 - Auto broiler.
[Am #5]
Quantity: Two
Manufacturer/Model: Nieco Model No. 624G Autobroilers.
Utilities: 66 mBTU; 13.5 amps; 208 volts; single phase.
Equipment:
o Dormont quick disconnects.
o One mobile stand 3'-0" X 2'-6" high (including casters) 14 gage stainless steel top, reinforced, with marine edge at all sides. 1-5/8" stainless steel legs with undershelf.
Special Instructions:
o Install stand on Jarvis and Jarvis Casters Model No. 5S-405-113P-NSP Swivel Casters, two with Model No. E75 Vertilok Brakes.

Item No. S 111 - Broiler/Mobile Stands
Quantity: Two
Manufacturer/Model: Vulcan Model No. MGB34 broiler/mobile stands.
Utilities: 72 mBTU.
Equipment:
o Dormont quick disconnects.
o Mobile Stands; Manufacturers stand with stainless steel shelf & stainless steel legs.
Special Instructions:
o Install stand on Jarvis and Jarvis Casters Model No. 5-405-113P-NSF Swivel Caster, Two with Model No. E75 Vertilok brakes.

Item No. S 112 - Exhaust Hood
Quantity: Two
Manufacturer/Model: Gaylord Model No. BDL-MA (modified) exhaust hoods (Ventmaster).
Unit Sizes: 17'-6" long x 24" high.
Utilities: Refer to drawings.
Equipment:
o Full length fluorescent light fixtures.
o Insulate make up air plenum with 1" thick foil faced fiberglass insulation.
o Exhaust hood fully welded/liquid tight interior, all welded exposed exterior panels.
o Phenolic identification plates at exhaust hood and control panel Item No. S113.
o Stainless steel drain line enclosure from drain connection to top of counter.
Special Instructions:
o Installed at 6'-10" aff to bottom of hood.
o Modify hood as indicated on drawings.
o Operation controlled from item No. S113 - Exhaust Hood Control Panel.
o Support from structure above ceiling with 1/2~ o.d. stainless steel rods at 48" o.c. maximum.
o Verify color of phenolic plates with Contracting Officer.

Item No. S 113 - Exhaust Hood Control Panel
Quantity: One
Manufacturer/Model: Gaylord Model No. GPC-3000S exhaust hood control panel (Ventmaster).
Utilities: Refer to drawings.
Equipment:
o Stainless steel perimeter frame.
o Hot water pressure regulator and vacuum breaker as required.

o Phenolic identification plates at control panel and exhaust hood Item No. S112.
Special Instructions:
o Unit to operate Item No. S112 - exhaust hood.
o Mount at 4'-0" aff to bottom.
o Verify color of phenolic plates with Contracting Officer.

Item No. S 114 - Exhaust Hood Fire Extinguishing System
Quantity: One
Manufacturer/Model: Ansul Model No. R102 exhaust hood fire extinguishing system. Utilities: 20 amps; 120 volts; single phase.
Equipment:
o Refer to drawings and Part 2 - Products.
o Stainless steel recessed cabinet and perimeter frame.
o Two remote fire pulls - refer to drawing for locations.
o Phenolic identification plate at exhaust hood Item No. S112 and remote pulls.
Special Instructions:
o Provide hood/duct protection for Item No. S112 - exhaust hood.
o Provide surface protection for cooking equipment.
o Install at 7'-0" aff to bottom.
o Verify color of phenolic plates with Contracting Officer.

Item No. S 115 - Ceiling Mounted Heat Lamps
Quantity: Twelve
Manufacturer/Model: Cres-Cor Model FW-65-UPD-1 ceiling mounted heat lamps. (Merco)
Utilities: 250 watts; 120 volt, single
Equipment:
o Koil Cord
Special Instructions:
o Verify color of Hood with Contracting Officer.
o Verify length of Koil Cord required.
o Installation in Division 16.

Item No. S 116 - Bread Warmers
Quantity: Two
Manufacturer/Model: Wells Model No. RW-bread warmers (Toastmaster) (Merco)
Utilities: 3.48 amps; 208 volts, single phase.
Special Instructions:
o Seal perimeter to counter top.
o Cord and cup.

Item No. S 118 - Novelty Ice Cream Cabinets
Quantity: Two
Manufacturer/Model: Silver Ring Model No. SKCTM-Di novelty ice cream cabinets. (Refer to Article 1.6)
Utilities: 3.1 amps; 120 volts; single phase.
Equipment:
o Cord set.
Special Instruction:
o Install in Item No. S 106 - Main Serving Line Counter.

Item No. S 119 - Yogurt Machines GF/CI
Quantity: Two
Manufacturer/Model: Stoelting Model No. 4231 yogurt machines.
Utilities: 2-1.1/2 hp; 208 volts, single phase, water-cooled.

Equipment:
o Hot/cold water faucet.
o Two Dormont Model No. W60-B2Q quick disconnects (1/2" dia) for hot/cold water.
o Brush cleaning kit.
o Cleaner-sanitizer.
o Tune-up kit.
o Cord set.
o Casters.
Special Instructions:
o Install in serving counter Item No. S 106.
o Provide cold water service and drain for water cooled unit.

Item No. S 120 - Toasters
Quantity: Two
Manufacturer/Model: Holman Model No. T914 toasters (Savory)
Utilities: 23.5 amps; 208 volts; single phase.
Equipment:
o Cord set.

Special Instruction:
o Provide for rear delivery of product.

Item No. S 121 - Mobile Cup/Glass Dispensers
Quantity: Six
Manufacturer/Model: Jero Model No. Ri2020MC mobile cup/glass dispensers (Delfield) (Sety-O-Lift)
Equipment:
o one piece wrap around bumper.
o Polyurethane tires, two with brakes.

Item No. S 122 - Milk Dispensers
Quantity: Two
Manufacturer/Model: Silver King Model No. Imperial NSF-SR-3 milk dispensers. (Norris)
Utilities: 2.5 amps; 120 volts; single phase.
Equipment:
o Cord set.
o Swivel turn-table with locking device.

Item No. S 123 - Ice/Beverage Dispensers
Quantity: Two
Manufacturer/Model: Follett Model No. U300B ice/beverage dispensers. (Refer to Article 1.6)
Utilities: 4.4 amps; 120 volts; single phase, water-cooled.
Equipment:
o Ten electric push button soda valves, six regular syrup and two diet valves, two non-carbonated valves, in Contracting Officer's selection of flavor strips at each ice/beverage dispenser.
o Ice bin with manual load top.
o Key lock switch for valves.
o Prepiped interconnection to water filter in Item No. S 106 with all necessary tubing and shut off valves for final connection in Division 15.
Special Instructions:
o Install on Item No. S 106 - Serving Counters.
o Seal to counter top with butyl sealant.
o Interconnection between Item No. B lO1 - Beverage System and Ice/Soda Dispensers with all necessary tubing and fittings by Purveyor.
o Prepiped interconnection to water filters in Item No. S 106 with

shut-off valve for final connection in Division 15.

Item No. S 124 - Juice Dispensers - GF/CI
Quantity: Two
Manufacturer/Model: Vitality 3 juice dispsnsers.
Utilities: 7.5 amps, 120 volts, single phase.
Equipment:
o Cord set.
Special Instructions:
o Prepiped interconnection to water filters in Item No. S 106 with shut-off valve for final connection in Division 15.
o Include stainless steel flexible hose at top.
o Provide penetrations for electrical hookups.

Item No. S 125 - Number Not Used

Item No. S 126 - Number Not Used

Item No. S 127 - Mobile Saucer Dipensers
Quantity: Two
Manufacturer/Model: Serv-O-Lift Model No. 2AT3-ST mobile saucer dispensers (Jero) (Delfield).
Equipment:
o One piece perimeter bumper.
o Polyurethane tires, 2 with brakes.
Special Instructions:
o Verify saucer size/shape/weight with Contracting Officer.

Item No. S 128 - Coffee Makers
Quantity: Two
Manufacturer/Model: Bunn-O-Matic Model No. STS-F-15 coffee makers. (Refer to Article 1.6)
Utilities: 20.0 amps; 120/208 volts; single phase; 3 wires.
Equipment:
o Cord set.
o Five Model No. 6078D decanters.
Special Instructions:
o Prepiped interconnection to water filter in Item No. S 106 to all necessary tubing and shut off valve, for final connection in Division 15.

Item No. 130 - Number Not Used

Item No. S 132 -Cash Registers - GF/SI

#2 Item No. S 133 - Cashier Counters
Quantity: Two Manufacturer/Model: Custom Fabricated
Unit Sizes: Refer to drawings x 3'-O" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2-Products.
Equipment:
o Top: Square turn down at free sides.
o Servery counter base construction.
o Cost-out serving counter top body for mobile plate/bowl dispensers.
o Fully lined dispenser packet.
o Four Nema 5-20R; 120 volts; single phase; duplex receptacles mounted

in recess panels for general use, as indicated or required.
o One cash drawer. One 3'-0" wide x 2'-4" high x 3'-0" deep lined pocket for cash register system. Millwork housing insert for cash registers by General Contractor Section 11400 to coordinate requirements.
o Tray slides: full length long sides.
o Front panels: full length plastic laminate removable panels.
o Chromed plastic grommets in top for electric lines. Grommets sealed water tight to counter top (due stamp opener).
Special Instructions:
o Install on 4" high finished platform with Jarvia Casters Model No. 551405-113P=NSP.
o Verify color/pattern of plastic laminate with Contracting Officer.

Item No. S 134 - Display Refrigerators
Quantity: Four
Manufacturer/Model: Traulsen Model No. TRC display refrigerators. (McCalls)
Utilities: 10.5 amps, 120 volts, single phase.
Equipment:
o All shelves to be glass.
o Three additional shelves.
o Door locks.
o Interior thermometer.
o Casters with brakes (all).
Special Instruction:
o Verify color of plastic laminate body panels with Contracting Officer.

Item No. S 135 - Number Not Used

Item No. S 136 - Number Not Used

Item No. S 137 - Number Not Used

Item No. S 138 - Mobile Fryer/Filter Assembly
Quantity: Two lots
Manufacturer/Model: Pitco Model No. 14-SS mobile fryer/filter assembly (Reating) (Anets) (Vulcan).
Utilities: 110 MBTU, 1/2 hp; 120 volts; single phase.
Equipment:
o One Pitco Model No. 14-SS fryer.
o Stainless steel back guard assembly.
o Stainless steel front and exposed side.
o Dormont quick disconnect kit.
o Caster assembly in lieu of legs.
o Cord set.
o Stainless steel tank ~nd cover.
o One Pitco built-in filter, 1/2 hp, 120 volt, single phase with cord set.
o One Pitco Model Fat Vat mobile waste shortening container.
Special Instructions:
o Install Fat Vat in janitor's closet.
o Confirm plug configuration of cord set.

Item No. S 139 - Mobile Heated Soup Bowl Dispensers
Quantity: Two
Manufacturer/Model: Serv-o-lift Model No. 2AT3-STH mobile heated soup bowl dispensers (Jero) (Delfield).
Utilities: 6.3 amps, 120 volt~, one phase.
Equipment:
o One piece wrap around perimeter bumper.

o Cord set.
o Polyurethane casters, 2 with brakes.
Special Instructions:
o Verify bowl size/shape/weight with Contracting Officer.

Item No. S 140 - Mobile Salad Plate Dispensers
Quantity: Two
Manufacturer/Model: Jero Model No. P/4072ME2 mobile salad plate dispensers. (Delfield) (Serv-O-Lif).
Equipment:
o One piece wrap around bumper.
o Polyurethane casters, 2 with brakes.
Special Instructions:
o Verify plate size/shape/weight with Contracting Officer.

Item No. S 141 - Soup/Salad Bar Counter
Quantity: Two
Manufacturer/Model: Custom Fabricated. Unit Sizes: Refer to drawings x 3'-o" high to table surface.
Utilities: Refer to drawings.
Construction: Refer to drawings and Part 2 - Products.
Equipment:
o Top: square turn down at free sides; 6" high splash at balance.
o Serving counter base construction.
o Two T & S Faucet Model No. 8101 faucets with two Model No. BR-F built-in protective flanges and 6'-0" of stainless steel hose, installed in top, one Fisher Model No. 2805CV blending valve and vacuum top. Pre-piped water lines with reduced pressure principle back flow preventer within counter body to utility compartment with shut off valves - for final connection in Division 15.
o Utility compartments.
o Control panel for soup wells with-in utility compartment.
o Phenolic identification plates at controls.
o One electrical load center compartment with one Square "D" Model No. QO412L125 circuit breaker load center, with Model No. QOC412L125S cover/door, Model No. PK9-GTA ground bar kit and Visi-Trip breakers (rated to 125 amps; 208 volts, three phase, 4 wires, 12 spaces). Breakers shall be provided/installed with amp rating and number of poles required for all equipment served by load center.
o Two wells Model No. HWI60D soup wells, 1.5 kw, 208 volts, single phase, with remote controls, drain to floor sink.
o One 1'-8" x 9'-O" cold pan, drain to floor sink.
o Full length self-serve breath protector, refer to drawings for construction.
o Compressor compartment.
o Five Capitol Model No. 1105-40 3/4" fluorescent light fixtures; remote ballasts Model No. 907; T-8 slim line warm white fluorescent bulbs, 30 watts each; 120 volts single phase; satin aluminum finish. (18 gauge stainless steel housing of longest possible length). Secured to under~ide of breath protectors. Conceal wiring in post.
o Tray Slide: as indicated on drawings.
o Body Panels: full length plastic laminated removable panels, painted metal louvers/access panels/doors where required for ventilation/service.
Special Instructions:
o Install on 4" high finished platform.
o Verify color/pattern of plastic laminate with Contracting Officer.
o Verify color of phenolic plates with Contracting Officer.

Item No. S 142 - Mobile Tray/Cutlery Dispensers
Quantity: Four (Two only shown on drawing)
Manufacturer/Model: Serv-O-Lift Model No. TS/i418MC mobile tray/cutlery dispensers (Delfield) (Serv-o-Lift).
Equipment:
- o One piece wrap around bumper.
- o Polyurethane tires, 2 with brakes.
- o Twelve stainless steel silverware cylinders each dispenser.

Special Instructions:
- o Verify tray size/shape/weight with Contracting officer.

#2 CLIPPER ROOMS

Item No. FS-01 - Dishwasher
Quantity: Two.
Size: 64" table to table.
Equipment:
- o Stainless steel, conveyor type, two tank, fully automatic, w/steam booster heater.

Item No. FS-02 - Pre-rinse unit
Quantity: Two.
Size: 19 3/4" dia. basin.
Equipment:
- o Stainless steel scraping, built into table top.
- o Pre-wash unit w/garbage disposer.
- o Separator.
- o Tableware trays.
- o Thermostatic controls.

Item No. FS-03 - Soiled dish table w/sink
Quantity: Two.
Size: See plan and details.
Equipment:
- o Stainless steel, custom built 10" backsplash.
- o 3" high rolled top, exposed edges.
- o Lever sink drain.
- o Trough drain at dishwasher.
- o Pass-through at window.
- o Sink for glass wash assembly.

Item No. FS-04 - Clean dish table
Quantity: Two.
Size: See plan and details.
Equipment:
- o Stainless steel, custom built 10" backsplash.
- o 3" high rolled top, exposed edges.
- o Trough drain at dishwasher.
- o Stainless steel undershelves.

Item No. FS-05 - Scrap block
Quantity: Two.
Size: 6"dia.
Equipment:
- o Neoprene, mount in dish tables.

Item No. FS-06 - Glass washing assembly
Quantity: Two.
Size: 20" x 10" x 13"H+/-.

Equipment:
- o Stainless steel.
- o Two brush, sink mounted type, w/hot and cold water swing spout fill faucet.

Item No. FS-07 - Dishwasher and utensil washer hoods
Quantity: Three.
Size: See drawing
Equipment:
- o Stainless Steel mechanical exhaust.

Item No. FS-08 - Tray carts
Quantity: Four.
Size: 19" x 21 1/2" x 36 1/2".
Equipment:
- o Stainless steel w/rubber tired swivel casters and bumpers.

Item No. FS-09 - Cup dispenser
Quantity: Two.
Size: 26 1/2" x 31 1/2".
Equipment:
- o Stainless steel, mobile, rack type, heated.

Item No. FS-10 - Bowl dispenser
Quantity: Four.
Size: 20" x 20".
Equipment:
- o Stainless steel, mobile, heated.

Item No. FS-11 - Rack dolly
Quantity: Four.
Size: 20 1/2" x 20 1/2" x 6 1/2".
Equipment: Stainless steel, w/4" dia. rubber tired, swivel casters.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15320

FIRE PUMPS

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 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 795	(1993) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 135	(1991b) Seamless Brass Tube
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM F 436	(1993) Hardened Steel Washers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
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	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993) Gate Valves for Water and Sewerage Systems
AWWA C651	(1992) Disinfecting Water Mains

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1995; Supple I; Supple II) Approval Guide

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev 1-1993; Rev 2-1995) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1993) Centrifugal Fire Pumps
NFPA 24	(1992) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 37	(1994) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1993) National Electrical Code
NFPA 1963	(1993) Fire Hose Connections

UNDERWRITERS LABORATORIES (UL)

UL-04	(1995; Supple) Fire Protection Equipment Directory
UL 80	(1980) Steel Inside Tanks for Oil-Burner Fuel
UL 142	(1993; Rev Apr 1995) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 262	(1994) Gate Valves for Fire-Protection Service
UL 448	(1994; Rev Jun 1995) Pumps For Fire-Protection Service
UL 789	(1993; Rev Feb 1994) Indicator Posts for Fire-Protection Service
UL 1247	(1995; Rev Jun 1995) Diesel Engines For Driving Centrifugal Fire Pumps

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Product

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation 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 jobsite.

1.2.2 Description

Fire pump, piping and associated equipment shall be provided complete and ready for operation. The fire pump shall be vertical shaft turbine type centrifugal fire pump. The fire pump shall be electric motor driven fire pump. Fire pump, appurtenances and installation shall conform to NFPA 20, unless more stringent requirements are specified herein or are indicated on the drawings. In NFPA 20, the advisory provisions including those listed in the appendix shall be considered mandatory; reference to the authority having jurisdiction shall be interpreted to mean the Contracting Officer. Devices and equipment for fire protection service shall be UL listed UL-04 or FM approved FM P7825.

1.2.3 Sequence of Operation

1.2.3.1 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 80 psi.Pump shall automatically stop when the system pressure reaches 86 psi and after the pump has operated for the minimum pump run time specified herein.

1.2.3.2 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 79 psi.The fire pump shall automatically stop operating when the system pressure reaches 86 psi and after the fire pump has operated for the minimum pump run time specified herein.

1.2.4 Safety Requirements

Coupling, rotating parts, gears, projecting equipment, etc. shall be fully enclosed or properly guarded so as to prevent possible injury to persons that come in close proximity of the equipment. The Contractor shall conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work and verify all dimensions in the field. The Contractor shall notify the Contracting Officer of any discrepancy before performing the work.

1.2.6 Electrical Work

Electric motor and controls shall be in accordance with NFPA 20 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 16415ELECTRICAL WORK, INTERIOR.

1.2.7 Factory Tests

Fire pump shall be tested by the manufacturer before shipment to provide detailed performance data and to demonstrate its compliance with the specifications.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. Unless otherwise indicated, 6 copies of each item shall be submitted. Submittals, except Fire Protection Engineer's Qualifications shall be submitted concurrently as a complete package. Each submittal shall be certified in writing by the Fire Protection Engineer. The Fire Protection Engineer shall certify that the submittal is complete, that the equipment and equipment arrangement meets contract requirements, and that the proposed system is coordinated and compatible with all other equipment connected to the system, the physical space, and the power sources. The Fire Protection Engineer shall sign and date all shop drawing submittal sheets and revisions. The submittal will be reviewed by the U.S. Army Engineer District Fire Protection Engineer.

The following shall be submitted in accordance with Section 01300SUBMITTAL PROCEDURES.

SD-01 Data

Equipment; GA.

Manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the

manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list which includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

b. Pressure maintenance pump and controller.

c. Piping and fittings.

d. Valves, including gate, check, globe and relief valves.

e. Gauges.

f. Hose valve manifold test header and hose valves.

g. Flow meter.

h. Restrictive orifice union.

i. Associated devices and equipment.

Final Test; GA.

A written request for scheduling of the final test at least 15 days prior to the date that the final acceptance test is to take place and after successful completion of the preliminary tests.

SD-04 Drawings

Pump Room, Equipment and Piping; GA.

Detailed drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

a. Fire pumps, controllers, piping, valves, and associated equipment.

b. Sensing line for each pump including the jockey pump.

c. Engine fuel system for diesel driven pumps.

d. Engine cooling system for diesel driven pumps.

e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.

f. Restraint of underground water main at entry-point to the building.

A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.

A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

As-Built Drawings; GA.

Detailed drawings updated to reflect as-built conditions after all associated work is completed, on reproducible full-size mylar film, no later than 10 working days after completion of the Final Tests. Each as-built drawing shall have a title block similar to the contract drawings.

SD-06 Instructions

Framed Instructions; GA.

Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for safe operation, sequence of operation, and procedures for safely starting and stopping the system, prepared in typed form, framed under glass or in laminated plastic. Instructions shall be posted where directed by the Contracting Officer. Wiring and control diagrams showing the complete layout of the entire system shall be framed under glass or in approved laminated plastic and posted near each controller as directed by the Contracting Officer. Proposed instructions, diagrams and other sheets shall be submitted for approval prior to posting. Framed instructions shall be posted before acceptance testing of the system.

SD-09 Reports

Field Tests; GA.

Test reports in booklet form showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

SD-13 Certificates

Engineer's Qualifications; GA.

Prior to all other submittals, certification that the Fire Protection Engineer is a registered Fire Protection Engineer or a Registered Engineer who has had at least 4 years experience in fire protection and fire pump installation design.

Preliminary Test; GA.

A signed and dated certificate that preliminary tests have been conducted, and that the fire pump installation is complete and ready to be placed in

operation, prior to submitting a formal request for a final inspection and test. The certificate shall include the names, companies, phone numbers, and titles of persons conducting and witnessing the test, including the required manufacturer's representatives. Complete test procedures, as well as results and readings taken during the preliminary tests shall be included.

Piping; GA.

A signed statement from the piping manufacturer certifying that the piping meets requirements specified. The statement shall be signed and dated after the award of this contract, shall include the name of the project, and shall list the specific requirements which are being certified.

SD-18 Records

Test Procedures; GA.

Detailed test procedures for testing the fire pump system, 60 days prior to performing the pump tests.

SD-19 Operation and Maintenance Manuals

Fire Pumps; GA.

Operating instructions outlining step-by-step procedures required for fire pump startup, operation and shutdown shall be provided. The instructions shall include the manufacturer's name, model number, catalog cuts, diagrams, drawings, parts list, and descriptive data covering the proper operation and testing.

Six complete copies of maintenance instructions listing routine maintenance procedures and frequencies, possible breakdowns and repairs, troubleshooting guides, a complete list of parts and current sources, and recommended spare parts to be kept on hand. The instructions shall include simplified diagrams for the system as installed.

1.4 MANUFACTURER'S SERVICES

The Contractor shall obtain the services of the fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine driver manufacturer (when provided) or their representative. The persons providing this service shall be factory-trained, shall be experienced in the installation, adjustment, and operation of the equipment and shall supervise the installation, the adjustments, and the testing of equipment. The persons providing the manufacturer service shall be present during the preliminary and final tests and shall assist in the testing of the equipment.

1.5 DELIVERY AND STORAGE

Equipment delivered to the site or placed in storage shall be protected from weather, humidity and temperature variations, dirt, dust, and other contaminants.

PART 2 PRODUCTS

2.1 FIRE PUMP

Fire pump shall be electric motor driven . Each pump capacity shall be rated at 750 gpm with a rated net pressure of 40 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

2.2 ELECTRIC MOTOR DRIVER

Motor shall comply to NEMA MG 1 and be marked as complying with NEMA Design B standards. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

2.4 NAMEPLATES AND MARKINGS

Pump and motor shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.5 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL-04 or FM approved FM P7825 for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F.

2.5.1 Controller for Electric Motor Driven Fire Pump

Controller shall monitor pump running, loss of a phase or line power, phase reversal, and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 300 psi, time, and date. Controller shall require the pumps to run for ten minutes

for pumps with driver motors under 200 horsepower and for 15 minutes for pumps with motors 200 horsepower and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors. Controller shall be wye-delta, closed circuit transition starting type. Controller shall be designed for 30 HP at 480 volts] . Controller shall have a short circuit rating of 22,000 amps r.m.s. symmetrical at 480 volts a.c. .

2.6 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inch H58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch orifice. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged per NFPA 20. One of the test connections shall be equipped with a 0 to 200 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.7 PRESSURE MAINTENANCE (JOCKEY) PUMP

Pressure maintenance pump shall be electric motor driven, in-line vertical shaft, centrifugal type with a rated discharge of 8 gpm at 100 psig. Pump shall draft from the suction supply side of the suction pipe gate valve of the fire pump and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

2.7.1 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely terminally wired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 5 minutes.

2.9 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 4 inchreinforced concrete pad that is an integral part of the reinforced concrete floor.

2.10 ABOVEGROUND WATER PIPING

2.10.1 Pipe Sizes 2.5 Inches and Larger

2.10.1.1 Pipe

Piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inchesand greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside per NFPA 20.

2.10.1.2 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

2.10.1.3 Gaskets

Gaskets shall be AWWA C111, cloth inserted red rubber gaskets.

2.10.1.4 Bolts

Bolts shall be ASTM A 193, Grade B8. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.10.1.5 Nuts

Nuts shall be ASTM A 194, Grade 8.

2.10.1.6 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provide under all bolt heads and nuts.

2.10.2 Piping Sizes 2 Inches and Smaller

2.10.2.1 Steel Pipe

Steel piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.39, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

2.10.2.2 Copper Tubing

Copper tubing shall be ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

2.10.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL-04 or FM approved FM P7825 and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

2.10.4 Valves

Valves shall be UL listed UL-04 or FM approved FM P7825 for fire protection service. Valves shall have flange or threaded end connections.

2.10.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

2.10.4.2 Tamper Switch

The suction control valves, the discharge control valves, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.10.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

2.10.4.4 Relief Valve

Relief valve shall be spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.10.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

2.10.4.6 Suction Pressure Regulating Valve

Suction pressure regulating valve shall be FM approved FM P7825. Suction pressure shall be monitored through a pressure line to the controlling mechanism of the regulating valve. Valve shall be arranged in accordance with the manufacturer's recommendations.

2.12 FLOW METER

Meter shall be UL listed UL-04 or FM approved FM P7825 as flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150

percent of the rated flow of the pump(s). The flow meter shall be arranged in accordance with Figure A-2-14.2.1 of NFPA 20. The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in Figure A-2-14.2.1 of NFPA 20.

2.13 PIPE SLEEVE

A pipe sleeve shall be provided at each location where piping passes through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Sleeves shall be grouted in position during construction. Sleeve shall be of sufficient length to pass through the entire thickness of the wall, ceilings, roofs and floors. Not less than 1 inch clearance shall be provided between pipe exterior surface and the interior of the sleeve, and between the tie rods and the interior of the sleeve. The space shall be firmly packed with mineral wool insulation and caulk at both ends with plastic waterproof cement which will dry to a firm but pliable mass, or with a segmented elastomeric seal. Where pipes pass through fire walls or fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07270 FIRESTOPPING. Sleeves in masonry and concrete walls, ceiling, roofs and floors shall be hot-dip galvanized steel, ductile-iron, or cast-iron. Other sleeves shall be galvanized steel sheet pipe not less than 0.90 psf.

2.14 ESCUTCHEON (WALL) PLATES

Escutcheon plates shall be one-piece or split-hinge type metal plates and shall be provided for piping passing through floors, walls, and ceiling in exposed areas. In finished areas, plates shall be polished stainless steel or chromium-plated finish on copper alloy. In unfinished areas, plates shall have painted finish. Plates shall be secured in position.

2.15 UNDERGROUND PIPING

2.15.1 Pipe and Fittings

Underground piping and piping under the building slab shall be ductile-iron pipe and fittings. Piping shall be AWWA C151 ductile-iron pipe with AWWA C110 fittings and shall conform to NFPA 24. Piping beyond 5 feet of the building shall be provided under Section 02660 WATER LINES.

2.15.2 Valves

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation.

2.15.2.1 Valve Boxes

Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

2.16 CHLORINATING AGENTS

Chlorinating agent must comply to one of the following.

2.16.1 Liquid Chlorine

AWWA B301

2.16.2 Calcium Hypochlorite and Sodium Hypochlorite

AWWA B300

PART 3 EXECUTION

3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

3.2 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

3.2.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

3.2.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

3.2.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

3.2.3.1 Vertical Piping

Piping shall be supported at each floor, but not more than 10 foot intervals.

3.2.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.2.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation per NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 3 feet.

3.3 ELECTRICAL WORK

Except as modified herein, interior wiring methods shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR; exterior wiring methods shall be in accordance with Section 16735 ELECTRICAL DISTRIBUTION SYSTEMS, UNDERGROUND or Section 16730 ELECTRICAL DISTRIBUTION SYSTEMS, AERIAL as appropriate.

3.4 FIELD PAINTING AND FINISHING

Field painting and finishing shall conform to the requirements specified in Section 09900 PAINTING, GENERAL. Piping shall be provided with plastic labels of standard manufacture to identify piping as FIRE PUMP DISCHARGE, FIRE PUMP SUCTION, FIRE PUMP BYPASS, FIRE PUMP TEST HEADER, TO SYSTEM, and RELIEF VALVE DISCHARGE. Labels shall have red letters 1 inch high, 1/4 inch brush stroke, on white background.

3.5 INSTRUCTING OPERATING PERSONNEL

Upon completion of the work and at a time designated by the Contracting Officer, the Contractor shall provide, for a period of not less than one 8-hour working day, the services of experienced technicians regularly employed by the manufacturer of the fire pump, the fire pump controller, and the pump drivers to instruct Government operating personnel in the proper operation, inspection, testing, and maintenance of the equipment. Manufacturer's representatives who were present during the final tests shall be present and shall conduct or assist in the instruction.

3.6 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. Where the pump installation consists of

more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 120 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Flushing operations shall continue until water is clear, but not less than 10 minutes. The Contractor shall submit a signed and dated flushing certificate before requesting field testing.

3.7 FIELD TESTS

3.7.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psig for a period of 2-hours, or at least 50 psiin excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi.

3.7.2 Preliminary Test

The fire pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied) or their representative shall witness the complete operational testing of the fire pump and drivers. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. All test results and readings shall be recorded during the tests and signed by the witnessing manufacturer's representative.

3.7.3 Final Test

The Engineer District Fire Protection Engineer will witness the final tests. The Contractor shall take all readings and measurements. An experienced technician regularly employed by the pump installer shall be present during the test. The pump manufacturer, the fire pump controller manufacturer, and the diesel engine manufacturer (when supplied), or their representative shall be present for the final tests. Where pumps are diesel driven, an experienced technician employed by the engine manufacturer capable of demonstrating engine trouble alarms and operating features shall be present. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

3.7.3.1 Inspection

Thorough inspection of the fire pump installation, including visual observation of the pump while running shall be conducted. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards.

3.7.3.2 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.7.3.3 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours.

3.7.3.5 Alarms

All pump alarms, both local and remote, shall be tested.

3.7.3.6 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.7.4 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall performed corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.7.5 Test Equipment

The Contractor shall provide all equipment and instruments necessary to conduct a complete final test. The Government will furnish water for the tests.

3.7.6 Test Documentation

Contractor shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Contractor shall record all test results and plot curve of each pump performance during the test. The Contractor shall provide complete pump acceptance test data of each fire pump. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. The Contractor shall provide pump test data sheet in a properly

labeled three ring binder.

3.8 DISINFECTION

Before acceptance of the fire pump installation, the complete system and existing water piping affected by the Contractor's operations shall be disinfected as specified herein. After pressure tests have been made, the fire pump piping to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing in chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph CHLORINATING AGENTS. The chlorinating material shall be provided to achieve a dosage of not less than 50 ppm and shall be introduced into the fire pump piping in an approved manner. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 10 ppm of chlorine throughout the system at the end of the retention time. All valves in the piping to be disinfected shall be opened and closed several times during the retention period. The line shall be flushed with clean water until the residual chlorine is reduced to 1.0 ppm. Samples of water in proper sterilized containers for bacteriological examination will be taken from several system locations which are approved by the Contracting Officer. Samples will be given to the Contracting Officer for accomplishing bacteriological examination of the water samples. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15330

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

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) Ferritic Malleable Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 135	(1993) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1990) Carbon Steel Tract Bolts and Nuts
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 795	(1995) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1995a) Seamless Copper Water Tube
ASTM D 3309	(1994) Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems
ASTM F 442	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) 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) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B18.2.1	(1981; Supple 1991; R 1992) 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 (ASSE)

ASSE 1015	(1993) Double Check Backflow Prevention Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-10062JU	(1992) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1990) 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	(1990) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C203	(1991) 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 P7825	(1995; Supple I; Supple II; Supple III) Approval Guide

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71	(1990) Cast Iron Swing Check Valves,

	Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1994) Installation of Sprinkler Systems
NFPA 13R	(1994) 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	(1995) Rack Storage of Materials
NFPA 1963	(1993) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL-01	(1996) Building Materials Directory
UL-04	(1996; Supple) Fire Protection Equipment Directory
UL 668	(1989; Rev Feb 1994) Hose Valves For Fire Protection Service

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.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 0.10 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area for the third floor open dormitory bays and 0.15 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area for the first floor kitchen area . 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 500 gpm for ordinary hazard and 250 gpm for light hazard shall be added to the sprinkler system demand at the point of connection to the existing system. An allowance of 250 gpm shall also be added to the sprinkler system demand for the standpipe

connection closest to the most hydraulically remote calculated area.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 50 psi, and a flow of 1125 gpm at a residual pressure of 30 psi. Water supply shall be presumed available at the base of the riser . 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 100 for existing underground piping.

1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13 for light and ordinary hazard occupancies.]

1.3 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

Load Calculations for Sizing Sway Bracing

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Sprinkler System Equipment; GA.

Manufacturer's Catalog Data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, a complete equipment list which 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 Shop Drawings; GA.

Detail drawings conforming to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views which establish 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, seismic separation assemblies, 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; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Drawings; GA.

As-built drawings, no later than 14 working days after completion of the Final Tests. The sprinkler system shop drawings shall be updated to reflect as-built conditions after work is completed and shall be on reproducible full-size mylar film.

SD-06 Instructions

Test Procedures; GA.

Proposed test procedures for piping hydrostatic test, testing of alarms, at least 14 days prior to the start of related testing.

SD-07 Schedules

Preliminary Tests; GA.

A schedule of preliminary tests, at least 14 days prior to the proposed start of the tests.

Final Test; GA.

Upon successful completion of tests specified under PRELIMINARY TESTS, written notification shall be given to the Contracting Officer of the date for the final acceptance test. 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

Installer Qualifications; GA.

Qualifications of the sprinkler installer.

Submittal Preparer's Qualifications; GA.

The name and documentation of certification of the individual who will prepare the submittals, prior to the submittal of the drawings and hydraulic calculations.

SD-13 Certificates

Contractor's Material & Test Certificates; FIO.

Certificates, as specified in NFPA 13, shall be completed and signed by the Contractor's Representative performing required tests for both underground and aboveground piping.

SD-19 Operation and Maintenance Manuals

Sprinkler System; GA.

Manuals shall be in loose-leaf binder format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. The manuals shall list routine maintenance procedures possible breakdowns, and repairs, and troubleshooting guide. This shall include procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

1.4 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software specifically designed for fire protection system design. Software which uses k-factors for typical branch lines is not acceptable. Calculations shall be taken back to the water supply source unless water supply data is otherwise indicated. Calculations shall substantiate that the design area indicated is the hydraulically most demanding. 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.

1.5 SUBMITTAL PREPARER'S QUALIFICATIONS

The sprinkler system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer 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.

1.6 INSTALLER QUALIFICATIONS

The installer shall be experienced and regularly engaged in the installation of the type and complexity of system included in this project. A statement prior to submittal of any other data or drawings, that the proposed sprinkler system installer is regularly engaged in the installation of the type and complexity of system included in this project shall be provided. In addition, data identifying the location of at least three systems recently installed by the proposed installer which are comparable to the system specified shall be submitted. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

1.7 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. Applicable material and installation standards referenced in Appendix A of NFPA 13 and NFPA 24 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. All requirements that exceed the minimum requirements of NFPA 13 shall be incorporated into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.8 DELIVERY AND STORAGE

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

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 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.

2.1.2 Requirements for Fire Protection Service

Equipment and materials shall have been tested by Underwriters Laboratories, Inc. and listed in UL-04 or approved by Factory Mutual and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL-04 or FM P7825.

2.1.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

2.2 UNDERGROUND PIPING SYSTEMS

2.2.1 Pipe

Piping from a point 6 inches above the floor 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 feetoutside the building walls shall comply with Section 02660 WATER LINES.

2.2.2 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.

2.2.3 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-04 or FM P7825.

2.3 ABOVEGROUND PIPING SYSTEMS

Aboveground piping shall be steel or copper .

2.3.1 Steel Piping System

2.3.1.1 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.

2.3.1.2 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.

Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.3.1.3 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.

2.3.1.4 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 be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

2.3.2 Copper Tube Systems

2.3.2.1 Copper Tube

Copper tube shall conform to ASTM B 88, Types L and M.

2.3.2.2 Copper Fittings

Cast copper alloy pressure fittings shall conform to ASME B16.18 and wrought copper and bronze pressure fittings shall conform to ASME B16.22.

2.4 Pipe Hangers

Hangers shall be listed in UL-04 or FM P7825 and of the type suitable for the application, construction, and pipe type and sized involved.

2.5 Valves

2.5.1 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 UL-01 or FM P7825.

2.5.2 Check Valve

Check valve 2 inches and larger shall be listed in UL-01 or FM P7825. Check valves 4 inchesand larger shall be of the swing type with flanged cast iron body and flanged inspection plates, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.3 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 inchAmerican National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 2-1/2 inch 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 RISER ASSEMBLY

Assembly shall include an isolation OS & Y valve, pressure gauge, main drain and other components as detailed on contract drawings.

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 include two SPDT (Form C) contacts, 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.

2.8.3 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 projecting 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 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.

2.10.1 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch inch orifice.

2.10.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, semi-recessed type with nominal 1/2 inch orifice. Pendent sprinklers shall have a polished chrome finish in metal ceilings and white enamel finish in acoustical tile and other smooth ceilings.

2.10.4 Residential Sprinkler

Residential sprinkler shall be the pendent and sidewall types with nominal 1/2 inch orifice. Residential sprinkler shall have a white enamel finish.

2.10.7 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.

2.8.8 Automatic Open And Close Sprinklers

Automatic open and close type sprinklers shall have a 1/2 inch nominal size orifice. Sprinklers shall automatically reset to closed position without replacement or adjustment. Temperature ratings of the sprinklers shall be in accordance with \-NFPA 13-\. Automatic sprinklers of standard temperature rating shall be used, except in areas where above normal temperatures will occur. In areas of above normal temperatures, as indicated on drawings, high temperature sprinklers suitable for the temperature condition shall be provided.
Sprinkler heads shall be quick response type in sleeping areas and as listed in NFPA-13 for other areas.

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.

2.14 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.

2.13
BACKFLOW PREVENTION VALVE TEST KIT

The test kit shall be capable of conveniently field testing all brands of reduced pressure principle, double check, and pressure vaccum breaker backflow prevention devices. The kit shall utilize a gauge body of anodized aluminum with stainless steel internals, a 4 1/2 inch dial with a 0 - 15 psi differential in 150 divisions, brass needle valves with stainless steel stems, nylon tubing, brass fittings, 3 foot long color coded hoses with brass shraeder couplers, and 90 micron cleanable brass filters. All components of the kit shall be rated for 250 psi at ambient temperature. All components shall come and fit in a polypropylene, pin hinged carrying case with countoured interior foam.

2.14
FLOW TEST EQUIPMENT

The test kit shall consist of one 4 1/2 inch chrome plated pitot tube, one 2 inch chrome plated pitot tube, entended air chamber, 2 1/2 inch chrome plated dual tapped hydrant cap, double bleeder valve assembly with brass nobs, a cleanable 3 piston pressure snubber, an inspector's pressure test gauge with a 3 inch dial and removable cap over bezel with a 0.5 % accuracy over full scale, a recalibrator screw for zero adjust, and a universal hydrant wrench. All components except the hydrant wrench shall fit in a polypropylene pin hinged carrying case with countoured

interior foam.

2.15
0&M STORAGE CABINET

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 steel top and doors. The doors hsall 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. Two shelves shall be provided each 24 inches deep with a 200 lb. load rating. Shelves shall be capable of repositioning on 2 inch increments seating firmly on welded strips. The freestanding cabinet shall measure 36 inches wide by 24 inches deep by 42 inches high.

2.16
COMPUTERIZED MAINTENANCE SOFTWARE

Furnish computer software to provide for the inspection, testing and maintenance of water based fire protection systems following the procedures outlined in \-NFPA 25-\. The software must be capable of managing the inspection, testing, and maintenance of fire protection systems and associated mechanical equipment per manufacturer's recommended procedures. The program must designate the required procedures for weekly, monthly, quarterly, semiannual and annual intervals for each piece of equipment. The resulting computer computer generated customized inspection forms shall detail the tasks to be performed. The program shall be capable of assigning the inspection, testing, or maintenance to varied responsible parties by property, interval, system, and system component. The program shall 1) maintain a database of properties, systems and equipment, 2) maintain historical records of procedures conducted, 3) report tracking of scheduled completed and or failed procedures, 4) initiate freezing weather inspections during the defined freezing weather season, 5) generate, coordinate, and assign the scheduled inspection, testing, and maintenace of territories or properties to responsible parties, 6) provide reports detailing system deficiencies and corrective actions taken, 7) afford a complete security access system. The software must be capable of running on an IBM PC compatible computer utilizing a 386sx or faster microprocessor with a Microsoft Mouse or compatible pointing device. The program must be capable of inputing and handling an unlimited number of equipment items for a single user. The purveyor of the software must be readily available to provide on-line help and offer program upgrades and maintenance at a nominal fee. The software shall be capable of upgrade for use on a local area network.

PART 3 EXECUTION

3.1 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.

3.2 ABOVEGROUND PIPING INSTALLATION

Piping shall be run straight and bear evenly on hangers and supports.

3.2.1 Protection of Piping Against Earthquake Damage

Protection of piping from earthquake damage is not required. Thrust restraints as indicated and detailed on drawings is required.

3.2.2 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.

3.2.3 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.

3.2.4 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.

3.2.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

3.2.5 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.

3.2.6 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.

3.2.7 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.

3.2.8 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 07270 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.

3.2.9 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.

3.2.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected to the remote branch line; 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.

3.2.11 Drains

Main drain piping shall be provided to discharge at the location indicated. 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.

3.2.12 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.

3.2.13 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.

3.2.14
Installation of O & M Storage Cabinet

The base of the freestanding cabinet shall be mounted on 1/4 inch bolts anchored in a 48 inch by 36 inch by 6 inch concrete housekeeping pad. Locate as part of or adjacent to the pad supporting the skid mounted fire pump as shown on the contract drawings.

3.3 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 feetoutside the building walls shall meet the requirements of Section 02660WATER LINES.

3.4 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02221 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.5 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM. Wiring color code shall remain uniform throughout the system.

3.6 STERILIZATION

After system components have been installed and pressure tested, each portion of the completed system shall be sterilized. After pressure tests have been made, the portion to be sterilized shall be thoroughly flushed with water until all entrained dirt and other foreign materials have been removed 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 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 is 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 be then flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in properly sterilized 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-10062JU. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilization 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.

3.7 FIELD PAINTING AND FINISHING

Field painting and finishing are specified in Section 09900 PAINTING, GENERAL.

3.8 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.

3.8.1 Underground Piping

3.8.1.1 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.

3.8.1.2 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.

3.8.2 Aboveground Piping

3.8.2.1 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.

3.8.3 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.

3.8.4 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 recorded 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.

3.8.5
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 American Water Works Association Manual of Cross Connection Control (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 Number
Location	Date of Test
Test Pressure Readings	Serial Number and Test Date of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9 FINAL ACCEPTANCE TEST

A technician employed by the installing Contractor shall be present for the final tests 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.

3.10
0 & M TRAINING

Upon completion of the work and at times designated by the Contracting Officer, the Contractor shall provide two periods of a minimum of 4 hours each the services of experience technicians to instruct Government

operating personnel in the proper operation, inspection, testing, and maintenance of the alarm check valve assemblies, floor control valves, and backflow preventer. The Contractor will also conduct a flow test utilizing two nearby hydrants and the main drains to verify the hydraulic data on the riser identification plate. The flow test and backflow preventer test will be conducted utilizing the equipment furnished under this contract. Upon completion of the training, the equipment will be turned over to the Contracting Officer.

3.11
COMPUTERIZED MAINTENANCE MANAGEMENT TRAINING

The Contractor shall furnish the software outlined in this specification and secure the services of the approved software purveyor to input the equipment installed under this specification onto a laptop computer and demonstrate the program in an electronic presentation to be held at the COE Resident Office. A four hour hands on demonstration will be conducted four times over two consecutive days. Upon completion of the training, the software and contract input, including the equipment furnished under section \=15320=\, will be loaded onto a Government furnished computer at the Central Fire Department.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15400

PLUMBING, GENERAL PURPOSE

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) 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	(1993; Z21.10.3a; Z21.10.3b) Gas Water Heaters Vol. III Storage, 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
ANSI Z124.1	(1995) Plastic Bathtub Units
ANSI Z124.3	(1995) Plastic Lavatories

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1996) Cast Iron Soil Pipe and Fittings
ASTM A 105	(1996) Forgings, Carbon Steel, for Piping Components

ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 515	(1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518	(1992) Corrosion-Resistant High-Silicon Iron Castings
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 888	(1994) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(1995b) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1994) Seamless Red Brass Pipe, Standard Sizes
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 111	(1993) Copper and Copper-Alloy Seamless Condenser Tubes and Ferule Stock
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 152	(1994) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(1996) Copper Drainage Tube (DWV)
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM B 584	(1996) Copper Alloy Sand Castings for General Applications
ASTM B 641	(1993) Seamless and Welded Copper Distribution Tube (Type D)

ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings
ASTM C 564	(1995) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM C 1053	(1990) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D 638	(1996) Tensile Properties of Plastics
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	(1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1996) Rubber Products in Automotive Applications
ASTM D 2235	(1993a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(1994) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(1994) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(1993) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1994) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1994a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1994) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 1996) Evaluating Coatings for High Temperature Service
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl

	Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1990) Heat-Joining Polyolefin Pipe and Fittings
ASTM D 2661	(1995) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(1995) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1993; R 1995) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(1993) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991) Asphalt Roof Cement
ASTM D 2846	(1995a) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1993) 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	(1993) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1993) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1993) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1989; R 1995) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1991a) 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	(1995a) Propylene Plastic Injection and Extrusion Materials
ASTM D 4551	(1991) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM E 1	(1995) ASTM Thermometers
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 409	(1995) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1993) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(1993) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1993a) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441	(1995) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(1995) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1993a) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(1995) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 891	(1993a) Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F 1290	(1993) Electrofusion Joining Polyolefin Pipe and Fittings

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) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1990) Backwater Valves
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1995; Errata) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991) 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	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.12	(1991) 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) 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; Errata) 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	(1988) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995) 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	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1995) 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	(1964; Rev thru Apr 1986) Water Closet Flush Tank Ball Cocks
ASSE 1003	(1964; Rev thru Oct 1993; Errata Dec 1993) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1993) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1006	(1986) Residential Use (Household) Dishwashers
ASSE 1011	(1995) Hose Connection Vacuum Breakers

ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1971; Rev thru Oct 1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1977; Rev Jan 1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1037	(1986; Rev thru Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures/F

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(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	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA D100	(1984; D100a) 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	(1995) 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-238	(Rev B) Seat, Water Closet
CID A-A-240	(Basic) Shower Head, Ball Joint
CID A-A-50012	(Basic) Garbage Disposal Machine, Commercial

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA-02	(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

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1996) Steel Pipe Line 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	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) 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) Brazing Joints for Copper and

	Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) 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-01	(1996) National Standard Plumbing Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1992) Installation of Oil Burning Equipment
NFPA 54	(1992) National Fuel Gas Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF Std 3	(1982) Dishwashing Machine/Commercial Spray Type
NSF Std 5	(1992) Hot Water Generating Equipment
NSF Std 14	(1965; Rev Nov 1990) 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	(1991) Testing and Rating Procedures for Grease Interceptors
PDI WH 201	(1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J1508	(1993) Hose Clamps

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 5	(1994) White Metal Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 174	(1996) Household Electric Storage Tank Water Heaters
UL 430	(1994; Rev Nov 95) Waste Disposers
UL 732	(1995) Oil-Fired Storage Tank Water Heaters
UL 749	(1995; Rev thru Mar 1996) Household Dishwashers
UL 921	(1992) 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 PERFORMANCE REQUIREMENTS

1.3.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

1.3.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with Section 16640 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

1.4 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.

1.5 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

Welding; FIO.

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; GA.

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

SD-04 Drawings

Plumbing System; GA.

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 Sterilization; 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; FIO.

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.

1.6 REGULATORY REQUIREMENTS

1.6.1 Plumbing

Plumbing work shall be in accordance with NAPHCC-01.

1.7 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 schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. 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 under concrete floor slabs or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: ASTM A 74, AWWA C606.

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12)Malleable Iron ASTM A 47, Grade 32510. Copper ASTM A 536.

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: 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.

o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.

p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.

q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.

s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

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 J1508.

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.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

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 15250 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

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants

Wall hydrants 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 inchexposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

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 valve shall be the size of the valve outlet.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. 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

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.]

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 approves 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 and Shower Drains

Floor and shower 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.

2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.6.1.2 Drains

Drains valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.3 Boiler Room Drains

Boiler room drains shall have combined drain and trap, hinged grate, removable bucket, and threaded brass cleanout with brass backwater valve. The removable galvanized cast-iron sediment bucket shall have rounded corners to eliminate fouling and shall be equipped with hand grips. Drain shall have a minimum water seal of 4 inches.The grate area shall be not less than 100 square inches.

2.6.4 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern

suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.5 Sight Drains

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

2.6.6 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 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 16 ounceweight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D 4551.

2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. ASTM D 638:

Ultimate Tensile Strength:	2600 psi
Ultimate Elongation:	398 percent
100 Percent Modulus:	445 psi

b. ASTM D 1004:

Tear Strength:	300 pounds per inch

c. ASTM E 96:

Permeance:	0.008 perms

d. Other Properties:

Specific Gravity:	1.29
PVC Solvent:	Weldable
Cold Crack:	-53 degrees F
Dimensional stability, 212 degrees F	minus 2.5 percent
Hardness, Shore A:	89

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. 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 inchover 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.

2.9 WATER HEATER

Water heater types and capacities shall be as indicated. Each primary water heater shall have controls adjustable from 90 to 120 degrees F. Each gas-fired water heater and booster water heater shall have controls adjustable from 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and stand by heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that the storage capacity need not meet the standard loss requirement if the tank surface area is not insulated to R-12.5 and if a standing light is not used.

2.9.1 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.

2.9.2 Phenolic Resin Coatings

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The 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. The coating shall be a product specifically intended for use on the material the water heating coils are made of. Steel, copper, copper alloy, or stainless steel coatings shall be capable of withstanding temperatures up to 400 degrees F dry bulb; and meet the requirements of 21 CFR 175.

2.9.2.1 Wash Primer

The wash primer shall be composed of a combination of polyvinyl butyral and a heat hardening phenolic resin. The weight per gallon shall be between 7.0 lbs per gallon minimum and 7.4 lbs. per gallon maximum.

2.9.2.2 Pigmented Base Coat

The pigmented baking phenolic base coat shall consist of heat hardening phenolic resins, suitable pigments of the earth type, and softening agents, and shall not contain drying oils or cellulose material. The weight per gallon shall be between 10.3 lbs per gallon minimum and 10.7 lbs per gallon maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

2.9.2.3 Clear Top Coat

The clear non-pigmented baking phenolic top coat shall have a weight per gallon of between 8.65 lbs per gallon minimum and 8.95 lbs per gallon maximum. The non-volatile solids content shall be between 48 percent minimum and 52 percent maximum by weight.

2.10 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 6 inchminimum diameter face. Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.11 PUMPS

2.11.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 4 enclosed, across-the-line, magnetic controller. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 4 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.11.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be integrally mounted on a cast-iron or steel subbase,. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Pump shall conform to HI 1.1-1.5. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than Fractional horsepower pump motorsshall have integral thermal overload protection in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

2.11.3 Booster Pumps

2.11.3.1 Centrifugal Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished. The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze wearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in gpm, head in feet,efficiency, brake horsepower, and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

2.11.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line-type magnetic controller complete in a NEMA 250 Type 1 enclosure with three position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously beeping a third pump as a standby.

2.11.4 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.11.5 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, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Hubless cast-iron pipe shall not be installed under concrete floor slabs. Piping located in air plenums shall conform to NFPA 90A requirements.

Unprotected plastic pipe shall not be installed in air plenum. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. 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 average local frost depth or as 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 after a thorough cleaning including probing with an adequate snake and flushing to insure free flow. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the pipe entry and pipe,the fixtures, thematerials, and theequipment shall be thoroughly cleaned, adjusted, flushed, 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 inchhose bibb with renewable seat and gate 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 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 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.

3.1.2 (null)

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 Union and Flanged

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-02 with flux and are acceptable for line 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 lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA-02.

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-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.3.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.7 Glass Pipe

Joints for corrosive waste glass pipe and fittings shall be made with corrosion-resisting steel compression-type couplings with acrylonitrile rubber gaskets lined with polytetrafluoroethylene.

3.1.3.8 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D 2657 and ASTM F 1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.3.9 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper 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 C203and 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 07920 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 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 ouncecopper 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 07920 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 07270 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.

3.1.8.3 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 inchesand 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 footfrom 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.

o. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of

expansion/contraction.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 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. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. 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 cast iron.

3.2 Installation of Gas-Water Heater Combustion Air Ducts

Installation shall conform to NFPA 54 for gas 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. Circulating systems need not have heat traps installed. 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.

3.3 Phenolic Resin Application Process

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory.

3.3.1 Surface Preparation

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. 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.

3.4 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.6 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.

3.6.1 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.

3.6.2 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.

3.6.3 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.

3.6.4 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.

3.6.5 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.

3.6.5.1 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.

3.6.5.2 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.

3.6.5.3 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.

3.6.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.6.5.5 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.

3.6.6 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-01 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. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.6.7 Access Panels

Access panels shall be provided for concealed valves 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.

3.6.8 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.

3.6.9 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. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.6.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as

nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.6.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.6.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flatlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 gallon per 50 square feet. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.6.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.6.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 6 inches in room areas and 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 2 inches.Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.7 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 25 percent of the lowest equipment rpm.

3.8 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.9 IDENTIFICATION SYSTEMS

3.9.1 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.

3.9.2 Color Coding

Color coding for piping identification shall be as specified in Section 15190 PAINTING, GENERAL.

3.9.3 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900PAINTING, GENERAL.

3.9.4 TESTS FLUSHING AND STERILIZATION

3.9.4.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

3.9.4.1.1 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.

3.10 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.11 Phenolic Resin Coatings

A certificate of compliance shall be submitted by the coating manufacturer that documents successful use of coating system under service conditions indicated on the drawings for a minimum of 2 years at three different locations, and that the coating material and application comply with the testing procedures outlined.

3.11.1 Test Panels

Steel test panel substrate shall be 24 gauge in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 4 to 6 mil, then clear baking phenolic to a total dry film thickness of 5 to 7 mil. The panels shall then be subjected to the tests specified below:

a. Heat Test: Test panel shall be minimum 2-3/4 x 5-7/8 inches in size. A coated test panel shall show no cracking, flaking, or other failure after the panel has been tested in accordance with ASTM D 2485, with a furnace temperature of 400 degrees F.

b. Abrasion Test: A coated test panel shall show no more than a 40 milligram loss when tested in accordance with ASTM D 4060, utilizing a Tabor Abraser CS-17F wheel with a 1000 g weight for 1000 cycles.

c. Corrosion Test: A coated test panel shall show no corrosion after being subjected to a 500 hour salt spray test in accordance with ASTM B 117.

3.12 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 materials. Caulking of screwed joints or holes will not be permitted.

3.13 System Flushing

After tests are completed, potable water piping shall be flushed. 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 discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service 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 work is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.14 Operational Test

Upon completion of and prior to acceptance of the installation, 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.

3.15 Disinfection

After pressure tests have been made, the entire domestic hot- and cold-water distribution system shall be sterilized. System shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material have been removed, 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 sterilized 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. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing 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.

3.16 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET:OPTION #2

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - CID A-A-238, 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-1A WATER CLOSET HANDICAPPED:

Top rim of bowl shall be 18 inches above the floor; other features are the same as P-1.

P-2 URINAL:OPTION #4

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.

P-3 LAVATORY:OPTION #3

Manufacturer's standard sink depth, enameled cast iron ASME A112.19.1M ledge back.

Faucet - Faucets shall be center set 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 - Four arm type. Cast, formed, or drop forged copper alloy.

Drain - Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-3A 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.

P-4 KITCHEN SINK:

Ledge back with holes for faucet and spout 24 x 30 inches double bowl 32 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 gallonper 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 copper alloy or stainless steel.

P-5 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3M trap standard 24 inches wide x 20 inches deep,splashback 9 inches high floor mounted 28 inches square, 6-3/4 inches deep.

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.

P-5A MOP SINK

Cast concrete with 6" ledge.

Faucet and Spout - Cast or wrought copper alloy, [with] [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. [Indexed turn] [Lever] [Four arm] type.

P-10 SURGEONS'S SINK:

30 inches wide x 20 inches deep countertop [20 inches wide x 15 inches deep , corrosion-resisting steel ASME A112.19.3M. Thickness of sinks

shall be manufacturer's standard. drain and trap shall be stainless steel].

Faucet and Spout - 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.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

P-11 SCULLERY SINK:

Stainless steel ASME A112.19.3M with drainboard, 36 x 24 inch compartments, 27 inch deep, 15 inch splashback, double compartment - 108 inches wide138 inches wide. Drain shall have quick opening valve. Support on stainless steel legs.

Faucet and Spout - Cast or wrought copper alloy, 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 copper alloy, wrought copper alloy, or stainless steel, four arm type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc. shall be copper alloy or stainless steel.

P-12 LAUNDRY SINK:

Double bowl, countertop 42 x 21 inches stainless steel ASME A112.19.3M.

Faucet and Spout - Cast copper alloy, wrought copper alloy, cast iron, or stainless steel, with backflow preventer. Faucets shall have replaceable seat and the stem shall rotate onto the seat. Strainers shall have internal threads. Combination faucets shall be mounted on the tub back. Spouts shall be externally threaded for hose connection.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

Traps - Copper alloy, or cast iron.

P-6 Shower: Shower heads, CID A-A-240 other than emergency showers, shall include a non-removable, tamperproof device to limit water flow to 2.5 gpm when tested in accordance with ASME A112.18.1M.

Wall Mounted: Shower head shall be adjustable spray, stainless steel or chromium plated brass with ball joint. Handles shall be chrome-plated die cast zinc alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be mechanical mixing, single lever type. Shower head shall be vandalproof with integral back. Shower heads shall be raised to 78 inches above floor directly beneath head.

P-14 BUBBLER DRINKING FOUNTAINS:

Bubbler drinking fountains shall have self-closing valves. Self-closing valves shall have automatic stream regulators, flow control capability, a push button actuation or a cross-shaped index metal turn handle without a hood. 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. Stops, stream regulators, flow controls, pushbuttons, handles, and traps shall be made of copper zinc alloy. Strainers and drains shall be made of copper zinc alloy or stainless steel.

Surface Wall-Mounted - Surface wall-mounted units shall be 13-1/4 inches wide, 13 inches deep, 10 inches high, and have a back height of 6 to 8 inches. The bowl shall be made of corrosion-resisting steel. The unit shall have concealed fasteners and be for exterior installation.

P-7B WATER COOLER DRINKING FOUNTAINS:
Water cooler drinking fountains 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 Fwhile 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.

Semi-Recessed Wall-Mounted - Semi-recessed wall-mounted units shall be 14 inches wide, 11 inches deep, and have a back height of 13 to 22 inches. The bowl shall be made of corrosion resisting steel and be for interior installation.

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 15 inches wide, 20 inches deep, with a back height of 6 to 8 inches. The unit shall clear the floor or ground by at least 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 27 inches and between the front edge of the bowl and the body of the unit of at least 8 inches. A 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 36 inches above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 6-1/2 inches high, made of corrosion resisting steel and be for interior installation.

P-16 FOOD WASTE DISPOSER:

Food waste disposers shall be in accordance with UL 430.

P-17 GARBAGE DISPOSAL MACHINES:

Garbage disposals machines shall be in accordance with CID A-A-50012.

P-19 DISHWASHING MACHINES:

Commercial dishwashing machines shall conform to NSF Std 3, NSF Std 5 and UL 921.

3.17 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.

3.18 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = o (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in gallons

3.12.1 Storage Water Heaters

3.12.1.1 Electric

a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

b. Storage capacity of more than 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

3.12.1.2 Gas

a. Storage capacity of 100 gallons or less, and input rating of

75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.

b. Storage capacity of more than 100 gallons - or input rating more than 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.12.1.3 Oil

a. Storage capacity of 50 gallons or less and input rating of 105,000 Btu/h or less: minimum EF shall be 0.59-0.0019V per 10 CFR 430.

b. Storage capacity of more than 50 gallons or input rating more than 105,000 Btu/h: EC shall be 83 percent; maximum SL shall be 1.3+38/V, per 10 CFR 430.

3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

3.12.3 Instantaneous Water Heater

3.12.3.1 Gas

Volumes and inputs: ET shall be 80 percent per ANSI Z21.10.3.

3.12.3.2 Oil

Capacities and inputs: EC shall be 83 percent per ANSI Z21.10.3.

3.12.4 Pool Heaters

Gas/oil fuel, capacities and inputs: ET shall be 78 percent per ANSI Z21.56.

TABLE I

PIPE AND FITTING MATERIALS FOR

DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	
2	Cast iron pipe and fittings hubless, CISPI 301 and ASTM A 888	X	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	X	X		X	X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47 for use with Item 5	X	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	X	
8	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152 C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	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	X	
11	Seamless red brass pipe, ASTM B 43			X	X		
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	

TABLE I

PIPE AND FITTING MATERIALS FOR

DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Materials	A	B	C	D	E	F
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	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40)	X	X	X	X	X	X
21	ASTM C 1053	X					
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518		X			X	
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain

TABLE I

PIPE AND FITTING MATERIALS FOR

DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Materials	A	B	C	D	E	F

B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		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	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47, non-ferrous pipe, ASTM A 536 and ASTM A 47	X	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47 for use with Item 2	X	X	X	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Item 4	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88	X**	X**	X**	X***
9	Seamless and welded copper distribution tube (Type D) ASTM B 641	X**	X**	X**	X****
10	Cast bronze threaded fittings, ASME B16.15 for use with Items 7 and 8	X	X		X
11	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 7 and 8	X	X	X	X

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
12	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 7 and 8	X	X	X	X
13	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
14	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
15	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
16	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
17	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 12, 13, and 16	X			X
18	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 13	X			X
19	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
20	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441	X			X
22	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442	X			X
23	Threaded chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21	X	X		X

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Item 23	X	X		X
25	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Item 23	X	X		X
26	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
27	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
28	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
29	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467	X			X
30	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
31	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X			X
32	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
33	Steel pipeline flanges, MSS SP-44	X	X		
34	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
35	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
36	Malleable-iron threaded pipe unions ASME B16.39	X	X		
37	Nipples, pipe threaded ASTM A 733	X	X	X	

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D

A - Cold Water Aboveground

B - Hot Water 180 degrees F Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground

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

**** - In or under slab floors only brazed joints

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	120 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min. OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.	75,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	100 min. OR	75,000 Btu/h	ANSI Z21.10.3	ET = 77 percent; SL = 1.3+38/V max.
Oil	50 max.	105,000 Btu/h	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	51 min. OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

C. Instantaneous Water Heater

Gas	All	All	ANSI Z21.10.3	ET = 80 percent
Oil	All	All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	ANSI Z21.56	ET = 78 percent

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 70 degrees F delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

NOTES: 1. ALL DRAIN LINES FROM KITCHEN APPLIANCES AND FIXTURES (INCLUDING FLOOR SINKS) SHALL BE INSTALLED WITH METAL PIPE WITH SCREWED FITTINGS. 2. ISOLATION VALVES SHALL BE ADDED FOR EACH INDIVIDUAL BATHROOM/SHOWER AREA.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15556

FORCED HOT WATER HEATING SYSTEMS USING WATER HEAT EXCHANGERS

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 designations only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1990b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105	(1992) Forgings, Carbon Steel, for Piping Components
ASTM A 106	(1991) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1992) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1992a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 366	(1991) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 515	(1990) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 525	(1991b) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 527	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality

ASTM A 528	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Drawing Quality
ASTM A 536	(1984) Ductile Iron Castings
ASTM A 569	(1991a) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 642	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Drawing Quality, Special Killed
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 32	(1993) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1992a) Seamless Copper Tube
ASTM B 88	(1993) Seamless Copper Water Tube
ASTM B 251	(1993) Wrought Seamless Copper and Copper-Alloy Tube
ASTM B 265	(1993) Titanium and Titanium Alloy Strip, Sheet, and Plate
ASTM B 333	(1992) Nickel-Molybdenum Alloy Plate, Sheet, and Strip
ASTM B 395	(1993) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM B 424	(1993) Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221) Plate, Sheet, and Strip
ASTM B 650	(1985) Electrodeposited Engineering Chromium Coatings of Ferrous Substrates
ASTM B 687	(1988) Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM B 828	(1992) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM D 596	(1991) Reporting Results of Analysis of Water
ASTM D 1248	(1984, R 1989) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1384	(1987) Corrosion Test for Engine Coolants in Glassware

ASTM D 2000	(1990) Rubber Products in Automotive Applications
ASTM D 3308	(1991a) PTFE Resin Skived Tape

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1992) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(1992) Cast Iron Threaded Fittings Classes 125 and 250
ASME B16.5	(1988; Errata; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) 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 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.34	(1988) Valves - Flanged, Threaded, and Welding End
ASME B31.1	(1992; B31.1a; B31.1b) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1992; Addenda Dec 1992, Dec 1993) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX	(1992; Addenda Dec 1992, Dec 1993) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA-01	(1980; Addenda 1985) EJMA Standards

HYDRONICS INSTITUTE (HYI)

HYI-01	(1992; Addenda Jan 1992) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1988) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1985) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01	(1993) National Standard Plumbing Code (Non-Illustrated Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

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

Spare Parts; FIO_____]
.

Spare parts data for each different item of material and equipment specified , after approval of the related submittals 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.

Welding Procedures

Welding Procedures and Qualifications; FIO.

6 copies of qualified procedures and list of names and identification symbols of qualified welders and welding operators, prior to welding operations.

SD-04 Drawings

Heating System; GA.

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. 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 and anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-06 Instructions

Framed Instructions; GA.

Proposed diagrams, instructions, and other sheets, prior to posting. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, 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.

SD-09 Reports

Performance Tests; FIO.

Performance 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, upon completion and testing of the installed system. Each test report shall indicate the final position of

controls.

Water Treatment Tests; FIO.

The water quality test report shall identify the chemical composition of the heating water. The report shall include a comparison of the condition of the water with the chemical company's recommended conditions. Any required corrective action shall be documented within the report.

SD-13 Certificates

Bolts; FIO.

Written certification that the bolts furnished comply with the requirements of this specification, provided by the bolt manufacturer. 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

Heating System; FIO.

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set, prior to performance testing and the remainder upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, water treatment procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Manuals shall be provided prior to the field training course.

1.3 QUALIFICATIONS

Procedures and welders shall be qualified in accordance with the code under which the welding is specified to be accomplished.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials 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.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 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 in accordance with 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.

2.1.4 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

2.1.5 Electrical Work

Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electric equipment (including motor efficiencies), and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. High efficiency motors shall be used. Electrical characteristics shall be as specified or indicated. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor 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, conduit, and connection to power required for controls and devices but not shown shall be provided.

2.2 PIPING, TUBING, AND FITTINGS

2.2.1 General

Piping, tubing, and fittings shall be as follows:

a. Low temperature water piping shall be black steel or copper tubing with cast iron, malleable iron or steel, solder-joint, flared-tube or grooved mechanical joint fittings.

c. Condensate return piping shall be black steel Schedule 80 with cast iron or malleable iron, Class 250 minimum.

d. High temperature water piping shall be black steel, Schedule 40.

e. Vent piping shall be black steel, Schedule 40, with black malleable iron fittings.

2.2.2 Steel Pipe

Pipe shall conform to ASTM A 53 or ASTM A 106, Grade A or B, black steel, Schedule 40, unless otherwise specified. Steel pipe to be bent shall be ASTM A 53, Grade A, standard, or Grade B, extra strong weight.

2.2.3 High Temperature Water Piping

Piping shall be Type S for 1-1/2 inches and smaller, Type S or Type E for pipe 2 inches and larger, schedule 40 steel conforming to ASTM A 53, Grade B; or to ASTM A 106, Grade B.

2.2.4 Gauge Piping

Piping shall be copper tubing for andlow temperature water. Black steel, ASTM A 106, seamless, Grade A pipe shall be used for high temperature.

2.2.5 Copper Tubing

Tubing shall conform to ASTM B 88, Type K or L. Tubing for compressed air tubing shall conform to ASTM B 251.

2.2.6 High Temperature Water Fittings

Fittings shall be steel welding fittings conforming in physical and chemical properties to ASTM A 234. Buttwelding fittings shall conform to ASME B16.9. Socket welded fittings shall conform to ASME B16.1. Screwed fittings, when required, shall be black forged steel, 2000-pound class, conforming to ASME B16.11. Flanges shall be serrated or raised-faced type.

2.2.7 Malleable Iron Pipe Fittings

Fittings shall conform to ASME B16.3, type required to match adjacent piping.

2.2.8 Cast Iron Pipe Fittings

Fittings shall conform to ASME B16.1 or ASME B16.4 type required to match adjacent piping.

2.2.9 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.2.9.1 Welded Fittings

Welded fittings shall conform to ASTM A 234 with WPA marking. Butt welded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11.

2.2.9.2 Grooved Mechanical Fittings

Standard fittings shall be of malleable iron conforming to ASTM A 47, Grade 32510, or ductile iron conforming to ASTM A 536, Grade 65-45-12. Fittings may also be constructed of steel, conforming to ASTM A 106, Grade B or ASTM A 53.

2.2.9.3 Grooved Mechanical Pipe Joints

Pipe joints shall conform to AWWA C606. Grooved mechanical joint fittings shall be full flow factory manufactured forged steel fittings. Fittings, couplings, gaskets, and pipe grooving tool or grooved end pipe shall be products of the same manufacturer. Mechanical pipe couplings shall be of the bolted type and shall consist of a housing fabricated in two or more parts, a synthetic rubber gasket, and nuts and bolts to secure unit together. Housings shall be of malleable iron conforming to ASTM A 47, Grade 32510 or ductile iron conforming to ASTM A 536, Grade 65-45-12. Coupling nuts and bolts shall be of steel and conform to ASTM A 183. Gaskets shall be of molded synthetic rubber, Type EPDM with central cavity, pressure responsive configuration and shall conform to ASTM D 2000.

2.2.10 Fittings for Copper Tubing

Wrought copper and bronze fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy fittings shall conform to ASME B16.18and ASTM B 828. Flared fittings shall conform to ASME B16.26and ASTM B 62. Adaptors may be used for connecting tubing to flanges and threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Cast bronze threaded fittings shall conform to ASME B16.15.

2.2.11 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns., etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

2.2.12 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.2.13 Nipples

Nipples shall conform to ASTM A 733 or ASTM B 687, standard weight.

2.2.14 Unions

Unions shall conform to ASME B16.39, type to match adjacent piping.

2.2.15 Adapters

Adapters for copper tubing shall be brass or bronze for soldered fittings.

2.2.16 Dielectric Unions

Unions shall conform to the tensile strength and dimensional requirements specified in ASME B16.39. Unions shall have metal connections on both ends to match adjacent piping. Metal parts of dielectric unions shall be separated so that the electrical current is below 1 percent of the

galvanic current which would exist upon metal-to-metal contact.

2.2.17 Grooved Mechanical Joints

Rigid grooved pipe joints may be provided in lieu of unions, welded, flanges or screwed piping connections at chilled water pumps and allied equipment, and on aboveground pipelines in serviceable locations, if the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to insure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications, will not be permitted. Rigid grooved pipe couplings shall be used with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 125 psi service and appropriate for static head plus the pumping head, and shall provide a water-tight joint. Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and verify the groove dimensions in accordance with the coupling manufacturer's specifications.

2.2.18 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, temperature, and circulating medium. The flexible section may have threaded, welded, soldered, flanged, grooved, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.3 MATERIALS AND ACCESSORIES

2.3.1 Iron and Steel Sheets

2.3.1.1 Galvanized Iron and Steel

Galvanized iron and steel shall conform to ASTM A 527, ASTM A 528, or ASTM A 642, with general requirements conforming to ASTM A 525. Gauge numbers specified are Manufacturer's Standard Gauge.

2.3.1.2 Uncoated (Black) Steel

Uncoated (black) steel shall conform to ASTM A 366 or ASTM A 569, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to Manufacturer's Standard Gauge.

2.3.2 Solder

Solder shall conform to ASTM B 32. Solder and flux shall be lead free.

2.3.3 Solder, Silver

Silver solder shall conform to AWS A5.8.

2.3.4 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and thermometers shall have rigid stems with straight, angular, or inclined pattern.

2.3.5 Gauges

Gauges shall conform to ASME B40.1.

2.3.6 Gaskets for Flanges

Composition gaskets shall conform to ASME B16.21. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

2.3.7 Polyethylene Tubing

Low-density virgin polyethylene shall conform to ASTM D 1248, Type I, Category 5, Class B or C.

2.3.8 Bellows-Type Joints

Joints shall be flexible, guided expansion joints. Expansion element shall be of stainless steel. Bellows-type expansion joints shall be in accordance with the applicable requirements of EJMA-01 and ASME B31.1 with internal liners.

2.3.9 Expansion Joints

Expansion joints shall provide for either single or double slip of connected pipes, as required or indicated, and for not less than the traverse indicated. Joints shall be designed for hot water working pressure not less than 150 psig and shall be in accordance with applicable requirements of EJMA-01 and ASME B31.1. Joints shall be designed for packing injection under full line pressure. End connections shall be flanged or beveled for welding as indicated. Joints shall be provided with anchor base where required or indicated. Where adjoining

pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 2 mils of hard chrome conforming to ASTM B 650. Joint components shall be fabricated from material equivalent to that of the pipeline. Initial settings shall be made in accordance with manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by joint manufacturer, but in any case shall not be more than 5 feet from expansion joint except for lines 4 inches or smaller, guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

2.3.10 Flexible Ball Joints

Flexible ball joints shall be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. Joint ends shall be threaded (to 2 inches only), grooved, flanged or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360-degree rotation. Balls and sockets shall be of equivalent material as the adjoining pipeline. Exterior spherical surface of carbon steel balls shall be plated with 2 mils of hard chrome conforming to ASTM B 650. Ball type joints shall be designed and constructed in accordance with ASME B31.1 and ASME BPV VIII Div 1, where applicable. Flanges where required shall conform to ASME B16.5. Gaskets and compression seals shall be compatible with the service intended.

2.3.11 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 VALVES FOR LOW TEMPERATURE WATER HEATING SYSTEMS

2.4.1 Check Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 3 or 4, Class 125. Sizes 3 inches through 24 inches, cast iron shall conform to MSS SP-71, Type III or IV, Class 125.

2.4.2 Globe Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 125. Sizes 3 inches through 12 inches, cast iron shall conform to MSS SP-85, Type III, Class 125.

2.4.3 Angle Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 125. Sizes 3 inches through 12 inches, cast iron shall conform to MSS SP-85, Type III, Class 125.

2.4.4 Gate Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1 or 2, Class 125. Sizes 3 inches through 48 inches, cast iron shall conform to MSS SP-70, Type I, Class 125, Design OT or OF (OS&Y), bronze trim.

2.4.5 Air Vents

Air vents shall be provided at all piping high points in water systems, with block valve in inlet and internal check valve to allow air vent to be isolated for cleaning and inspection. Outlet connection shall be piped to nearest open site or suitable drain, or terminated 12 inches above finished grade. Pressure rating of air vent shall match pressure rating of piping system. Body and cover shall be cast iron or semi-steel with stainless steel or copper float and stainless steel or bronze internal parts. Air vents installed in piping in chase walls or other inaccessible places shall be provided with an access panel.

2.4.6 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register degree of valve opening. Valves shall be calibrated so that flow in gpm can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing. Plug valves and ball valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.7 Automatic Flow Control Valves

The valves shall be designed to be sensitive to pressure differential across the valve to provide the required opening. The valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Valves shall be suitable for the maximum system operating temperature and pressure. Valve materials shall be same as specified for low temperature heating system check, globe, angle and gate valves. Valve operator shall be the electric motor type as applicable. Valve operator shall be capable of positive shutoff against the system pump head.

2.4.8 Gravity Flow Control Valves

Ends shall be soldered, threaded, or flanged type as applicable, and designed for easy cleaning without disconnecting piping. Valves for copper tubing shall be bronze. Valves shall prevent flow due to gravity when circulators are off.

2.5 VALVES FOR HIGH AND MEDIUM TEMPERATURE WATER SYSTEMS

2.5.1 Check Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Class 300 Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Class 300 minimum. Sizes 3 inches through 24 inches, steel shall conform to ASME B16.34, Class 300 minimum, flanged ends, swing disc; water, oil gas service to 850 degrees F.

2.5.2 Globe Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 300 minimum. Sizes 3 inches through 24 inches,steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas, service to 850 degrees F.

2.5.3 Angle Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, 2 or 3, Class 300 minimum. Sizes 3 inches through 24 inches,steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas, service to 850 degrees F.

2.5.4 Gate Valves

Sizes 2-1/2 inches and less, bronze shall conform to MSS SP-80, Type 1, or 2, Class 300 minimum. Sizes 3 inches through 24 inches,steel shall conform to ASME B16.34, Class 300 minimum, flanged ends; water, oil, gas service to 850 degrees F. Gate shall be split wedge (double disc) type.

2.6 COLD WATER CONNECTIONS

Connections shall be provided which include consecutively in line a strainer, backflow prevention device, and water pressure regulator. The backflow prevention device shall be provided as indicated and in compliance with Section 15400 PLUMBING, GENERAL PURPOSE.

2.6.1 Strainers

Basket or Y-type strainers shall be the same size as the pipelines in which they are installed. Strainer bodies shall be rated for 125 pound service, with bottoms drilled and plugged. Bodies shall have arrows cast on the sides to indicate the direction of flow. Each strainer shall be equipped with a removable cover and sediment basket. Basket shall not be less than 22 gauge and shall have perforations to provide a net free area through the basket of at least four times that of the entering pipe.

2.6.2 Pressure Regulating Valve

Valve shall be a type that will not stick nor allow pressure to build up on the low side. Valve shall be set to maintain a terminal pressure approximately 5 psi in excess of the static head on the system and shall operate within a 20 psivariation regardless of initial pressure and without objectionable noise under any condition of operation.

2.7 EXPANSION TANK

Pressurization system shall include a replaceable diaphragm-type captive air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. Sizes shall be as indicated. Expansion tank shall be welded steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 psig and precharged to the minimum operating pressure. Tank air chamber shall be fitted with an air charging valve. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations.

2.8 AIR SEPARATOR TANK

External air separation tank shall be steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 psi.The capacity of the air separation tank indicated is minimum.

2.9 SYSTEM EQUIPMENT AND ACCESSORIES

2.9.1 Circulating Pumps

Pumps for hot water shall be of the single-stage centrifugal type, electrically driven. Pumps shall be supported on a concrete foundation as indicated. Pumps shall be either integrally mounted with the motor or direct-connected by means of a flexible-shaft coupling on a cast iron, or steel sub-base. Pump housing shall be of close grained cast iron. Shaft shall be carbon or alloy steel, turned and ground. Shaft seal shall be mechanical-seal or stuffing-box type. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Bearings shall be ball-, roller-, or oil-lubricated, bronze-sleeve type, and shall be sealed or isolated to prevent loss of oil or entrance of dirt or water. Motor shall be of a type approved by the manufacturer of the pump.

2.9.2 Factory Testing

The Contractor shall submit a certificate of compliance from the pump manufacturer covering the actual test of the unit and certifying that the equipment complies with the indicated requirements.

2.10 Pressure Gauges and Thermometers

Gauges shall be provided for each heat exchanger and piping as indicated. A thermometer and pressure gauge shall be provided on the high temperature water supply and return mains. Thermometers shall be separable socket type.

2.11 Pressure Relief Valves

One or more pressure relief valves shall be provided for each heat exchanger in accordance with ASME BPV VIII Div 1. The aggregate relieving capacity of the relief valves shall be not less than that required by the above code. Discharge from the valves shall be installed as indicated. .

2.12 Drains

A drain connection with 3/4 inch hose bib shall be installed at the lowest point in the low temperature water return main near the heat exchanger. In addition, threaded drain connections with threaded cap or plug shall be installed wherever required for thorough draining of the low temperature water system.

2.13 Strainers

Basket or Y-type strainer-body connections shall be the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blowdown. The flow shall be into the basket and out through the perforations. For high temperature water systems, only cast steel bodies shall be used.

2.14 INSULATION

Shop and field applied insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.15 FACTORY PAINTED EXPOSED SPACE HEATING EQUIPMENT

Radiator and convector enclosures shall be coated with the manufacturer's standard rust inhibiting primer for painting in the field as specified in Section 09900 PAINTING, GENERAL. All other exposed heating equipment shall be painted at the factory with the manufacturer's standard primer and enamel finish.

2.16 UNIT HEATERS

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated.

2.16.1 Propeller Fan Heaters

Heaters shall be designed for suspension and arranged for vertical discharge of air as indicated. Casings shall be not less than 20 gauge black steel and finished with lacquer or enamel. Suitable stationary deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

Unit Capacity, cfm	Face Velocity, fpm
Up to 1,000	800
1,001 to 3,000	900
3,001 and over	1,000]

2.16.4 Motors

Motors shall be provided with NEMA 250 general purpose enclosure. Motors and motor controls shall otherwise be as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

2.16.5 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

2.16.6 Controls

Controls shall be provided as specified in Section 15950 HEATING, VENTILATING, AND AIR CONDITIONING HVAC CONTROL SYSTEMS.

2.17 HEATING AND VENTILATING UNITS

Heating and ventilating units shall be as specified in Section 15895AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.18 WATER TREATMENT SYSTEM

The water treatment system shall be capable of manually feeding chemicals into the heating system to prevent corrosion and scale within the heat exchanger and piping system. All water treatment equipment and chemicals shall be furnished and installed by a water treatment company regularly engaged in the installation of water treatment equipment and the provision of water treatment chemicals based upon water condition analyses. The water treatment company shall provide a water sample analysis taken from the building site, each month for one year.

2.18.1 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping. All materials of construction shall be compatible with the chemicals being used.

2.18.2 Make Up Water Analysis

The make up water conditions are as follows:

Date of Sample	5-15-99
Temperature	73 degrees F
Silica (SiO_2)	12 ppm (mg/1)
Insoluble	< 0.5 ppm (mg/1)
Iron and Aluminum Oxides	< 0.05 ppm (mg/1)

Calcium (Ca)	183 ppm (mg/1)
Magnesium (Mg)	< 0.05 ppm (mg/1)
Sodium and Potassium (Na and K)	10 & 1 ppm (mg/1)
Carbonate (HCO3)	259 ppm (mg/1)
Sulfate (SO4)	22 ppm (mg/1)
Chloride (C1)	18 ppm (mg/1)
Nitrate (NO3)	1.3 ppm (mg/1)
Turbidity	1NTU unit
pH	7.6
Residual Chlorine	0.4 ppm (mg/1)
Total Alkalinity	212 ppm (meq/1)
Noncarbonate Hardness	88 epm (meq/1)
Total Hardness	244 epm (meq/1)
Dissolved Solids	400 ppm (mg/1)
Fluorine	0.10 ppm (mg/1)
Conductivity	500 microsiemens/cm

2.18.3 Chemicals

The chemical company shall provide pretreatment chemicals that will remove and permit flushing of mill scale, oil, grease, and other foreign matter from the water heating system. The chemical company shall also provide all treatment chemicals required for the initial fill of the system and for a period of one year of operation. The chemical company shall determine the correct chemicals and concentrations required for the water treatment. The chemicals shall not be proprietary and shall meet required federal, state, and local environmental regulations for the treatment of heating water systems and discharge to the sanitary sewer. The chemicals shall remain stable throughout the operating temperature range of the system, and shall be compatible with pump seals and other elements of the system.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as indicated and in accordance with the manufacturer's diagrams and recommendations.

3.2 FIELD PAINTING

Field painting of exposed pipe shall be as specified in Section 09900 PAINTING, GENERAL. Field painting of factory primed equipment shall be as specified in Section 09900 PAINTING, GENERAL.

3.3 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

3.4 PIPING

Unless otherwise specified, pipe and fittings installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cuttings or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall be so installed as to permit free expansion and contraction without causing damage to building structure, pipe, joints, or hangers. Changes in direction shall be made with factory made fittings, except that bending of pipe up to 4 inches will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center line radius of bends shall not be less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be installed through the roof as indicated and shall be flashed as specified. Horizontal mains shall pitch up or down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unions and other components for copper pipe or tubing shall be brass or bronze. Connections between ferrous and copper piping shall be electrically isolated using dielectric unions.

3.4.1 Joints

Except as otherwise specified, joints used on steel pipe shall be threaded for fittings 1 inch and smaller; threaded or welded for 1-1/4 inches up through 2-1/2 inches; and flanged or welded for 3 inches and larger. Joints between sections of copper tubing or copper pipe shall be flared or sweated. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduits or trenches beneath concrete floor slabs shall be welded. Unless otherwise specified, connections to equipment shall be made with black malleable iron unions for pipe 2-1/2 inches or smaller in diameter, and with flanges for pipe 3 inches or larger in diameter.

3.4.2 Low Temperature Systems

Piping may have threaded, welded, flanged or flared, sweated, or grooved mechanical joints as applicable and as specified. Reducing fittings shall be used for changes in pipe sizes. In horizontal lines, reducing fittings shall be the eccentric type to maintain the top of the adjoining pipes at the same level.

3.4.3 (null)

3.4.4 High And Medium Temperature Systems

Temperature systems shall have welded joints to the maximum extent practicable, except screwed joints and fittings may be used at connections to equipment and on piping 2-1/2 inches and smaller. Equipment connections 3 inches and larger shall be flanged. Piping connections 3 inches and larger may be welded or flanged. In horizontal lines, reducing fittings shall be the eccentric type to maintain the tops

of adjoining pipes at the same level. Grooved mechanical joints shall not be used.

3.4.5 Threaded Joints

Threaded joints shall be made with tapered threads properly cut, and shall be made tight with PTFE tape complying with ASTM D 3308, or equivalent thread joint compound applied to the male threads only, and in no case to the fittings.

3.4.6 Welded Joints

Joints shall be fusion-welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only. Branch connection may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.4.7 Flanged Joints or Unions

Flanged joints or unions shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and similar items. Flanged joints shall be faced true, provided with gaskets, and made square and tight. Full-faced gaskets shall be used with cast iron flanges.

3.4.8 Flared and Sweated Pipe and Tubing

Pipe and tubing shall be cut square and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned with an abrasive before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connection. Installation shall be made in accordance with the manufacturer's recommendations. Changes in direction of piping shall be made with flared or soldered fittings only. Solder and flux shall be lead free. Joints for soldered fittings shall be made with silver solder or 95:5 tin-antimony solder. Cored solder shall not be used. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing.

3.4.9 Mechanical Tee Joint

An extracted mechanical tee 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. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Joints shall be brazed in accordance with NAPHCC-01. Soldered joints will not be permitted.

3.5 CONNECTIONS TO EQUIPMENT

Supply and return connections shall be provided by the Contractor unless

otherwise indicated. Valves and traps shall be installed in accordance with the manufacturer's recommendations. Unless otherwise indicated, the size of the supply and return pipes to each piece of equipment shall be not smaller than the connections on the equipment. No bushed connections shall be permitted. Change in sizes shall be made with reducers or increasers only.

3.5.1 Low Temperature Water and Return Connections

Connections, unless otherwise indicated, shall be made with malleable iron unions for piping 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter.

3.5.2 High And Medium Temperature Water Connections

Connections shall be made with 2000 poundblack malleable iron unions for pipe 3/4 inch or less in diameter and with flanges for pipe 1 inchand larger in diameter.

3.6 BRANCH CONNECTIONS

Branches shall pitch up or down as indicated, unless otherwise specified. Connection shall be made to insure unrestricted circulation, eliminate air pockets, and permit drainage of the system.

3.6.1 Low Temperature Water Branches

Branches taken from mains shall pitch with a grade of not less than 1 inch in 10 feet.

3.6.2 (null)

3.6.3 High And Medium Temperature Water Branches

Branches shall take off at 45 degrees in the direction of the fluid flow from the supply and return lines and should be branched from the top or upper half of the main line unless otherwise indicated. Abrupt reduction in pipe sizes shall be avoided.

3.7 RISERS

The location of risers is approximate. Exact locations of the risers shall be as approved.

3.8 SUPPORTS

3.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while 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. All 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.

3.8.1.2 Structural Attachments

Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

3.8.1.3 Multiple Pipe Runs

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 any individual pipe in the multiple pipe run.

3.8.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as specified as follows:

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

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 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. Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle shall be used on all pipe 4 inches and larger.

h. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 footfrom the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

i. Vertical pipe shall be supported at each floor, except at

slab-on-grade, and at intervals of not more than 15 feet,except that pipe shall be supported not more than 8 feet from end of risers, and at vent terminations.

j. Type 35 guides using steel, reinforced PTFE or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions and bearing loads encountered. Where steel slides do not require provision for restraint or lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate. Where there are high system temperatures and welding to piping is not desirable, then 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, which ever is greater.

k. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

ITEM INDENT=-0.33>K. All hangers and anchors shall be new, ie. use of existing hangers is not allowed it any instance.

3.8.3 Piping in Trenches

Piping shall be supported as indicated.

3.9 PIPE SLEEVES

3.9.1 Pipe Passing Through Concrete or Masonry

Pipe 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 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 wall, floor, or roof, and shall be cut flush with each surface. Unless otherwise indicated, sleeves shall provide a minimum of 1/4 inch annular space between bare pipe or insulation surface and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, cast iron pipe, or galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls and floors shall be sealed as indicated and specified in Section 07920 JOINT SEALING. Penetrations in fire walls and floors shall be sealed in accordance with Section 07270 FIRESTOPPING.

3.9.2 Pipes Passing Through Waterproofing Membranes

Pipes passing through waterproofing membranes shall be installed through a 4 pound lead-flashing sleeve, a 16 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each having an integral skirt or flange. Flashing sleeve shall be suitably formed, and the skirt or flange shall

extend 8 inches or more from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the highest flood level of the roof or a minimum of 10 inches above the roof, whichever is greater, or 10 inches above the floor. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. At the Contractor's option, 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. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.9.3 Mechanical Seal Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit 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 bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.9.4 Counterflashing Alternate

As an alternate to caulking and sealing the annular space between the pipe and flashing sleeve or metal-jacket-covered insulation and flashing sleeve, counterflashing may be by standard roof coupling for threaded pipe up to 6 inches in diameter; lead-flashing sleeve for dry vents and turning the sleeve down into the pipe to form a waterproof joint; or tack-welded or banded-metal rain shield round the pipe and sealing as indicated.

3.9.5 Waterproofing Clamping Flange

Pipe passing through wall waterproofing membrane shall be sleeved as specified. In addition, a waterproofing clamping flange shall be installed as indicated.

3.9.6 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 07270 FIRESTOPPING.

3.9.7 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or covered, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be

fastened securely to pipe sleeves or to extensions of sleeves without any part of sleeves being visible. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrew.

3.10 ANCHORS

Anchors shall be provided where necessary or indicated to localize expansion or prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed using turnbuckles where required. Supports, anchors, or stays shall not be attached in places where construction will be damaged by installation operations or by the weight or expansion of the pipeline.

3.11 PIPE EXPANSION

The expansion of supply and return pipes shall be provided for by changes in the direction of the run of pipe, by expansion loops, or by expansion joints as indicated. Low temperature water expansion joints may be one of the types specified. Medium temperature water system expansion joints may be one of the joints specified, except slip-tube type.

3.11.1 Expansion Loops

Expansion loops shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops shall be cold-sprung and installed where indicated. Pipe guides shall be provided as indicated.

3.11.2 Bellows-Type Joint

Bellows-type joint design and installation shall comply with EJMA-01 standards. The joints shall be designed for the working temperature and pressure suitable for the application and shall be not less than 150 psig in any case.

3.11.3 Flexible Ball Joints

Flexible ball joints may be threaded (to 2 inchesonly), flanged, or welded end as required. The ball-type joint shall be designed and constructed in accordance with the generally accepted engineering principle stated in ASME B31.1, and ASME BPV VIII Div 1, where applicable. Flanges shall conform to the diameter and drilling of ASME B16.5. Molded gaskets furnished shall be suitable for the service intended.

3.12 VALVES AND EQUIPMENT ACCESSORIES

3.12.1 Valves and Equipment

Valves shall be installed at the locations shown or specified, and where required for the proper functioning of the system as directed. Gate valves shall be used unless otherwise indicated, specified, or directed. Valves shall be installed with their stems horizontal to or above the main body of the valve. Valves used with ferrous piping shall have threaded or flanged ends and sweat-type connections for copper tubing.

3.12.2 Gravity Flow-Control Valve

The valve to control the flow of water shall be installed in the supply main near the heat exchanger. The valve shall operate so that when the circulating pump starts, the increased pressure within the main will open the valve; when the pump stops, the valve will close. The valve shall be constructed with a cast iron body and shall be provided with a device whereby the valve can be opened manually to allow gravity circulation. The flow-control valve shall be designed for the intended purpose, and shall be installed as recommended by the manufacturer.

3.12.3 Thermometer Socket

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.12.4 Air Vents

Vents shall be installed where indicated, and on all high points and piping offsets where air can collect or pocket.

3.12.4.1 Water Air Vents

Medium temperature water air vents shall be as indicated. Vent discharge lines shall be double-valved with globe valves and shall discharge into a funnel drain.

3.12.4.2 (null)

3.14 UNIT HEATERS

Unit heaters shall be installed as indicated and in accordance with the manufacturer's instructions.

3.15 INSULATION

Thickness of insulation materials for piping and equipment and application shall be in accordance with Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.16 TESTING AND CLEANING

3.16.1 Pressure Testing

The Contractor shall notify the Contracting Officer 10 days before the tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests. Electricity, and water will be furnished by the Government. All test results shall be accepted before thermal insulation is installed. The entire low temperature heating system, including heat exchanger, radiators and fittings, shall be hydrostatically tested and proved tight under a pressure of 45 psig for a period of four hours.

3.16.2 Cleaning

After the hydrostatic tests have been made and prior to the operating tests, the heat exchanger and piping shall be thoroughly cleaned by filling the system with a solution of 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallonsof water. Observe the proper safety precautions in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F, and the solution circulated in the system for a period of 48 hours, then drained and the system thoroughly flushed out with fresh water. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. The Contractor shall be responsible for maintaining the system in a clean condition until final acceptance. Bearings shall be lubricated with oil or grease as recommended by the manufacturer.

3.16.3 Water Treatment Testing

3.16.3.1 Water Quality Test

The heating water shall be analyzed prior to the acceptance of the facilityanda minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	[_____]	
Temperature	[_____]	degrees [F] [C]
Silica (SiO2)	[_____]	ppm (mg/1)
Insoluble	[_____]	ppm (mg/1)
Iron and Aluminum Oxides	[_____]	ppm (mg/1)
Calcium (Ca)	[_____]	ppm (mg/1)
Magnesium (Mg)	[_____]	ppm (mg/1)
Sodium and Potassium (Na and K)	[_____]	ppm (mg/1)
Carbonate (HCO3)	[_____]	ppm (mg/1)
Sulfate (SO4)	[_____]	ppm (mg/1)
Chloride (C1)	[_____]	ppm (mg/1)
Nitrate (NO3)	[_____]	ppm (mg/1)
Turbidity	[_____]	unit
pH	[_____]	
Residual Chlorine	[_____]	ppm (mg/1)
Total Alkalinity	[_____]	ppm (meq/1)
Noncarbonate Hardness	[_____]	epm (meq/1
Total Hardness	[_____]	epm (meq/1)
Dissolved Solids	[_____]	ppm (mg/1)
Fluorine	[_____]	ppm (mg/1)
Conductivity	[_____]	microsiemens/cm

3.17 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing shall be in accordance with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.18 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall

be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.19 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.20 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 32 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15569

WATER HEATING; GAS ; UP TO 20 MBTUH

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 MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 801	(1992) Industrial Process/Power Generation Fans: Specification Guidelines

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13	(1991; Z21.13a; Z21.13b) Gas-Fired Low-Pressure Hot Water Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105	(1997) Forgings, Carbon Steel, for Piping Components
ASTM A 106	(1994) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 183	(1983, R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 366	(1991; R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 515	(1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 653	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(1995a) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings
ASTM C 27	(1993) Fireclay and High-Alumina Refractory Brick
ASTM C 34	(1993) Structural Clay Load-Bearing Wall Tile
ASTM C 155	(1988; R 1992) Classification of Insulating Firebrick
ASTM C 401	(1991) Alumina and Alumina Silicate Castable Refractories
ASTM D 596	(1991) Reporting Results of Analysis of Water
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1990; R 1994) Rubber Products in Automotive Applications
ASTM F 872	(1984; R 1990) Filter Units, Air Conditioning: Viscous-Impingement Type, Cleanable
ASTM F 1097	(1991) Mortar, Refractory (High-Temperature, Air-Setting)

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 B16.4	(1992) Gray Iron Threaded Fittings
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
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	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(1988) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1986; R 1994) 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	(1995) Power Piping
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IV	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IV, Heating Boilers
ASME BPV VIII Div 1	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1992; CSD-1a; CSD-1b) Controls and Safety Devices for Automatically Fired Boilers
ASME PTC 10	(1965; Errata; R 1992) Compressors and Exhausters

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA 404/0 RR	(1993) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration

EXPASION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA-01	(1993) EJMA Standards

HYDRONICS INSTITUTE (HYI)

HYI-01	(1996) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) 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	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) 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) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1992) Ball Valves Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1992) Installation of Oil Burning Equipment
NFPA 54	(1992) National Fuel Gas Code
NFPA 70	(1996) National Electrical Code
NFPA 85C	(1991) Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces
NFPA 211	(1992) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances
NFPA 8501	(1992) Single Burner Boiler Operations

UNDERWRITERS LABORATORIES (UL)

UL-06	(1996) Gas and Oil Equipment Directory
UL 296	(1994; Rev Aug 1995) Oil Burners
UL 726	(1995) Oil-Fired Boiler Assemblies
UL 795	(1994; Rev Jan 1996)Commercial-Industrial Gas Heating Equipment
UL 1738	(1993) Venting Systems for Gas-Burning Appliances, Categories II, III and IV

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the 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.

1.2.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

1.2.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp.

1.2.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with 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 in accordance with Section 05500 MISCELLANEOUS METAL.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

1.2.6 Welding

Boilers and piping shall be welded and brazed in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

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 Data; FIO_____.

Manufacturer's catalog data shall be included with the detail drawings for the following items:

Boilers
Fuel Burning Equipment
Combustion Control Equipment
Pumps
Fittings and Accessories
Fuel Oil Storage System
Water Treatment System

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements.

Spare Parts Data; FIO_____.

Spare parts data for each different item of material and equipment, after approval of the detail drawings and no later than 2 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, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Water Treatment Plan; FIO.

Six complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in paragraph BOILER WATER TREATMENT, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Heating and Fuel Systems Test Procedures; FIO_____.

Proposed test procedures for the heating system tests and fuel system tests, 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.

Qualification; FIO_____.

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item 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-04 Drawings

Heating System; GA_____.

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of 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 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

Posted Instructions; GA.

System layout 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, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

SD-07 Schedules

Tests; GA_____.

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

SD-09 Reports

Heating System and Fuel System Tests; GA_____.

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

Water Treatment Tests; FIO_____.

(1) The water quality test report shall identify the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the manufacturer's recommended conditions. Any required corrective action shall be documented within the report.

(2) A test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions.

SD-13 Certificates

Bolts; FIO_____.

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture,

and the number of each type of bolt to be furnished based on this certification.

Boiler Emissions; FIO_____.

Written certification by the boiler manufacturer that each boiler furnished complies with Federal, state, and local regulations for emissions. The certification shall also include a description of applicable emission regulations. If any boiler is exempt from the emission regulations, the certification shall indicate the reason for the exemption.

SD-19 Operation and Maintenance Manuals

Heating System; FIO_____.

Six complete 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, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

Water Treatment System; FIO____.

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality.

1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

PART 2 PRODUCTS

2.1 BOILERS

Each boiler shall have the output capacity in British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, forced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed

and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPV IV. Each boiler shall be of the firetube type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-01 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

2.1.2 Watertube Boiler

Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. The heat input rate for finned tube designs shall not be greater than 12,000 Btu/hr per square ft based on internal heater area. The heat input rate for other boilers shall not be greater than 6,700 Btu/hr per square ft of fireside heating surface.

2.2 Modular Configuration

Modular boilers shall be of the cast iron type. Modular boilers shall have the capability of independent operation. Upon failure of any module, the remaining modules shall be capable of operating at their designed capacity. The size of the individual modules shall be as indicated.

2.3 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency. The boiler design conditions shall be as follows:

a. Boiler design pressure 30 psig.

b. Operating pressure at boiler outlet 5_____ psig.

c. Hot water temperature 180 degrees F.

d. Temperature differential between boiler discharge and system return 20_____ degrees F.

e. Water pressure drop 10 psig.

f. Outdoor ambient air temperature 97_____ degrees F (max), 29_____ degrees F (min).

g. Site elevation 400____ feet.

h. Maximum continuous capacity 4,400,000_____ Btuh.

i. Rated capacity 4,400,000_____ Btuh.

j. Maximum exhaust stack temperature 500_____ degrees F.

k. Gas fired boilers with a capacity of greater than or equal to 300,000 Btuh shall have a combustion efficiency of at least 80

percent when fired at the maximum and minimum ratings allowed by the controls

2.4 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas. Each boiler shall comply with Federal, state, and local emission regulations.

2.4.1 Burners

2.4.1.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

a. Gas-fired units with inputs greater than 400,000 Btuh per combustion chamber shall conform to UL 795. Gas fired units less than 12,500,000 Btuh input shall conform to ANSI Z21.13.

2.4.2 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved blades or axial flow type. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a 3 foot station. Forced draft fan bearings shall be air cooled.

2.4.2.1 Draft Fan Control

Forced-draft centrifugal fans shall have inlet vane controls or shall have variable speed control where indicated. Inlet vanes shall be suitable for use with combustion control equipment. Axial propeller fans shall have variable propeller pitch control.

2.4.2.2 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be totally enclosed fan cooled . Motor starter shall be magnetic across-the-line type with general purpose enclosure and shall be furnished with four auxiliary interlock contacts.

2.4.3 Draft Damper

Boilers shall be provided with automatic dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic damper shall be arranged for automatic operation by means of a damper motor.

2.4.4 Ductwork

Air ducts connecting the forced-draft fan units with the plenum chamber shall be designed to convey air with a minimum of pressure loss due to friction. Ductwork shall be galvanized sheet metal conforming to ASTM A 653. Ducts shall be straight and smooth on the inside with laps made in direction of air flow. Ducts shall have cross-break with enough center height to assure rigidity in the duct section, shall be angle iron braced, and shall be completely free of vibration. Access and inspection doors shall be provided as indicated and required, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius 1-1/2 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes may be used. Duct joints shall be substantially airtight and shall have adequate strength for the service, with 1-1/2 by 1-1/2 by 1/8 inch angles used where required for strength or rigidity. Duct wall thickness shall be 16 gauge (0.0598 inch) for ducts 60 inches or less and 12 gauge (0.1046 inch) for ducts larger than 60 inches in maximum dimension. Additional ductwork shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.5 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate either electrically. On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller. If recording instruments are provided, a 1 year supply of ink and 400 blank charts for each recorder shall be furnished.

2.6 Electrical controls

Electrical control devices shall be rated at 120 volts and shall be connected as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

2.7 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet. Modulating controllers shall control the fuel burning equipment to maintain set boiler water temperature within 2 percent. Controller shall be furnished with necessary equipment to automatically adjust the setting to suit the outside weather conditions. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

2.8 Boiler Plant Master Controller

A boiler plant master controller, sensitive to a temperature transmitter in the return water header for the boiler shall be furnished to provide anticipatory signals to all boiler controllers. Boiler controllers shall react to anticipatory signals from the plant master controller as necessary

in response to the boiler temperature indication to maintain the preset temperature. An automatic-manual switch shall be provided to allow the sequence of boiler loading to be varied to distribute equal firing time on all boilers in the plant. The plant master controller shall load the boilers one at a time as the plant load increases.

2.9 Boiler Combustion Controls and Positioners

a. Gas boiler units shall be provided with combustion controls with gas pilot or spark ignition. Modulating controls shall be provided with a means for manually controlling the firing rate.

c. Modulating control function shall be accomplished using positioning type controls. Air flow ratio and fuel control valve shall be controlled by relative positions of operative levers on a jackshaft responding to a water temperature controller. Positioning type combustion control equipment shall include draft controls with synchronized fuel feed and combustion air supply controls, while and shall maintain the proper air/fuel ratio. The desired furnace draft shall be maintained within 0.01 inch of water column.

2.10 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL listed, microprocessor-based distributed process controller. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section 16415 ELECTRICAL WORK, INTERIOR. A 4 inch diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

a. Flame failure.

b. Failure to establish pilot flame.

c. Failure to establish main flame.

d. Low-water cutoff.

e. High temperature cutoff.

2.10.1 Low-water Cutoff

Low-water cutoff shall be provided to stop the burner and draft fan when the water level drops below a predetermined point. The cutoff shall consist of a float chamber with float, float switch, and drain valve. The float switch shall be mounted on the float chamber with a packless-type leakproof connection. The float mechanism and drain valve shall be constructed of a corrosion-resistant material. The low-water cutoff shall be UL-06 listed and shall be furnished with approved fittings and installed according to ASME boiler code requirements. The following types of low-water cutoffs shall be utilized.

a. Feedwater Regulator with Low-Water Cutoff: Regulator shall be an approved design sized for the application. A regulator shall be provided for each boiler. The feeder shall be so arranged that water will be fed to the boiler automatically when the water level in the boiler drops below a preset point and will actuate the alarm bell when the water level reaches the low danger point. The boiler feeder shall be arranged so that the burner and forced-draft fan will stop whenever the water level drops below a preset danger point. The boiler feeder shall be constructed so that the feedwater valve and seat are isolated from the float chamber to prevent overheating of the feed water and precipitation of scale on either the valve or seat. Each float mechanism, valve, and seat shall be constructed of an approved, durable, corrosion-resistant steel alloy. Valve seats shall be removable and renewable. The regulator shall be equipped with a large, self-cleaning strainer. The drain valve on the regulator shall be the gate or other straight-through type.

b. Pump Controller with Low-Water Cutoff: Controller shall be a design approved by the boiler manufacturer. A pump controller shall be provided for each boiler which is used for space heating loads or long distribution lines. Pump controller shall control the operation of the burner, forced-draft fan, and pump. Pump controller and low-water cutoff shall have a float-operated mercury switch arranged to start and stop the pump at preset boiler water levels. If the water level in the boiler reaches the low danger point, a second mercury switch shall shut down the burner and actuate the alarm bell.

c. Supplementary Low-Water Cutoff: Supplementary low-water cutoff of the float activated type shall be provided in addition to the low-water cutoff required above on each boiler. Supplementary low-water cutoff shall be mounted directly in the boiler shell and shall be set below the low-water cutoff required above.

2.10.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

2.11 PUMPS

2.11.1 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported by the piping on which installed and shall be closed-coupled shaft. The boiler circulating pumps shall be horizontal split case. Hot water circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base and shall have a flexible-coupled shaft. The hot water circulating pumps shall be horizontal split case type. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 240 degrees F temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The hot water circulating pump discharge heater shall be provided with a flow switch. Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Switch shall be a SPDT with 120-volt, 15-ampere rating.

2.12 HEATING AND VENTILATING UNITS

Heating and ventilating units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.13 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.14 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPV IV, unless otherwise specified.

2.15 Conventional Breeching and Stacks

2.15.1 Breeching

Each boiler shall be connected to the existing breeching by a flue with a backdraft damper sized according to the recommendations made by the Boiler manufacturer.

2.15.2 Stacks

Individual stacks shall extend to the existing breeching as stated above.

2.16 Direct Vents

Direct venting shall be used for condensing type boilers. Both the air intake and exhaust vents shall be sized and located as indicated on the drawings and as recommended by the boiler manufacturer. A separate combustion air intake vent and exhaust vent shall be provided for each boiler.

2.16.1 Combustion Air Intake Vent

The combustion air intake piping shall be constructed of Schedule 40 PVC per ASTM D 1784. The vent shall be suitable for the temperature at the boiler combustion air intake connection point. Each intake shall be provided complete with bird screen.

2.16.2 Exhaust Vent

The exhaust vent piping shall be constructed of Schedule 40 PVC or stainless steel conforming to UL 1738 and the boiler manufacturer's recommendations. The exhaust vent shall be suitable for the maximum anticipated boiler exhaust temperature and shall withstand the corrosive effects of the condensate. A 0.3125 inchdiameter hole shall be provided in the stack not greater than 6 inches from the boiler flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each exhaust stack shall be provided complete with bird screen.

2.17 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1for a working pressure of 125 psi and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 250 degrees F.

2.18 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.19 Filters

Filters shall conform to CID A-A-1419.

2.20 Foundation (Setting) Materials

2.20.1 Firebrick

Firebrick shall be ASTM C 27 class as recommended by boiler manufacturer.

2.20.2 Tile

Tile shall be ASTM C 34, Grade LBX.

2.20.3 Insulating Brick

Insulating brick shall comply with ASTM C 155.

2.20.4 Refractory Mortar

Refractory mortar shall comply with ASTM F 1097.

2.20.5 Castable Refractories

Castable refractories shall be ASTM C 401. The minimum modulus of rupture for transverse strength shall be not less than 600 psi after being heat soaked for 5 hours or more at a temperature in excess of 2500 degrees F.

2.21 Steel Sheets

2.21.1 Galvanized Steel

Galvanized steel shall be ASTM A 653.

2.21.2 Uncoated Steel

Uncoated steel shall be ASTM A 366, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to manufacturer's standard gauge.

2.22 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.21, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.23 Steel Pipe and Fittings

2.23.1 Steel Pipe

Steel pipe shall be ASTM A 53, Type E or S, Grade A or B, black steel, standard weight.

2.23.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.23.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516 cold service and ASTM A 515 for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193.

2.23.4 Welded Fittings

Welded fittings shall conform to ASTM A 234 with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.23.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

2.23.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

2.23.7 Unions

Unions shall be ASME B16.39, Class 150.

2.23.8 Threads

Pipe threads shall conform to ASME B1.20.1.

2.23.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 125 psig 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; or steel conforming to ASTM A 106, Grade B or ASTM A 53. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000, Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade N0. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.24 Copper Tubing and Fittings

2.24.1 Copper Tubing

Tubing shall be ASTM B 88, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.24.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B 828.

2.24.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62.

2.24.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be

used.

2.24.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

2.24.6 Brazing Material

Brazing material shall conform to AWS A5.8.

2.24.7 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.

2.24.8 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

2.24.9 Solder Flux

Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

2.25 Dielectric Unions

Dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. Metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact.

2.26 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.27 Pipe Supports

Pipe supports shall conform to MSS SP-58 and MSS SP-69.

2.28 Pipe Expansion

2.28.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops and offsets shall be cold-sprung and installed where indicated. Pipe guides and anchors shall be provided as indicated.

2.28.2 Expansion Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the transverse indicated. The joints shall be designed for a hot water working pressure not less than 125_____ psig and shall be in accordance with applicable requirements of EJMA-01 and ASME B31.1. End connection shall be flanged. Anchor bases or support bases shall be provided as indicated or required. Sliding surfaces and water wetted surfaces shall be chromium plated or fabricated of corrosion resistant steel. Initial setting shall be made in accordance with the manufacturer's recommendations to compensate for an ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall not be more than 5 feet from expansion joint, except in lines 4 inches or smaller guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

a. Bellows-type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows-type expansion joints shall conform to the applicable requirements of EJMA-01 and ASME B31.1 with internal lines. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but shall not be less than 150 psig.

b. Flexible ball joints shall be constructed of alloys as appropriate for the service intended. The joints shall be threaded, grooved, flanged, or welded end as required and shall be capable of absorbing the normal operating axial, lateral, or angular movements or combination thereof. Balls and sockets shall be polished, chromium-plated when materials are not of corrosion-resistant steel. The ball type joint shall be designed and constructed in accordance with ASME B31.1 and EJMA-01. Flanges shall conform to the diameter and drilling of ASME B16.5. Molded gaskets shall be suitable for the service intended.

c. Slip type expansion joints shall be EJMA-01 and ASME B31.1, class 1 or 2. Type II joints shall be suitable for repacking under full line pressure.

2.29 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

2.29.1 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

2.29.2 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.29.3 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-72orMSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

2.29.4 (null)

2.29.5 Grooved End Valves

Valves with grooved ends per AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the standards indicated for each type of valve.

2.29.6 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.29.7 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head

capability shall be increased. Valves shall be suitable for 250 degrees F temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

2.29.8 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.29.9 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPV IV and ASTM A 53.

2.29.10 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 2 and 10 psig. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPV IV, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.30 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 125_____ psig service and 180_____ degrees F. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 22 gauge corrosion-resistant steel with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.31 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 3-1/2 inches. A pressure gauge shall be provided for each boiler in a visible location on the boiler.

2.32 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 9 inch scale.

2.33 Air Vents

2.33.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

2.33.2 Automatic Air Vents

Automatic air vents shall be 3/4 inchquick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of water from the system. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

2.34 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Motors which are not an integral part of a packaged boiler shall be rated for high efficiency service. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. 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.

2.34.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 1/2 hp and larger shall be three-phase, unless otherwise indicated. Motors

shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

2.34.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 10 hp ratings. Adjustable frequency drives shall be used for larger motors.

2.35 INSULATION

Shop and field-applied insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.36 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

2.36.1 Breeching Cleaner

A cleaner shall be provided to clean the breeching. The cleaner shall have a jointed handle of sufficient length to clean the breeching without dismantling.

2.36.2 Tube Cleaner

If a watertube boiler is being furnished, a water-driven tube cleaner with three rotary cutters and rotary wire brush complete with the necessary length of armored water hose, valves, and other appurtenances necessary for operation shall be provided. Tube cleaner and rotary brush shall be provided for each size of water tube in the boiler, with one extra set of cutters for each size cleaner. Necessary valves and fittings shall be provided to permit ready connection of the cleaner hose to a high-pressure pump for cold water supply to operate the cleaner.

2.36.3 Tube Brush

If a firetube boiler is being furnished, a tube brush, with steel bristles and jointed handle of sufficient length to clean full length of firetubes, shall be provided.

2.36.4 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

2.37 BOILER WATER TREATMENT

The water treatment system shall be capable of feeding chemicals and bleeding the system to prevent corrosion and scale within the boiler and piping distribution system. The water shall be treated to maintain the conditions recommended by the boiler manufacturer. Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct chemicals and concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines and proprietary chemicals shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.37.1 MakeUp Water Analysis

The makeup water conditions reported per ASTM D 596 are as follows:

Date of Sample	5-15-99
Temperature	73 degrees F
Silica (SiO2)	12 ppm (mg/1)
Insoluble	<0.5 ppm (mg/1)
Iron and Aluminum Oxides	<0.05 ppm (mg/1)
Calcium (Ca)	183 ppm (mg/1)
Magnesium (Mg)	<0.05 ppm (mg/1)
Sodium and Potassium (Na and K)	10 & 1 ppm (mg/1)
Carbonate (HCO3)	259 ppm (mg/1)
Sulfate (SO4)	22 ppm (mg/1)
Chloride (C1)	18 ppm (mg/1)
Nitrate (NO3)	1.3 ppm (mg/1)
Turbidity	1 NUT unit
pH	7.6
Residual Chlorine	0.4 ppm (mg/1)
Total Alkalinity	212 epm (meq/1)
Noncarbonate Hardness	88 epm (meq/1)
Total Hardness	244 epm (meq/1)
Dissolved Solids	400 ppm (mg/1)
Fluorine	0.10 ppm (mg/1)
Conductivity	500 microhm, cm

2.37.2 Boiler Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Causticity	20-200 ppm
Total Alkalinity (CACO3)	900-1200 ppm
Phosphate	30-60 ppm
Tanin	Medium
Dissolved Solids	3000-5000 ppm
Suspended Solids	300 ppm Max
Sodium Sulfite	20-40 ppm Max
Silica	Less than 150 ppm
Dissolved Oxygen	Less than 7 ppm

Iron	10 ppm
pH (Condensate)	7 - 8]
[Sodium Sulfite	20-40 ppm
Hardness	Less than 2 ppm
pH	9.3 - 9.9

2.37.3 Water Softening System

The water softening system shall be as specified in Section 11250 WATER SOFTENERS, CATION-EXCHANGE (SODIUM CYCLE)and on the Drawings.

2.37.4 Chemical Feed Pumps

One pump shall be provided for each chemical feed tank. The chemical feed pumps shall be positive displacement diaphragm type. The capacity of the pumps shall be adjustable from 0 to 100 percent while in operation. The discharge pressure of the pumps shall be not less than 1.5 times the pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge.

2.37.5 Tanks

The tanks shall be constructed of stainless steelwith a hinged cover. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation. A level indicating device shall be included with each tank. An electric agitator shall be provided for each tank.

2.37.6 Injection Assemblies

An injection assembly shall be provided at each chemical injection point located along the boiler piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the water line.

2.37.7 Water Meter

The water meter shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the makeup water line, as indicated.

2.37.8 Water Treatment Control Panel

The control panel shall be a NEMA 12, single door, wall-mounted box conforming with NEMA 250. The panel shall be constructed of [steel] [stainless steel] with a hinged door and lock. The panel shall contain, as a minimum, the following functions identified with a laminated plastic nameplate:

a. Main power switch and indicating light

b. MAN-OFF-AUTO selector switch

c. Indicating lamp for blow down

d. Indicating lamp for each chemical feed pump

e. Indicating lamp for the water softener

2.37.9 Sequence of Operation

The flow rate of chemical addition shall be based upon a manual setting. The boiler shall be provided with the necessary connections for manual blowdown. The required rate of chemical feed and boiler blowdown shall be determined by the water treatment company.

2.37.10 Chemical Piping

The piping and fittings shall be constructed of stainless steel.

2.37.11 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

PART 3 EXECUTION

3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 100 degrees F. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 4 inchesand smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 2-1/2 inches or less in diameter and with flanges

for pipe 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

3.2.1 Cold Water Connections

Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately 5 psiin excess of the static head on the system and shall operate within a 2 psi tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

3.2.2 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above \230 degrees F.~\

3.2.3 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.2.4 Gauge Piping

Piping shall be copper tubing.

3.2.5 (null)

3.2.6 (null)

3.2.7 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 1 inch and smaller shall be threaded; fittings 1-1/4 inches and up to but not including 3 inchesshall be either threaded, grooved, or welded; and fittings 3 inches and larger shall be either flanged, grooved, or welded. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 2-1/2 inches or smaller in diameter and with flanges for pipe 3 inches inches or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.2.7.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.2.7.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inchand no more than 1/8 inch.

3.2.7.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not exceed 230 degrees F. Grooves 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 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. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

3.2.7.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation 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. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA 404/0 RR with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.2.7.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA 404/0 RR.

3.2.7.6 Copper Tube Extracted Joint

An extruded mechanical tee 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. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.8 Flanges and Unions

Flanges shall be faced true, provided with 1/16 inch thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.2.9 Branch Connections

3.2.9.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 1 inch in 10 feet.When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.2.10 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation 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 for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to

provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with MSS SP-73, and CDA 404/0 RR. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 2 inches or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA 404/0 RR.

3.2.11 Copper Tube Extracted Joint

An extracted mechanical tee 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. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.12 Supports

3.2.12.1 General

Hangers and anchors used to support piping 2 inches and larger shall be of only new materials and 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.

3.2.12.2 Pipe Hangers, Inserts, and Supports shall be new and of quality as specified.

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 which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.

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 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. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 footfrom the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

h. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet,not more than 8 feet from end of risers, and at vent terminations.

i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

(1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

(2) 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.

j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

k. Piping in trenches shall be supported as indicated.

l. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

3.2.12.3 Multiple Pipe Runs

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 member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 1/8 inch shall be provided between the pipe insulation and

the clip or clamp for piping which may be subjected to thermal expansion.

3.2.13 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.2.14 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.2.15 Pipe Sleeves

Pipe 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. A waterproofing clamping flange shall be installed as indicated where membranes are 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 wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Sleeves through roofs shall extend above the top surface of roof at least 6 inches for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 1/4 inch between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07920 JOINT SEALING. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

Metal jackets shall not be thinner than 0.006 inch thick aluminum, if corrugated, and 0.016 inch thick aluminum, if smooth.

Metal jackets shall be secured with aluminum or stainless steel bands not less than 3/8 inch wide and not more than 8 inches apart. When penetrating roofs and before fitting the metal jacket into place, a 1/2 inch wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 36 inches above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a

point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below the back-up material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above the floor; when passing through walls above grade, the jacket shall extend at least 4 inches beyond each side of the wall.

3.2.15.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 4 pound lead flashing or 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 set over the membrane in a troweled coating of bituminous cement. The flashing shall extend above the roof or floor a minimum of 10 inches. 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. Pipes up to and including 10 inches in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.2.15.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit 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/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.2.15.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 6 inches in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.2.15.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07270 FIRESTOPPING.

3.2.16 Balancing Valves

Balancing valves shall be installed as indicated.

3.2.17 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.2.18 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.2.19 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, 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 chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.2.20 Drains

A drain connection with a 1 inch gate valve or 3/4 inch hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.2.21 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.2.22 Direct Venting for Combustion Intake Air and Exhaust Air

The intake air and exhaust vents shall be installed in accordance with NFPA 54 and boiler manufacturer's recommendations. The exhaust vent shall be sloped 1/4 inch per fttoward the boiler's flue gas condensate collection point.

3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section 15488 GAS PIPING SYSTEMS. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL-06. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety

shutoff valve or valves shall be provided.

3.4 Earthwork

Excavation and backfilling for tanks and piping shall be as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.5 FIELD PAINTING

Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section 09900 PAINTING, GENERAL. Exposed pipe covering shall be painted as specified in Section 09900 PAINTING, GENERAL. Aluminum sheath over insulation shall not be painted.

3.6 HEATING SYSTEM TESTS

Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested. Caulking of joints shall not be permitted. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS; and operating tests required to demonstrate satisfactory functional and operational efficiency shall be performed. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

a. Certification of balancing.

b. Time, date, and duration of test.

c. Outside and inside dry bulb temperatures.

d. Temperature of hot water supply leaving boiler.

e. Temperature of heating return water from system at boiler inlet.

f. Quantity of water feed to boiler.

g. Boiler make, type, serial number, design pressure, and rated capacity.

h. Fuel burner make, model, and rated capacity; ammeter and voltmeter

readings for burner motor.

i. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.

j. Flue-gas temperature at boiler outlet.

k. Percent carbon dioxide in flue-gas.

l. Grade or type and calorific value of fuel.

m. Draft at boiler flue-gas exit.

n. Draft or pressure in furnace.

o. Quantity of water circulated.

p. Quantity of fuel consumed.

q. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. The Contractor shall furnish all instruments, equipment, and personnel required for the tests and balancing. Fuels, water, and electricity shall be obtained as specified in the SPECIAL CONTRACT REQUIREMENTS. .

3.6.1 Water Treatment Testing

3.6.1.1 Water Quality Test

The boiler water shall be analyzed a minimum of once a month for a period of 1 year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	[_____]	
Temperature	[_____]	degrees F
Silica (SiO2)	[_____]	ppm (mg/1)
Insoluble	[_____]	ppm (mg/1)
Iron and Aluminum Oxides	[_____]	ppm (mg/1)
Calcium (Ca)	[_____]	ppm (mg/1)
Magnesium (Mg)	[_____]	ppm (mg/1)
Sodium and Potassium (Na and K)	[_____]	ppm (mg/1)
Carbonate (HCO3)	[_____]	ppm (mg/1)
Sulfate (SO4)	[_____]	ppm (mg/1)
Chloride (C1)	[_____]	ppm (mg/1)
Nitrate (NO3)	[_____]	ppm (mg/1)
Turbidity	[_____]	unit
pH	[_____]	
Residual Chlorine	[_____]	ppm (mg/1)
Total Alkalinity	[_____]	epm (meq/1)
Noncarbonate Hardness	[_____]	epm (meq/1)
Total Hardness	[_____]	epm (meq/1)
Dissolved Solids	[_____]	ppm (mg/1)
Fluorine	[_____]	ppm (mg/1)
Conductivity	[_____]	microhm/cm

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

3.6.1.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler and condensate piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

3.7 CLEANING

3.7.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and feed water piping shall be thoroughly cleaned by filling the system with a solution consisting of either 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.7.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new filters shall be installed after construction dirt has been removed from the building, and the ducts, plenum, 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.

3.8 FUEL SYSTEM TESTS

3.8.1 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

3.9 FIELD 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 40_____ hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the

operating and maintenance instructions, as well as demonstrations of routine maintenance operations and boiler safety devices. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

-- End of Section --

ACCOMPANYING AMENDMENT NO. OOO5 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15650

CENTRAL REFRIGERATED AIR-CONDITIONING SYSTEM

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 210/240	(1989) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 365	(1987) Commercial and Industrial Unitary Air-Conditioning Condensing Units
ARI 450	(1987) Water-Cooled Refrigerant Condensers, Remote Type
ARI 460	(1994) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 495	(1993) Refrigerant Liquid Receivers
ARI 520	(1990) Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units
ARI 550	(1998) Centrifugal or Rotary Screw Water-Chilling Packages
ARI 560	(1992) Absorption Water-Chilling Packages
ARI 575	(1987) Method of Measuring Machinery Sound Within an Equipment Space
ARI 590	(1992) Reciprocating Water-Chilling Packages
ARI 700	(1993) Specifications for Fluorocarbon and Other Refrigerants
ARI 710	(1986) Liquid-Line Driers
ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1987) Thermostatic Refrigerant Expansion Valves
ARI 760	(1987) Solenoid Valves for Use with

Volatile Refrigerants

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.13	(1971; R 1986) Methods for the Measurement of Sound Pressure Levels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1994) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 181	(1994) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 334	(1991) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-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 B 32	(1995) Solder Metal

ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 209	(1995) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 210	(1995) Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B 280	(1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 395	(1993) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM B 650	(1993) Electrodeposited Engineering Chromium Coatings of Ferrous Substrates
ASTM C 67	(1994) Sampling and Testing Brick and Structural Clay Tile
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 596	(1991) Reporting Results of Analysis of Water
ASTM D 1384	(1993) Corrosion Test for Engine Coolants in Glassware
ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1990; R 1994) Rubber Products in Automotive Applications
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM E 84	(1995) Surface Burning Characteristics of Building Materials
ASTM F 104	(1993) Nonmetallic Gasket Materials
ASTM F 1199	(1988, R 1993) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

ASTM F 1200	(1988, R 1993) 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 34	(1994) Number Designation and Safety Classification of Refrigerants
ASHRAE 64	(1995) Methods of Testing Remote Mechanical-Draft Evaporative Refrigerant Condensers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.5	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) 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	(1989) 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 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995) 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	(1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995) Boiler and Pressure Vessel Code;

	Section IX, Welding and Brazing Qualifications
ASME PTC 23	(1986; Addenda 1992; R 1992) Atmospheric Water Cooling Equipment

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS D1.1	(1994) Structural Welding Code - Steel

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA-RIS-01-SS	(1995) Standard Specifications for Grades of California Redwood Lumber

COOLING TOWER INSTITUTE (CTI)

CTI ACT 105	(1990) Acceptance Test Code for Water Cooling Towers
CTI Std-103	(1986) Standard Specifications for the Design of Cooling Towers with Redwood Lumber
CTI Std-111	(1986) Gear Speed Reducers
CTI Std-114	(1986) Specifications for the Design of Cooling Towers with Douglas Fir Lumber
CTI Std-134	(1985) Plywood for Use in Cooling Towers
CTI Std-137	(1988) Fiberglass Pultruded Structural Products for Use in Cooling Towers
CTI WMS-112	(1986) Pressure Preservative Treatment of Lumber for Industrial Water-Cooling Towers

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA-01	(1993) EJMA Standards

HYDRAULIC INSTITUTE (HI)

HI-01	(1983) Standards for Centrifugal, Rotary, & Reciprocating Pumps

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1995) Butterfly Valves
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) 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-78	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1992) Ball Valves Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(1993; Rev 1-1993; Rev 2-1995) Motors and Generators
NEMA SM 23	

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 214	(1992) Water-Cooling Towers
NFPA 255	(1990) Method of Test of Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES (UL)

UL 1995	(1990) Heating and Cooling Equipment

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01 (1991; Supple No. 3) Western Lumber Grading Rules 91

1.2 SYSTEM DESCRIPTION

This specification section covers the provisions and installation procedures necessary for a complete and totally functional refrigerant system. The system shall be provided and installed with all necessary System Components, Accessories, Piping Components, and Supplemental Components\Services.

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

Central Refrigerated Air-Conditioning System; GA.

Manufacturer's catalog data, at least 5 weeks prior to beginning construction, shall be highlighted to show model #, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be adequate to demonstrate compliance with contract requirements as specified within the paragraphs:

a. Refrigeration System
b. System Components
c. Accessories

e. Piping Components

If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

Water Treatment Systems; GA.

Six complete copies, at least 5 weeks prior to the purchase of the water treatment system, of the proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in Paragraph Water Analysis, a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

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 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with source of supply.

Qualifications; FIO.

6 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

SD-04 Drawings

Central Refrigerated Air-Conditioning System ; GA.

Drawings, at least 5 weeks prior to beginning construction, shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Equipment layouts which identify assembly and installation details.
b. Piping layouts which identify all valves and fittings.
c. Plans and elevations which identify clearances required for maintenance and operation.
d. Wiring diagrams which identify each component individually and all interconnected or interlocked relationships between components.
e. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.
f. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

SD-06 Instructions

Posted Instructions; GA.

Posted instructions, at least 2 weeks prior to construction completion, shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

SD-07 Schedules

Factory Tests; GA.

Schedules, at least 2 weeks prior to the factory test, which identify the date, time, and location for each test. Schedules shall be submitted for both the Chiller Performance Test and the Chiller Sound Test. The Chiller Performance Test schedule shall also allow the witnessing of the test by a Government Representative.

Tests; GA.

Test schedules, at least 2 weeks prior to the start of related testing, for each of the field tests, the system performance tests, and the condenser water quality tests. The schedules shall identify the date, time, and location for each test.

Demonstrations;
FIO.

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-08 Statements

Verification of Dimensions;
FIO.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-09 Reports

Factory Tests;
GA.

Six copies of the report shall be provided in bound 8 1/2 by 11 inch booklets. Reports shall certify the compliance with performance requirements and follow the format of the required testing standard for both the Chiller Performance Tests and the Chiller Sound Tests. Test report shall include certified calibration report of all test instrumentation. Calibration report shall include certification that all test instrumentation has been calibrated within 6 months prior to the test date, identification of all instrumentation, and certification that all instrumentation complies with requirements of the test standard.

Field Tests; FIO.

Six copies of the report shall be provided in bound 8 1/2 by 11 inch booklets. Reports shall document all phases of tests performed during the Water Pipe Testing, the Refrigerant Pipe Testing, and the Cooling Tower Tests. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

System Performance Tests; FIO.

Six copies of the report shall be provided in bound 8 1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.
b. The load on the system based on the following:
   (1) The refrigerant used in the system.
   (2) Condensing temperature and pressure.
   (3) Suction temperature and pressure.
   (4) Running current, voltage and proper phase sequence for each phase of all motors.
   (5) The actual on-site setting of all operating and safety controls.
   (6) Chilled water quantity and temperature in and out of the chiller.
   (7) The position of the capacity-reduction gear at machine off, one-third loaded, one-half loaded, two-thirds loaded, and fully loaded.

Condenser Water Quality Tests; FIO.

Test reports, each month for a period of one year after project completion, in bound 8 1/2 by 11 inch booklets. The reports shall identifying the chemical composition of the condenser water. The reports shall also include a comparison of the manufacturer's recommended operating conditions for the cooling tower and condenser in relation to the condition of the condenser water. Any required corrective action shall be documented within the report.

Inspections; FIO.

Test report, at the completion of one year of service, in bound 8 1/2 by 11 inch booklets. The report shall identifying the condition of the cooling tower and condenser. The report shall also include a comparison of the condition of the cooling tower and condenser with the manufacturer's recommended operating conditions.

SD-13 Certificates

Central Refrigerated Air-Conditioning System; GA.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate 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 may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

SD-19 Operation and Maintenance Manuals

Operation Manual; FIO.

Six complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manual; FIO.

Six complete copies of maintenance manual in bound 8 1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

Water Treatment System; FIO.

Six complete copies of operating and maintenance manuals for the

step-by-step water treatment procedures. The manuals shall include testing procedures used in determining water quality.

1.4 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.Welding and nondestructive testing procedures are specified in Section 15052 WELDING PRESSURE PIPING.

1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size. The two years experience shall be satisfactorily completed by a product which has been

sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two-year field service record shall 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. All products shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and shall be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 NAMEPLATES

Each major component of equipment shall have the manufacturer's name, address, type or style, and catalog or serial number on a plate securely attached to the item of equipment. Nameplates shall be provided for:

a. Condensing and Compressors Unit(s)
b. Liquid-Chilling Package(s)
c. Compressor(s)
d. Compressor Driver(s)
e. Condenser(s)
f. Liquid Cooler(s)
g. Receiver(s)
h. Pump(s)
i. Pump Motor(s)
j. Cooling Tower(s)
k. Cooling Tower Gear Drive Assemblies
l. Refrigerant Leak Detectors
m. Oxygen Sensors
n. Expansion Tanks
o. Air Separator Tanks

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. All motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor starter shall be provided with NEMA 1 enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 MATERIALS

2.4.1 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.4.2 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.4.3 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.4.4 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.4.5 Gauges

Gauges shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case.

2.5 REFRIGERATION SYSTEM

2.5.1 Condensing and Compressor Unit;

Each compressor unit shall be designed, fitted, tested, and rated in accordance with ARI 550. Each unit shall also meet the requirements of ASHRAE 15, UL 1995and NFPA 70 as applicable. The unit shall include the following components as defined in paragraph SYSTEM COMPONENTS:

a. Refrigerant and Oil
b. Rotary Screw Compressor
c. Compressor Driver, Electric Motor
d. Compressor Driver Connections
e. Liquid Cooler
f. Integral Water-cooled Condenser
g. Receivers

i. Tools
j. All customary auxiliaries deemed necessary by the manufacturer for safe, controlled, automatic operation of the equipment

2.5.1.1 Capacity Criteria

Each unit shall produce an Coefficient of Performance (COP)of 5.67 when rated in accordance with ARI 550.

2.5.1.2 Controls Package

Units of 10 tons or more shall be provided with automatic capacity controls actuated by either pressure or temperature to provide automatic capacity reduction. Compressors with capacity reduction devices shall start with capacity-reduction devices in the unloaded position. Multiple compressor units shall start compressors in sequence. Pressure cutouts and

gauges shall be factory or field mounted on a gauge board. Alarm circuit terminals shall be provided in the control panel to actuate a 4 inch diameter alarm bell in the event of machine cutout on any protective device except when the low-pressure control is used as an operating control. Alarm bell shall be provided by the Contractor and located where indicated. Transformer for the bell circuit requiring low voltage shall be provided by the Contractor. The controls package for the unit shall include:

a. Separate high- and low-pressure cutouts.
b. Suction gauges.
c. Discharge gauges.
d. Oil-pressure gauges when available from the manufacture.
e. Low-oil-pressure cutout for forced-feed positive displacement type lubrication system when available from the manufacturer.
f. Manual resets for all cutouts.

2.5.1.3 Base

Unit shall be mounted on a structural steel or cast iron base. Compressors shall be mounted on vibration isolators. The entire unit shall be isolated from the building structure on vibration isolators with submitted and published load ratings. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

2.5.2 Liquid-Chilling Package; Screw

helical rotary screw unit shall be designed, rated and certified in accordance with ARI 550 and shall bear the ARI label. Unit shall be of the open or hermetically sealed type and shall meet the requirements of ASHRAE 15. The unit shall include the following components as defined in paragraph SYSTEM COMPONENTS:

a. Refrigerant and Oil
b. Helical Rotary Screw Compressor
c. Compressor Driver, Electric Motor
d. Compressor Driver Connections
e. Liquid Cooler
f. Integral Water-cooled Condenser
g.
h. Receivers
i.
j. Tools
k. All customary auxiliaries deemed necessary by the manufacturer for safe, controlled, automatic operation of the equipment

2.5.2.1 Capacity Criteria

Unit shall have a minimum Coefficient of Performance (COP) of 5.67 at full load rating in accordance with ARI 550. Unit shall have a minimum Integrated Part Load Value (IPLV) of .62 KW/Ton in accordance with ARI 550.

2.5.2.2 Controls Package

Each liquid chilling unit shall be provided with controls of the electric, electronic. The Contractor shall properly coordinate the chiller controls with the temperature-control system specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and 15974 BUILDING AUTOMATION & CONTROL SYSTEMS.

a. The chiller controls package shall include a gateway device to interface to the building automation & control system (BACS). The gateway shall perform bi-directional protocol translation between the chiller control system and the BACS.

b. Operating Control: The control system shall provide self diagnostics, operation status, and running hours meter. Operating control for chilled-liquid system shall be of the modulating type and shall control the chilled water temperature within one degree of set point. The chilled water temperature set point shall be adjustable. The chilled water temperature control system shall have:

(1) A means of calibration
(2) User programmable ramp loading at startup to assure gradual pull down of the chilled water loop temperature
(3) Power-demand limiting to permit power demand limiting with 4-20 mAstepped position contact closure with a minimum of 80/60/40 percent positions selectable
(4) Reset of chilled water temperature with 4-20 mA

c. Gauges or Digital Displays: Each unit shall be provided with a control panel housing the compressor operating control, the start-stop switch, and at least the following gauges or digital displays:

(1) Liquid cooler refrigerant pressure
(2) Condenser pressure
(3) Oil pump pressure for units with oil pumps
(4) Purge drum pressure if purge is furnished
(5) Ammeters, (mounted on starter)
(6) Entering and leaving evaporator water temperature
(7) Entering and leaving condenser water temperature
(8) Chilled water temperature set-point
(9) Start counter and running-time meter

d. Protective Devices: Signal lights or digital display shall be provided for all protective devices. Alarm circuit terminals shall be provided in the basic chiller package control panel to actuate a field installed minimum 4 inch diameter alarm bell in event of machine cutout by any protective device requiring manual reset. Transformer, matching bell circuit requirements shall be field or factory installed if required. Alarm bell shall be located where indicated. Each unit shall be provided with a control panel housing the following protective devices:

(1) Low-liquid cooler refrigerant temperature or pressure cutout or both
(2) High condenser temperature or pressure cutout or both
(3) Low-oil pressure or flow cutout
(4) High motor temperature cutout
(5) Motor overcurrent cutout (may be located in starter)
(6) High voltage cutout (may be located in starter)
(7) Low voltage cutout (may be located in starter)
(8) Momentary power loss protection (may be located in starter)
(9) Loss of chilled water and condenser water flow cut-out (may be field installed)
(10) Excessive compressor motor acceleration time cutout

(11) High oil temperature cutout
(12) Compressor motor anti-recycle
(13) Starter failure
(14) Excessive starter transition time

2.5.2.3 Base

A base shall be provided for the liquid chilling package as recommended by the manufacturer of the unit and approved by the Contracting Officer.

2.5.2.4 Purge System

When a positive pressure machine is used by the manufacturer in the liquid chiller package, a purge system will not be required . When a negative pressure machine, below atmospheric pressure, is used by the manufacturer in the liquid chiller package, a purge system shall be required. When in operation, the purge system shall function to automatically remove air, water vapor, and non-condensible gases from the refrigerant. The discharge shall be piped to vent the refrigerant vapors outdoors. The system shall be manually or automatically started and stopped and be assembled as a compact unit. The system shall be complete with all necessary operating and safety devices and with an oil separator if required by the manufacturer. The system shall operate independently of the unit and be operational while the chilled water pump is shutdown. No external water cooling source shall be required. If the purge system cannot operate when the chiller is off, a positive pressure device shall be provided on the evaporator to raise the pressure of the bundle above atmospheric pressure when the machine is off to prevent non-condensables from entering the machine. Excess purge requirements shall enable a fault indication light at the purge. A contact closure shall be provided for remote ammunition of excess purge. At standard operating conditions and with a condensing refrigerant temperature less than 80 degrees F, the purge exhaust shall be rated for no more than 0.75 to 1.0 pound of refrigerant per one pound of non-condensables. The purge unit indication shall include lights indicating condenser running, fault indication, service operation, elapsed time meter, and a number of starts counter.

2.5.2.5 Economizer

When required by the manufacturer, an economizer shall be provided. The flash gas shall be piped from the economizer to the inlet of the intermediate-stage impeller wheel or the intermediate compression point on helical rotary screw units. Necessary flow control to automatically regulate the flow of the liquid refrigerant through the economizer shall be provided. If external-type economizer is used, such economizer shall be designed, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1, where applicable, for the working pressure corresponding to the refrigerant saturation pressure at 80 degrees F. Unit shall meet the requirements of ASHRAE 15.

2.6 SYSTEM COMPONENTS

2.6.1 [AM#5]Refrigerant and Oil

Refrigerants shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. The unit shall be factory leak tested and

dehydrated. Where factory does not precharge the system, Contractor shall provide and install a complete charge of refrigerant and oil required for the installed system as recommended by the manufacturer.

2.6.2 Compressor(s)

2.6.2.1 Helical Rotary Screw Compressor(s)

Compressors shall operate stably for indefinite time periods at any stage of capacity reduction without hot-gas bypass. Provision shall be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Helical rotary screw compressors shall include:

a. An accessible, hermetic, positive displacement, oil-injected design directly driven by the compressor driver.
b. Rotors which are solid steel forging with sufficient rigidity for proper operation.
c. A maximum rotor operating speed no greater than 3600 RPM.
d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors.
e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.
f. Shaft main bearings of the sleeve type with heavy duty bushings or rolling element type in accordance with ABEMA 9 or ABEMA 11. Bearings shall be conservatively loaded and rated for an L(10) life of not less than 200,000 hours.
g. A differential oil pressure or flow cutout to allow the compressor to operate only when the required oil pressure or flow is provided to the bearings.
h. A temperature- or pressure-initiated, hydraulically actuated, single-slide-valve, capacity-control system to provide automatic capacity modulation from 100 percent to 15 percent.
i. An external oil separator and oil return system to remove oil entrained in the refrigerant gas and automatically return the oil to the compressor.
j. Crankcase oil heaters controlled as recommended by the manufacturer.

2.6.3 Compressor Driver, Electric Motor

Motor starter shall be unit mounted. The compressor(s) shall be driven by an electric motor that has a maximum speed of 3,600 rpm. Motor shall be of the constant-speed, squirrel-cage induction, open enclosure, or hermetically sealed, normal- or high-torque type as required by the compressor manufacturer to adequately bring the compressor up to full operating speed without damaging the equipment. Motor shall be furnished with magnetic across-the-line or reduced-voltage motor starter as required by the unit manufacturer to limit unit total instantaneous-current flow during start-up to a maximum of 880 amps. Motor starter shall be provided with NEMA 1 enclosures with an integral circuit breaker which trips the breaker when the starter door is opened. Hermetically sealed motors shall be refrigerant-gas cooled. Wiring shall be as recommended by the compressor manufacturer to provide completely automatic operation of the system. Motors shall be protected against running overload and motor-winding temperature overloads. All compressors shall be protected from rapid on-off cycling by a 20-minute time-delay switch initiated by unit shutdown with an adjustable time delay. Motor controller shall be suitable for starting compressor motor intermittently at 20 minute

intervals continuously without damage to controller.

2.6.4 Liquid Cooler

Liquid coolers shall be designed, fitted, and rated in accordance with ARI 590 for reciprocating and scroll compressors and ARI 550 for centrifugal or rotary screw compressors. Coolers shall be designed, constructed, tested, and certified in accordance with ASME BPV VIII Div 1 as applicable, and shall comply with the provisions of ASHRAE 15. Liquid coolers shall be designed for waterside working pressures not less than 150 psig. On direct-expansion-type units, refrigerant circuit shall be complete with liquid solenoid valve and expansion device capable of modulating to the minimum step of capacity unloading. Liquid coolers shall be of the removable or fixed-tube bundle type except that units less than 20 tons may be coaxial-tube type. Tubes shall be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Nominal tube thickness shall be no less than 0.028 inches. Each tube shall be individually replaceable, excluding the coaxial-tube type. Tubes shall be installed into carbon mild steel tube sheets by rolling. Tube baffles shall be carbon mild steel properly spaced to provide adequate tube support, and cross flow liquid cooler feed control shall be complete and designed to feed the cooler at all levels of capacity from 100 percent down to minimum required operating level. Performance shall be based on a water velocity not less than 3 fps nor more than 12 fps and fouling factor of 0.0001 sq. ft.-hour-degree F/btu.

2.6.5 Water-Cooled Condenser

2.6.5.1 Construction

Condenser shall be of shell-and-coil or shell-and-tube construction and may be provided as an integral part of the compressor unit specified. Condenser shall be designed, fitted, and rated in accordance with the recommendations of ARI 450, ARI 550, and ARI 590 as applicable. Condenser shall be constructed and tested in accordance with ASME BPV VIII Div 1, and ASHRAE 15. Condenser shall be designed for not less than 250 psi waterside working pressure. Condensers shall be of the removable or fixed-tube bundle type. Tubes shall be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube shall be individually replaceable, except for the coaxial tubes. Tubes shall be installed into carbon mild steel tube sheets by rolling. Tube baffles shall be carbon mild steel properly spaced to provide adequate tube support and cross flow. The unit shall have a fouling factor of 0.00025 sq. ft.-hour-degree F/btu. Condensers shall be complete with liquid line shut-off valves, pressure relief valve, and refrigerant charging valve. Condenser shall be provided with a purge valve located at the highest point in the condenser to purge non-condensibles trapped in the condenser. Condenser shall be provided with side inlet water connections and factory mounted flange connections.

2.6.5.2 Performance

Performance shall be based on allowable water velocity not less than 3 fps nor more than 10 fps; 12 fps maximum water velocity will be allowed provided that the manufacturer can provide evidence of satisfactory performance over a minimum period of 2 years in accordance with paragraph STANDARD PRODUCTS; and provided that the water is on the shell side of the heat exchanger.

2.6.5.3 Refrigerant Storage

Water-cooled condensers screw compressor may be used for refrigerant storage in lieu of a separate liquid receiver, if the condenser storage capacity is 5 percent in excess of the fully charged system for single packaged systems and 20 percent in excess of the fully charged system for remote water cooled condensers.

2.6.5.4 Condenser Control

If the equipment or system served by the condenser requires control of head pressure or entering condenser water temperature, refrigerant head pressure, condensing temperature or condenser water temperature shall be controlled by a controller which shall control the head pressure, condensing temperature or entering condenser water temperature by cycling, sequential cycling, varying the speed of the cooling tower fans or by modulating the cooling tower water bypass valve or bypass dampers to maintain the saturated refrigerant condensing temperature at a minimum of 85 degrees F or the minimum condenser water temperature recommended by the manufacturer.

2.6.6 Tools

One complete set of special tools as recommended by the manufacturer for field maintenance of the system shall be provided. Tools shall be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.7 ACCESSORIES

2.7.1 Pumps

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI-01. Pump capacity, efficiency, motor size, and impeller type shall be as indicated on the drawings. Pumps shall be selected at or near peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Shutoff head shall be approximately 20 percent greater than design head. Pump motor shall be totally enclosed and have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

2.7.1.1 Construction

Shaft seal shall be mechanical-seal or stuffing-box type. Impeller shall be statically and dynamically balanced. Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water. Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings.Pump shall be provided with shaft coupling guard.Close coupled pumps shall be provided

with drip pockets and tapped openings. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 60 feet of water, the pump speed shall not exceed 1,750 rpm. Pump shall be accessible for servicing without disturbing piping connections.

2.7.1.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone separator in line.

2.7.1.3 Stuffing-Box Type Seals

Seals shall be single unit construction separate from the casing, secured against rotation. Stuffing box shall include minimum 5 rows of square, graphite braided asbestos packing and a bronze split-lantern ring. Packing gland shall be bronze interlocking split type.

2.7.2 Expansion Tanks

Expansion tanks shall be welded steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 125 150 psig and precharged to the minimum operating pressure. Expansion tanks shall have a replaceable diaphragm and be the captive air type. Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with an air charging valve. Tanks shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.7.3 Air Separator Tanks

External air separation tank shall be steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 150 psig.

2.7.4 Refrigerant Leak Detector

A refrigerant leak detector shall be provided in any mechanical room or enclosed area which houses a chiller utilizing R-123. The detector shall be located where refrigerant is likely to concentrate. The detector shall be a Halogen-Specific detector which shall be specifically designed for area monitoring. The detector shall have an adjustable sensitivity such that it can detect refrigerant at or above 3 ppm. The detector shall energize the local mechanical ventilation system and initiate an audible and visible alarm upon detecting a refrigerant level greater than 10 ppm.

2.7.5 Sensor#.1 Sub TitleAn oxygen sensor shall be provided in any mechanical room or enclosed area which houses a chiller utilizing R-22. The sensor shall be located where refrigerant is likely to concentrate. The sensor shall be specifically designed to measure the percent oxygen level

withing a area. The sensor shall have an adjustable sensitivity such that it can detect an oxygen level at or below 21 percent by volumn. The sensor shall energize the local mechanical ventilation system and initiate an audible and visible alarm upon detecting an oxygen level below 19.5 percent by volumn.

Text

2.7.6 Signs

Metal signs shall be provided having letters not less than 0.5 inches in height designating the main shut-off valves to each refrigerant vessel, the electrical control of the chiller, and the pressure limiting device.

2.7.7 Pump-Out System

A manually initiated pump-out system shall be provided, consisting of a motor-driven, air- or water-cooled, reciprocating condensing unit and a receiver of sufficient capacity to store the entire refrigerant charge of the largest water-chilling system or unit when 80 percent full at 90 degrees F. Pump-out system condensing unit shall be assembled as a complete unit and meet the requirements of ASHRAE 15. Receiver and relief devices shall conform to requirements of ASME BPV VIII Div 1. Unit shall be mounted on the chiller or mounted on floor brackets and provided with rupture members and unit relief valves in series. Entire system shall be complete with all valves, piping, and controls so that the pump-out system may be operated without requiring any temporary wiring or piping. The pump-out system shall be capable of removing both refrigerant liquid and refrigerant vapor from the refrigeration system. The pump-out system shall be capable of reducing the pressure within the refrigeration system to 150 mm Hg.

2.7.8 Insulation

2.7.8.1 Field Installed Insulation

Field installed insulation shall be as specified in Section 15250THERMAL INSULATION FOR MECHANICAL SYSTEM, except for header and waterbox insulation which shall be flexible cellular insulation in accordance with ASTM C 534, Type I.

2.7.8.2 Factory Installed Insulation

For Liquid-Chilling Packages (Screw), liquid cooler shell and suction piping between cooler and first stage of each compressor unit shall be insulated, including the water headers or boxes of the liquid cooler. Where motors are the gas-cooled type, insulation shall be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice.

2.8 COOLING TOWER

2.8.1 Fire Safety

Towers shall conform to NFPA 214. Fire hazard rating for plastic impregnated materials shall not exceed 25. Plastics shall not drip or run during combustion. Determine ratings by ASTM E 84 or NFPA 255.

2.8.2 Lumber

Lumber required for cooling tower construction shall be as defined by the following type woods:

2.8.2.1 Douglas Fir

CTI Std-114, WWPA-01, Grade B and better, Industrial Clear. Douglas fir shall have a preservative treatment in accordance with CTI WMS-112.

2.8.2.2 Plywood

CTI Std-134, Exterior Grade, type and thickness as specified for the application.

2.8.2.3 Pressure Treated Lumber

Pressure treated lumber shall be in accordance with CTI WMS-112. Wood exposed as the result of notching, cutting, or drilling shall be saturated with the preservative.

2.8.2.4 Redwood

CTI Std-103, CRA-RIS-01-SS California Redwood, clear of all hearts.

2.8.3 Fiberglass Reinforced Plastic (FRP)

FRP components shall be inert, corrosion resistant, and fire-retardant with a thickness of 12 ounces per square foot. FRP components shall contain an ultraviolet (UV) ray inhibitor as per CTI Std-137, Grade 1 or 3.

2.8.4 Zinc-Coated Steel

Components fabricated of zinc-coated steel shall be not lighter than 16 gauge steel, protected against corrosion by a zinc coating. The zinc coating shall conform to ASTM A 153 and ASTM A 123, as applicable and have an extra heavy coating of not less than 2-1/2 ounces per square foot of surface. Galvanized surfaces damaged due to welding shall be coated with zinc rich coating conforming to ASTM D 520, Type 1.

2.8.5 Polyvinyl Chloride (PVC) Formed Sheets

ASTM D 1784, Type I, Grade 1 with a flame spread rating of 15 or less per ASTM E 84.

2.8.6 Hardware

Bolts shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads. Nails shall be silicon bronze, commercial bronze, or stainless steel. Hardware shall meet the salt-spray fog test as defined by ASTM B 117.

2.8.7 Noise Control

Sound power levels (in decibels with a reference pressure of 0.0002 microbar) of the cooling tower shall not exceed the maximum permitted decibel levels for the designated octave band as set forth in the following tables. Sound power level data for the cooling tower shall be based on

tests conducted in accordance with ANSI S1.13.

Octave Band (in Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level in dB	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

2.8.8 Conventional Type Tower

a. Factory-Assembled: Each tower shall be the induced mechanical draft, crossflow, factory fabricated, factory-assembled type.

b. Field-Assembled: Each tower shall be the induced mechanical draft, counterflow, factory fabricated, field-assembled type. Notching structural members may be permissible only if the members are increased proportionately in size to provide equivalent strength. Framework design for wood towers shall conform to requirements of CTI Std-103 for redwood construction and CTI Std-114 for douglas fir construction.

2.8.8.1 Casing

Casing shall be constructed of zinc-coated steel. Towers shall be designed and constructed to withstand a wind pressure of not less than 30 pound-force per square foot (psf) on external surfaces. Fan decks shall be designed to withstand a live load of not less than 60 psf in addition to the concentrated or distributed loads of equipment mounted on the fan decks. A 15-percent increased loading shall be included for ice or snow load. Air inlet and discharge terminations shall have flanged or lipped projections for connecting ductwork.

2.8.8.2 Cold-Water Basin

Basin shall be completely watertight and constructed of 1-1/2 inch tongue and groove lumber. Basin shall be constructed and installed to ensure that air will not be entrained in outlets when operating and no water will overflow on shutdown. Each individual sump shall be provided with an individual outlet. Each outlet shall be provided with a 1/2 inch mesh, zinc-coated steel wire securely mounted to prevent trash from entering the outlet. Each basin shall be provided with overflow and valved drain connections. Each basin shall be provided with a float-controlled, makeup water valve as indicated. The makeup water shall discharge not less than 2 inches or two pipe diameters, whichever is greater, above the top of the basin.

2.8.8.3 Hot-Water Distribution

Design water distribution systems for each cell of each tower so that a water flow of 140 percent of specified water flow will not cause overflowing or splashing. Water distribution systems shall be accessible and permit flexibility of operation. Provide removable covers of same material and thickness as casing for entire water distribution basin. Support covers by basin sides with top of cover flush with top of basin. Provide separate regulation and stop valves for complete balancing and complete shutoff from each cell. Systems shall be self-draining and nonclogging. The water distribution system shall be either one of the following types.

a. Open Basins: Basins shall be provided with a splash box or baffles to minimize splashing of incoming hot water, holes that evenly distribute the water over the entire decking area, and a basin cover. Holes used in a water basin shall be provided with ceramic or plastic orifice inserts.

b. Spray Nozzles: Spray nozzles shall be cleanable; stainless steel, bronze, or high-impact plastic, nonclogging, removable; and, spaced for even distribution.

2.8.8.4 Fill Material

The fill shall be the following materials as specified. PVC formed sheets arranged in a honeycomb or waveform configuration; zinc-coated steel treated Douglas-fir; or treated hemlock and treated redwood. Zinc-coated steel shall have a minimum of 2.5 ounces per square foot of surface. Fill material shall be free to expand or contract without warping. PVC fill shall not be provided when inlet temperatures exceed 125 degrees F. No plasticized wood cellulose shall be provided for fill material. Fill shall be removable or otherwise made accessible for cleaning. Provide space supports as required to prevent sagging and misalignment, and provide for an even mixing of air and water.

2.8.8.5 Drift Eliminator

Provide in tower outlet to limit drift loss to not over 0.02 percent of specified water flow. Eliminators shall be constructed of not less than 3/8 inch lumber or polyvinyl chloride (PVC).

2.8.8.6 Fan Cylinder

Each fan shall be mounted in a fan cylinder to elevate the fan discharge air. Total extension height shall not exceed the fan diameter. Fan cylinders shall be constructed of zinc-coated steel, lumber, Type 304 stainless steel, or FRP and be compatible with the entire tower construction. Each fan cylinder shall be provided with a zinc-coated steel 12 gauge wire mesh securely mounted to the top of the cylinder in accordance with manufacturer's recommendations.

2.8.8.7 Framework and Equipment Supports

Framework and equipment supports shall be zinc-coated steel or lumber. Materials provided for framework, casings and equipment supports shall be compatible.

2.8.8.8 Structural Supports

Structural supports shall be provided in accordance with the recommendations of the manufacturer of the tower unless otherwise indicated.

2.8.8.9 Foundations

Cooling tower foundations shall meet the requirements of the cooling tower manufacturer and be as indicated. Foundation design shall be based on the load conditions and soil bearing value indicated. Foundation calculations shall be submitted with the equipment drawings.

2.8.9 Concrete Structured Type

Each tower shall be the induced mechanical draft, counterflow, factory fabricated, field-assembled type.

2.8.9.1 Casing

The wall sections shall be constructed of air entrained concrete mix. Concrete shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Exposed concrete shall be rub-finished for smooth and uniform surfaces free of form marks and defects. Honeycomb concrete shall not be permitted. Any cold-pour joints in vertical walls shall have a continuous water-stop stripping of molded polyvinyl plastic (6 inchdumbbell).

2.8.10 Hot-Water Distribution

Distribution system for each cell shall consist of a centrally located header complete with junction boxes, side laterals, fittings, and nozzles. Piping shall be either cast iron, ductile iron, threaded-glass-fiber reinforced epoxy pipe, polypropylene, PVC or Schedule 80 black steel. Junction boxes shall be cast iron and nozzles shall be brass, stainless steel or plastic. Distribution piping including spray nozzles, pipe, fittings, and junction boxes shall be provided complete to flange face located at a point 6 inches below top of fill support beam. Provisions shall be provided for balancing of water flow between cells or spray trees.

2.8.11 Fill Material

Fill material shall be PVC formed sheets, in a pattern, and of sufficient height to meet the performance specifications. PVC fill shall be manufactured from minimum nominal 20 mil sheets. PVC fill shall be supported by the tower structure using corrosion resistant members. PVC sheets shall be arranged in a honeycomb or waveform configuration and shall have a flame spread rating of 25 or less when tested in accordance with ASTM E 84. Fill material shall be free to expand or contract without warping or cracking.

2.8.12 Drift Eliminators

Eliminators shall be of the multi-pass zigzag type, assembled into sections making a strong, stable unit. Provide in tower outlet to limit drift loss to not over 0.005 percent of the water flow. These sections shall be supported on PVC or FRP tee sections. Tee sections shall be suspended with 1/4 inch brass rods connected to stainless steel clips embedded in the bottom side of the roof deck at the time of casting. Stainless steel clips shall be supplied by cooling tower manufacturer for installation by Contractor at time of roof deck pour. Eliminators may be supported by brass or stainless steel suspension rods from the fan deck or supported directly on concrete beams. Eliminators may be either PVC extruded sections or wave formed sheets of PVC resin conforming to ASTM D 1784 Type I, Grade 2. Eliminators and supporting framework shall have flame spread rating of 25 or less when tested in accordance with ASTM E 84.

2.8.13 Fan Decks and Stacks

Construct fan decks of precast, reinforced lightweight concrete, in multiple sections, forming a complete, vibration-free base for mounting fan, speed reducer, drive shaft, motor, and fan stacks. Construct fan

stacks of precast, reinforced lightweight concrete in multiple sections, constrained with bands of zinc-coated steel conforming to ASTM A 123, not less than 1/8 by 3 inches, and bolted to form a compressive load on stack perimeter. Secure stack in place on fan deck with Class A mortar.

2.9 Louvers

Air inlets for each cooling tower shall be provided with individually removable louvers arranged to prevent the escape of water. Louvers shall be zinc-coated steel, or lumber. Materials provided for casings and louvers shall be compatible; one material shall not produce stains upon the other. Louvers constructed of lumber shall be of a thickness to withstand alternate wetting and drying without cracking or splitting. Air intakes shall be provided with 1 inch zinc-coated steel mesh.

2.10 Fans

Fans shall be the adjustable-pitch propeller type, constructed of zinc-coated steel, Type 304 stainless steel, aluminum or an aluminum alloy, or FRP. Propeller type shall have a maximum tip speed of 11,000 fpm. Fan blade assembly shall be both statically and dynamically balanced after assembly of the cooling tower. Fan hub shall be constructed of stainless steel with adequate surface protection against corrosion. Complete fan assembly (fan and mounting) shall be designed to give maximum fan efficiency and long life when handling saturated air at high velocities.

2.11 Speed Reducer Gears and Drive Shaft

Speed reducer gears shall be rated in accordance with CTI Std-111. Gear reducers shall be of the spiral bevel, single reduction type. Reducer shall be mounted in accordance with manufacturer's recommendations. Each reducer shall be provided with an oil level cutoff switch interlocked to the fan motor. Each reducer shall be provided with an oil level sight glass, fill, drain, and vent lines located in a readily accessible position. Drive shafts shall be the full floating type with flexible couplings at both ends and have a service factor of 1.0 or greater. Drive shafts shall be of stainless steel, fitted each end with flexible couplings (stainless steel plate type). Each drive shaft shall be provided with a galvanized steel guard, to prevent damage to surrounding equipment in case of shaft failure. Provision shall be made for lubrication of all bearings. Bearings shall be accessible to the extent that each bearing can be lubricated without dismantling fan.

2.12 Fan Motor

Each motor shall be a single speed, totally enclosed, insulation Class B, NEMA Design B, continuous-rated, and conforming to NEMA MG 1. Fan motors shall have opendripproof enclosures and be located outside the discharge airstream. Motors shall be mounted according to manufacturer's recommendations.

2.13 Stairways and Ladders

Provide stairs, 60-degree ship ladders or straight-rung ladders of standard design, starting at ground level and extending as high as required to gain access to fan decks and water distribution systems. Stairways and ladders shall be hot-dip, zinc-coated steel. Ladders higher than 12 feet shall have a safety cage.

2.14 Handrailings

Steel handrailings shall be not less than 42 inches high around the exterior of each working surface that is 12 feet or more above the ground, roof, or other supporting construction. Railings shall be not smaller than 1-1/4 inch zinc-coated steel pipe with standard zinc-coated steel railing.

2.15 Access Doors

Each tower shall be provided with access doors at grade level to provide entry to the interior for service maintenance without removal of the fill. Doors shall be provided with doors on each endwall of each cooling tower cell. Frame and brace access doors to prevent damage when opening and closing. Doors shall be located adjacent to float controls.

2.16 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing hexavalent chromium (Cr) is prohibited.

2.16.1 Water Analysis

Conditions of make-up water to be supplied to the condenser and chilled water systems are as follows:

Date of Sample	5-15-99
Temperature	73 degrees F.
Silica (SiO 2)	12 ppm (mg/1)
Insoluble	< 0.5 ppm (mg/1)
Iron and Aluminum Oxides	< 0.05 ppm (mg/1)
Calcium (Ca)	183 ppm (mg/1)
Magnesium (Mg)	< 0.05 ppm (mg/1)
Sodium and Potassium (Na and K)	10 & 1 ppm (mg/1)
Carbonate (HCO 3)	259 ppm (mg/1)
Sulfate (SO 4)	22 ppm (mg/1)
Chloride (Cl)	18 ppm (mg/1)
Nitrate (NO 3)	1.3 ppm (mg/1)
Turbidity	1 NTU unit
pH	7.6
Residual Chlorine	0.4 ppm (mg/1)
Total Alkalinity	212 epm (meq/1)
Non-Carbonate Hardness	88 epm (meq/1)
Total Hardness	244 epm (meq/1)
Dissolved Solids	400 ppm (mg/1)
Fluorine	0.10 ppm (mg/1)
Conductivity	500 micrmho/cm

2.16.2 Chilled and Condenser Water

Water to be used in the chilled and condenser water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.

2.16.3 Water Treatment Services

The services of a company regularly engaged in the treatment of condenser and chilled water systems shall be used to determine the correct chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall maintain the chemical treatment and provide all chemicals required for the [condenser] [condenser and chilled] water systems for a period of 1 year from the date of occupancy. The chemical treatment and services provided over the 1 year period shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Acid treatment and proprietary chemicals shall not be used.

2.16.4 Chilled Water System

A shot feeder shall be provided on the chilled water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.16.5 Condenser Water

The water treatment system shall be capable of continuouslymanually feeding chemicals and bleeding the system to prevent corrosion, scale, and biological formations. Automatic chemical feed systems shall automatically feed chemicals into the condenser water based on varying system conditions. Continuous chemical feed systems shall continuously feed chemicals into the condenser water at a constant rate. The system shall be initially set manually based on the water analysis of the make-up water.

2.16.5.1 Chemical Feed Pump

One pump shall be provided for each chemical feed tank. The chemical feed pumps shall be positive displacement diaphragm type. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge.

2.16.5.2 Tanks

Two chemical tanks shall be provided. The tanks shall be constructed of stainless steel with a hinged cover. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation. A level indicating device shall be included with each tank. An electric agitator shall be provided for each tank.

2.16.5.3 Injection Assembly

An injection assembly shall be provided at each chemical injection point along the condenser water piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the condenser water piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the condenser water line.

2.16.5.4 Water Meter

Water meters shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the

make-up water line, as indicated.

2.16.5.5 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

2.16.5.6 Bleed Line

A bleed line with a flow valve of the needle-valve type sized for the flow requirement or fixed orifice shall be provided. The bleed line shall be extended to the nearest drain for continuous discharge.

2.17 PIPING COMPONENTS

2.17.1 Water Piping and Fittings

2.17.1.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Schedule 40, Type E or S, Grades A or B. Type F pipe shall not be used.

2.17.1.2 Steel Pipe Joints and Fittings

Joints and fittings shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 1 inch and smaller shall be threaded; piping larger than 1 inch and smaller than 3 inches shall be either threaded, grooved, or welded; and piping 3 inches and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

a. Welded Joints and Fittings: Welded fittings shall conform to ASTM A 234, and identified with the appropriate grade and marking symbol. Butt-welding fittings shall conform to ASME B16.9. Socket-welding and threaded fittings shall conform to ASME B16.11.

b. Flanged Joints and Fittings: Flanges shall conform to ASTM A 181 and ASME B16.5 Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. This gaskets shall contain aramid fibers bonded with styrene butadeine rubber (SBR) or nitrile butadeine rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193.

c. Threaded Joints and Fittings: Threads shall conform to ASME B1.20.1. Pipe nipples shall conform to ASTM A 733, type and material to match adjacent piping. Unions shall conform to ASME B16.39, type as required to match adjacent piping.

d. Dielectric Unions and Flanges: Dielectric unions shall have the tensile strength and dimensional requirements specified. Unions

shall have metal connections on both ends threaded to match adjacent piping. Metal parts of dielectric unions shall be separated with a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation.

e. Grooved Mechanical Joints and Fittings: Joints and fittings shall be designed for not less than 125 psigservice 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; or steel conforming ASTM A 106, Grade B or ASTM A 53. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.17.1.3 Copper Tube

Copper tubing for water service shall conform to ASTM B 88, Type K or L.

2.17.1.4 Copper Tube Joints and Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.17.2 Water Piping Valves and Accessories

Valves shall be rated for Class 125 and shall be suitable for operating temperature of 250 degrees F. Valves shall be suitable for the working pressure of the pipe in which installed. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 10 feet or higher above the floor. Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.17.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, Type I, II, III, or IV, Class 125 or 150 and shall be cast iron with bronze trim and flanged or threaded ends.

2.17.4 Butterfly Valves

Butterfly valves shall be in accordance with MSS SP-67, Type 1 and shall be 2 flange or lug wafer type, and shall be bubble tight at [150] [250] psig. Valve bodies shall be cast iron, malleable iron, or steel. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.17.5 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be ductile iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.17.6 Calibrated Balancing Valves

Each valve shall be calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valves shall have an integral pointer which registers the degree of valve opening. Each valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves Cv rating shall be as indicated. Valve bodies shall be provided with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter, suitable for the operating pressure specified, shall be provided. The meter shall be complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.17.7 Automatic Flow Control Valves

Valves shall automatically maintain a constant flow as indicated. Valves shall modulate by sensing the pressure differential across the valve body. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves. Valve Cv rating shall be as indicated. Valve operators shall be the electric type as indicated. Valves shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure specified. The meter shall be complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

2.17.8 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for 125 psig service, and furnished with threaded plugs or caps. Automatic air

vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for 125 psig service.

2.17.9 Strainers

Strainers shall be in accordance with ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 22 gauge corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.17.10 Combination Strainer and Suction Diffuser

A combination strainer and suction diffuser, consisting of an angle type body with removable strainer basket and straightening vanes, a suction pipe support, and a blowdown outlet, shall be provided on pump suction. The combination strainer and suction diffuser shall be in accordance with ASTM F 1200, except as modified herein.

2.17.11 Pump Discharge Valves

Pump discharge valves shall be installed where indicated and shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valves shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Valves shall have an integral pointer which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 2 inches shall have NPT connections. Valves 2 inches and larger shall have flanged or grooved end connections. The valve design shall allow the back seat for the stem to be replaced in the field under full line pressure. Valve Cv rating shall be as indicated.

2.17.12 Backflow Preventers

Backflow preventers shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

2.17.13 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psig or 150 psig service as appropriate for the static head plus the system head, and 230 degrees F, for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.17.14 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure.

2.17.15 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers shall have rigid stems with straight, angular, or inclined pattern.

2.17.16 Pipe Nipples

Pipe nipples shall be in accordance with ASTM A 733 and be of material to match adjacent piping.

2.17.17 Pipe Unions

Pipe unions shall be in accordance with ASME B16.39 and be of material to match adjacent piping.

2.17.18 Solder

Solder for water piping shall be in accordance with ASTM B 32, alloy grade 50B.

2.18 Expansion Joints

2.18.1 Slip-Tube Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for working temperature and pressure suitable for the application, but not less than 150 psig, and shall be in accordance with applicable requirements of EJMA-01 and ASME B31.1. End connections shall be flanged or beveled for welding as indicated. Joints shall be provided with an anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 5 mils of hard chrome in accordance with ASTM B 650. All joint components shall be suitable for the intended service. Initial settings shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer. Pipe alignment guides shall in no case be more than 5 feet from expansion joints except for pipe 4 inches or smaller. Pipe alignment guides on pipe 4 inches or smaller shall be installed not more than 2 feet from expansion joints. Service outlets shall be provided where indicated.

2.18.2 Flexible Ball Joints

Flexible ball joints shall be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. The joint ends shall be threaded to 2 inches only, grooved, flanged, or beveled for welding as indicated or required and shall be capable of absorbing a

minimum of 15 degree angular flex and 360 degree rotation. Ball and sockets shall be suitable for the intended service. The exterior spherical surface of carbon steel balls shall be plated with minimum 5 mils of hard chrome in accordance with EJMA-01 and ASME B31.1 where applicable. Where required, flanges shall conform to ASME B16.5.

2.18.3 Bellows Type Joints

Bellows type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows type expansion joints shall conform to the applicable requirements of EJMA-01 and ASME B31.1 with internal sleeves. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but not less than 150 psig.

2.19 FABRICATION

2.19.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.19.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 15190PAINTING, GENERAL.

2.19.2.1 Color Coding

Color coding for piping identification is specified in Section 15190 IDENTIFICATION OF PIPING.

2.19.2.2 Color Coding Scheme

A color coding scheme for locating hidden piping shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

2.20 FACTORY TESTS

2.20.1 Chiller Performance Test

The Contractor and proposed chiller manufacturer shall be responsible for performing the chiller factory test to validate the specified full load capacity, full load EER, and IPLV in accordance with ARI 550except as indicated. The chiller factory test shall be performed in the presence of a Government representative. The Contractor and chiller manufacturer shall provide to the Government a certified chiller factory test report in

accordance with ARI 550 to confirm that the chiller performs as specified. All tests shall be conducted in an ARI certified test facility in conformance with ARI 550 procedures and tolerances, except as indicated. Tolerance or deviation shall not be allowed on chiller capacity orIPLV. Stable operation at minimum load of 10 percent of total capacity shall be demonstrated during the factory test.

a. Temperature adjustments shall adhere to ARI 550 to adjust from the design fouling factor to the clean tube condition. Test temperature adjustments shall be verified prior to testing by the manufacturer. There shall be no exceptions to conducting the test with clean tubes with the temperature adjustments per section A7.3 of ARI 550. The manufacturer shall clean the tubes, if necessary, prior to testing to obtain a test fouling factor of 0.0000.

b. The factory test instrumentation shall be per ARI 550 and the calibration shall be traceable to the National Institute of Standards and Technology.

c. A certified test report of all data shall be forwarded to the Government for approval prior to project acceptance. All calibration curves and information sheets for all instrumentation shall be provided.

d. If the equipment fails to perform within allowable tolerances, the manufacturer shall be allowed to make necessary revisions to his equipment and retest as required. The manufacturer shall assume all expenses incurred by the Government to witness the retest.

2.20.2 Chiller Sound Test

All centrifugal chillers shall be sound tested at the factory prior to shipment to confirm the sound pressure level specified below. All tests and data shall be conducted and measured in strict accordance with ARI 575. The centrifugal chiller sound pressure level, in decibels (dB), with a reference pressure of 20 micropascals, shall not exceed 85 dB, A weighted, at full load. All ratings shall be in accordance with ARI 575. No reduction of entering condenser water temperature or raising of leaving chilled water temperature shall be allowed. A minimum of 75 percent of the sound data points shall be taken along the length of the machine, and established as the minimum percentage of total possible points used to determine sound levels. In the event that the chiller does not meet the dBA sound pressure level, the manufacturer shall, at his expense, provide sufficient attenuation to the machine to meet the specified value. This attenuation shall be applied in such a manner that it does not hinder the operation or routine maintenance procedures of the chiller. The attenuation material, adhesives, coatings, and other accessories shall have surface burning characteristics as determined by ASTM E 84 not to exceed 25 for flame spread and 50 for smoke-development rating.

2.21 SUPPLEMENTAL COMPONENTS\SERVICES

2.21.1 Drain and Makeup Water Piping

Piping shall comply with the requirements of Section 15400 PLUMBING, GENERAL PURPOSE. Drains which connect to sanitary sewer system shall be connected by means of an indirect waste.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPV VIII Div 1 and ASME BPV IX, the design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX.

3.1.1 Refrigeration System

3.1.1.1 Equipment

Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, liquid coolers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators shall limit vibration to 25 percent at lowest equipment rpm. Lines connected to pumps 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 and concrete-structured or cased-cooling towers shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.1.2 Refrigerant Charging

a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system shall be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance with the manufacturer's recommendations. Contractor shall provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system shall be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points shall be installed and tightened.

b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant shall be pumped into the system receiver or other suitable container. The refrigerant shall not be discharged into the atmosphere.

c. Contractor's Responsibility: The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 oz. of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the specified requirements including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.1.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the performance testing period, and upon the satisfactory completion of the tests, the oil shall be drained and replaced with the second charge.

3.1.1.4 Automatic Controls

Automatic controls for the central refrigeration system specified in paragraph REFRIGERATION SYSTEM shall be provided with the central refrigeration equipment. These controls shall operate automatically to balance the equipment capacity with the load on the air conditioning system, and shall be fully coordinated with and integrated [into the temperature control system specified in Section 15974-BUILDING AUTOMATION AND CONTROL SYSTEMS.

3.1.2 General Piping Installation

3.1.2.1 Brazed Joints

Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. All piping shall be supported prior to brazing and shall not be sprung or forced.

3.1.2.2 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.2.3 Welded Joints

Welding shall be in accordance with qualified procedures using qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be

accepted as permitted by ASME B31.1. Contracting Officer shall be notified 24 hours in advance of welding tests and the tests shall be performed at the work site if practical. A permanent mark shall be applied near each weld to identify the welder who made that weld. Welding and nondestructive testing procedures are specified in Section 15052 WELDING PRESSURE PIPING. Welded joints in steel refrigerant piping shall be fusion-welded. Changes in direction of piping shall be made with welded fittings only; mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. Branch connections shall be made with welding tees or forged welding branch outlets. Steel pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.2.4 Flanged Joints

Flanged joints shall be faced true, provided with gaskets suitable for use with refrigerants and made square and tight. When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items.

3.1.2.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.2.6 Thermometers

Thermometers shall be located specifically on, but not limited to the following: condenser water lines entering and leaving the condenserandthe suction line at each evaporator or liquid cooler.

3.1.2.7 Supports

a. General: All refrigerant pipe supports shall be in accordance with ASME B31.5. 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.

c. Structural Attachments: Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.2.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used.

a. Hangers: Type 3 shall not be used on insulated piping.

b. Inserts: Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.

f. Saddles and Shields: Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

g. Horizontal Pipe Supports: 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. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

h. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

i. Pipe Guides: Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

j. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be

used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

k. High Temperature Guides with Cradles: Where there are high system temperatures and welding to piping is not desirable, then 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.

l. Multiple Pipe Runs: 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.

3.1.2.9 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.2.10 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.1.2.11 Pipe Sleeves

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 wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed as indicated and specified in Section 07920 JOINT SEALING. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed.

a. Roof and Floor Penetrations: Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and 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 troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above highest floor level of the roof or a minimum of 10 inches above the roof, whichever is greater, or 10 inches above the floor. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. 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. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. 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/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

b. Fire-Rated Walls and Partitions: Penetration of fire-rated walls and partitions shall be sealed as specified in Section 07270 FIRESTOPPING.

3.1.2.12 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.2.13 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, 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.

3.1.3 Water Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the

jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.1.3.1 Directional Changes

Changes 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 weep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.1.3.2 Functional Requirements

Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded.

3.1.3.3 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.3.4 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.3.5 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.3.6 Flexible Pipe Connectors

Preinsulated flexible pipe connectors shall be attached to other components in strict 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 flexible

pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.3.7 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.3.8 Grooved Mechanical Joints

Grooves shall be prepared in accordance with 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 pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.1.4 Directional Changes

Changes 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 centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

3.1.5 Functional Requirements

All piping shall be installed 1/2 inch per 10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

3.1.6 Valves

a. Stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. All valves except check valves shall be identified with a brass or aluminum tag not less than 1-3/8 inchin diameter, correctly stamped to explain the valve function, and with a number for identification. Tags shall be secured to the valve with No. 12 AWG copper wire.

b. Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches.

The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.1.7 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.1.8 Strainers

Strainers shall be provided immediately ahead of all solenoid valves and expansion devices. Strainers may be an integral part of the expansion valve.

3.1.9 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. The filter dryer shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. The filter dryer shall be installed such that the filter dryer can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Filter dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.1.10 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers.

3.1.11 Discharge Line Oil Separator

Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

3.1.12 Accumulator

Accumulators shall be provided in the suction line to each compressor.

3.2 Mechanical Room Ventilation

Mechanical rooms containing a central refrigerated air-conditioning system shall be ventilated to the outdoors. The ventilation system shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3 Field Applied Insulation

Field applied insulation other than that specified for water boxes and headers shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.4 Factory Applied Insulation

3.5 Liquid Coolers

Liquid coolers (including chilled water headers or boxes), which may have factory or field applied insulation, shall be insulated with unicellular plastic foam. Insulation shall be not less than 3/4 inch thick or have a maximum thermal conductivity of 0.28 Btu/(hr.)(sq. ft.)(degree F.))). In lieu of the above insulation, a 2 inch thickness of urethane foam may be used. Urethane foam shall be completely covered and sealed with a sheet metal jacket not lighter than 20 gauge. Insulation on heads of coolers shall be constructed to provide easy removal and replacement of heads without damage to the insulation.

3.6 TESTS

3.6.1 Field Tests

Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.6.1.1 Water Pipe Testing

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 shall be allowed. Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

3.6.1.2 Refrigerant Pipe Testing

a. Refrigerant Leakage Test: After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a refrigerant leakage test. The refrigerant leakage test shall be done with dry nitrogen before any refrigerant pipe is insulated or covered. High and low side of the refrigerant system shall be tested for the minimum refrigerant leakage test pressure specified in ASHRAE 15, for the refrigerant employed in the system. System shall be proved tight and free of leaks by allowing the refrigerant leakage test pressure to remain on the system for 24 hours with no drop in pressure. The initial test pressure and surrounding air temperature will be recorded. After the 24 hour hold period, the final system pressure and surrounding air temperature will be recorded. A correction of 0.3 psishall be allowed for each degree F change in the initial and final temperature of the surrounding air, plus for an increase and minus for a decrease. The system shall have passed the refrigerant leakage test if the corrected final system pressure is

equal to the initial system test pressure. If the pressures are not equal, the leaks shall be located and repaired.

b. Refrigerant Leaks: To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking or remelting and adding more brazing material will not be acceptable. After leak repairs have been made, the refrigerant leakage test shall be conducted again.

c. Evacuation Test: After the foregoing tests have been satisfactorily completed and the pressure relieved, entire system shall be evacuated to an absolute pressure of 300 microns. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. Vacuum line shall be closed, and the system shall stand for 1 hour. After this period, the absolute pressure shall not exceed 500 microns. If the pressure rises over 500 microns, the system shall continue to be evacuated until the system reaches 300 microns and can stand for 1 hour with the vacuum line closed without the absolute pressure rising over 500 microns. During evacuation, pressures shall be recorded by a thermocouple type, electronic type, or a calibrated-micron type gauge.

3.6.1.3 Cooling Tower Tests

After cooling tower has been found acceptable under the visual and dimensional examination, a field performance test shall be performed in accordance with ASME PTC 23 or CTI ACT 105. The electromagnetic interference suppression testand the salt spray test is not required. The cooling tower test shall be performed in the presence of a Government representative.

3.6.2 System Performance Tests

After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's startup representative experienced in system startup and testing, at such times as directed. Tests shall cover a period of not less than 15 days for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified.

3.6.3 Condenser Water Quality Tests

The condenser water shall be analyzed a minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	_____
Temperature	_____ degrees F.
Silica (SiO2)	_____ ppm (mg/1)
Insoluble	_____ ppm (mg/1)
Iron and Aluminum Oxides	_____ ppm (mg/1)
Calcium (Ca)	_____ ppm (mg/1)
Magnesium (Mg)	_____ ppm (mg/1)

Sodium and Potassium (Na and K)	_____ ppm (mg/1)
Carbonate (HCO3)	_____ ppm (mg/1)
Sulfate (SO4)	_____ ppm (mg/1)
Chloride (Cl)	_____ ppm (mg/1)
Nitrate (NO3)	_____ ppm (mg/1)
Turbidity	_____ unit
pH	_____
Residual Chlorine	_____ ppm (mg/1)
Total Alkalinity	_____ epm (meq/1)
Non-Carbonate Hardness	_____ epm (meq/1)
Total Hardness	_____ epm (meq/1)
Dissolved Solids	_____ ppm (mg/1)
Fluorine	_____ ppm (mg/1)
Conductivity	_____ micrmho/cm

3.7 INSPECTIONS

At the conclusion of the one year period, the cooling tower and condenser shall be inspected for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturers recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.8 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative shall be provided for 365 days. The representative shall advise on the following:

a. Hermetic machines:

(1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 microns.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

b. Open Machines:

(1) Erection, alignment, testing, and dehydrating.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

c. Absorption Units:

(1) Testing and evacuation.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

3.9 CLEANING AND ADJUSTING

3.9.1 Piping

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all 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 all 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.

3.9.2 Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. 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.

3.10 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 40 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance along with Chiller disassembly and assemble manuals for periodic maintenance operations.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15652

COLD STORAGE REFRIGERATION SYSTEMS

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 420	(1989) Unit Coolers for Refrigeration
ARI 450	(1993)& Water-Cooled Refrigerant Condensers, Remote Type
ARI 460	(1994) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 490	(1989) Remote Mechanical-Draft Evaporative Refrigerant Condensers
ARI 495	(1993) Refrigerant Liquid Receivers
ARI 510	(1993) Ammonia Compressor Units
ARI 520	(1990) Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units
ARI 700	(1993) Specifications for Fluorocarbon and Other Refrigerants
ARI 710	(1986) Liquid-Line Driers
ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1994) Thermostatic Refrigerant Expansion Valves
ARI 760	(1994) Solenoid Valves for Use With Volatile Refrigerants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 53	(1995a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105	(1996) Forgings, Carbon Steel, for Piping Components
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 126	(1993) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 153	(1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 181	(1995b) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 197	(1987; R 1992) Cupola Malleable Iron
ASTM A 234	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 278	(1993) Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 334	(1991) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 653	(1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 209	(1995) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1995a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 280	(1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet & Tubular Form

ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM F 104	(1993) Nonmetallic Gasket Materials

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

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 17	(1986; R 1990) Method of Testing for Capacity Rating of Thermostatic Refrigerant Expansion Valves
ASHRAE 23	(1993) Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units
ASHRAE 34	(1994) Number Designation and Safety Classification of Refrigerants
ASHRAE 64	(1995) Methods of Testing Remote Mechanical-Draft Evaporative Refrigerant Condensers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe threads, General Purpose (Inch)
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1995) 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	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze

	Welding
AWS BRH	(1991) Brazing Manual
AWS D1.1	(1994) Structural Welding Code - Steel

INTERNATIONAL INSTITUTE OF AMMONIA REFRIGERATION (IIAR)

IIAR 2	(1992) Equipment, Design, and Installation of Ammonia Mechanical Refrigeration Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993; Rev 1-1993; Rev 2-1995) Motors and Generators
NEMA MG 2	(1989; R 1992) Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators

UNDERWRITERS LABORATORIES (UL)

UL 207	(1993; Rev through Mar 1995) Refrigerant-Containing Components and Accessories, Nonelectrical

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

Refrigeration System; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of a particular component, shall be highlighted to show brand name, model number, size, options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract requirements. Data shall be provided for each specified component. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's

recommendations.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of 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, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

SD-04 Drawings

Refrigeration System; GA.

Drawings shall provide adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

(1) Equipment layouts which identify assembly and installation details.

(2) Piping layouts which identify valves, fittings, pipe sizes, and pipe slopes. Changes to the design in any way shall be clearly identified and explained.

(3) Plans and elevations which identify clearances required for maintenance and operation.

(4) Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

(5) Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

(6) Details of supports, if other than those indicated, including loadings and type of frames, brackets, stanchions, or other supports.

(7) Automatic temperature control diagrams and control sequences.

(8) Installation details which include the amount of factory set superheat and corresponding refrigerant pressure/temperature.

SD-06 Instructions

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

SD-07, Schedules

Tests; FIO.

A letter, at least 10 working days in advance of each test, advising the Contracting Officer of the test. Individual letters shall be submitted for the refrigerant system, the system performance, and the acceptance tests. Each letter shall identify the date, time, and location for each test.

Demonstrations; GA.

A letter, at least 14 working days prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-08 Statements

Qualifications; GA.

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc. and a list of the names of qualified welders and their identification symbols.

Verification of Dimensions; FIO.

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-09 Reports

Tests; GA.

Six copies of each test containing the information described below in bound 8-1/2 by 11 inchbooklets. Individual reports shall be submitted for the refrigerant system, the system performance, and the acceptance tests.

(1) The dates the tests were started and completed.

(2) A list of equipment used, with calibration certifications.

(3) Initial test summaries.

(4) Repairs/adjustments performed.

(5) Final test results and comments.

SD-13 Certificates

Refrigeration System; FIO.

Where the system, components, or equipment are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate 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 may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organizations; FIO.

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3 QUALIFICATIONS

[Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record.] [Welding and nondestructive testing procedures shall be as specified in Section 15052 WELDING PRESSURE PIPING.] Structural members shall be welded in accordance with Section 05055 WELDING, STRUCTURAL.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper protection and care of material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

The Contractor shall investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Equipment, ductwork, and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

1.6 OPERATION AND MAINTENANCE MANUALS

1.6.1 Operation Manual

Six complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown shall be provided. The booklets shall include the manufacturer's name, model number, parts list, and a brief description of

all equipment and their basic operating features.

1.6.2 Maintenance Manual

Six complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide shall be provided. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's 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. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including compressors, condensers, unit coolers, receivers, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor

terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. Unit control panels and electrical components shall be mounted in a NEMA ICS 6, Type 1 or 3A enclosure.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 34. Refrigerants shall meet the requirements of ARI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential of less than or equal to 0.05. Refrigerant systems shall be charged in accordance with manufacturer's recommendations, including types and quantities of refrigerant and lubricating oil. Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the system performance testing period. Following the satisfactory completion of the performance testing, the oil shall be drained and replaced with a second charge.

2.4.2 Gaskets

Gaskets shall conform to ASTM F 104 classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.4.3 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall conform to ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies, in accordance with ASTM A 307.

2.4.4 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69 and all pieces shall be new.

2.4.5 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.4.6 Pressure and Vacuum Gauge

Gauge shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle third of the range.

2.4.7 Temperature Gauges

Industrial duty thermometers shall be provided for the required temperature range. Thermometers shall have a Fahrenheit scale on a white face. The pointer shall be adjustable.

2.4.7.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube.

2.4.7.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.4.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.4.7.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.4.8 Unicellular Plastic Foam

Unicellular plastic foam shall be in accordance with ASTM C 534, Type I.

2.4.9 Bird Screen

Screen shall be square mesh, plain weave, 2 by 2 mesh, 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.4.10 Galvanized Steel Sheet

ASTM A 653, Coating Class G-90, lockforming quality.

2.4.11 Galvanized Steel Shapes

ASTM A 36 to commercial weight of not less than 2.3 ounces per square foot of single side surface.

2.4.12 Aluminum Sheets and Plates

ASTM B 209, Alloy 3003, H-14. Sheets shall be lockforming quality.

2.4.13 Aluminum Shapes

ASTM B 221, Alloy 6061, T-5 and T-6.

2.5 COMPRESSOR/CONDENSING UNITS

Compressorand Condensing unit shall be factory fabricated, assembled, tested, packaged, and ready for full capacity operation after terminal point connection and field charging with operating fluids. Unit shall

conform to ARI 520, ASHRAE 23, and ASHRAE 15. Ammonia systems shall also conform to IIAR 2 and ARI 510.

2.5.1 Compressor

Compressors shall be selected for maximum energy efficiency and operating reliability. Rotating parts shall be statically and dynamically balanced at the factory to eliminate vibration at both partial and full load conditions. Compressors shall be capable of continuous operation at lowest partial load. Compressor over 10 hp shall start from rest unloaded. Compressor unloaders shall not be used when saturated suction temperatures are below 25 degrees F.

2.5.1.1 Construction

Compressors 2 hp and less shall be the accessible, sealed reciprocating type of either the open or hermetic design. Compressors above 2 hp shall be the accessible hermetic, sealed reciprocating type. Compressors shall have integrally cast housings of close-grained iron with an oil-level bull's eye, cast cylinder heads, cast aluminum or forged steel connecting rods, and cast iron or forged steel crankshafts. Main bearings shall be the sleeve-insert type. Ammonia service compressor cylinder blocks and heads shall be fitted with self-draining water- or refrigerant-cooled jackets where recommended by the manufacturer. Water jackets shall be freeze protected.

2.5.1.2 Lubrication System

The lubrication system on compressors 3 hp or larger shall be the forced-feed, positive-displacement type with oil strainer. The oil pump shall be reversible. Lube oil pressure gauge and failure switch shall be provided for forced-feed lubrication type compressors. Compressor shall be provided with an adjustable oil level regulator with a shutoff valve on each inlet to allow removal of individual compressors without shutting down the entire system.

2.5.1.3 Motor

Compressor motors shall be of the constant-speed, squirrel-cage, induction, hermetically sealed, low-starting-current, high-torque type. Motors shall be furnished with magnetic NEMA across-the-line motor starters in general purpose enclosures.

2.5.1.4 Compressor Components

Compressor systems shall include, as a minimum, the following:

a. Compressors 1-1/2 hp and larger shall be provided with double seated suction and discharge service valves each with gauge ports.

b. Compressors 5 hp or larger shall have a solid state oil pressure safety switch with a manual reset with auxiliary alarm contacts. Time delay duration shall be as recommended by compressor manufacturer.

c. Each compressor shall have a single low-pressure control with automatic reset and adjustable cut-in and cut-out range. Braided steel lines shall be used.

d. Each compressor shall have a single high-pressure control with manual reset, adjustable set-point, and auxiliary alarm contact. Braided steel lines shall be used.

e. A compressor cooling fan shall be provided for each compressor which operates below 0 degrees Fsaturated suction temperature.

f. Each compressor shall have a crankcase oil heater. Control of the heaters shall be as recommended by the compressor manufacturer.

g. When required by the compressor manufacturer, compressors shall be provided with a hot-gas muffler to reduce vibration and noise from pulsations.

2.5.2 Base Mounting

Compressor and accommodating components shall be factory mounted on a rigid, steel base, where indicated. Compressor assembly shall be mounted with spring type vibration isolation mountings selected to limit transmissibility of imbalanced forces at lowest equipment rpm to 5 percent.

2.5.3 Unit Accessories

. Accessories to be used in combination with each unit shall be provided as indicated and shall be in accordance with paragraph REFRIGERANT ACCESSORIES. Outdoor condensing units shall be provided with weather hoods.

2.5.4 Electrical Controls

Electrical controls for the unit shall be in accordance with paragraph ELECTRICAL WORK and include at a minimum main and branch circuit overload protective devices compensated for ambient temperatures as recommended by the manufacturer; status pilot lights; compressor safety, operating and capacity controls; defrost controls; local and remote audible and visual alarms with provisions to silence; short cycling control with lock-out timer; time delay for sequenced compressor starts; and remote component interface.

2.6 CONDENSER, AIR-COOLED

Unit shall be factory fabricated and tested, packaged, self-contained and ready for full capacity operation after terminal point connections. Unit shall conform to ARI 460. Split systems shall be manufacturer matched units. Fans shall be propeller or centrifugal type as specified in paragraph Fans. Fan motors shall have [open] [dripproof] [totally enclosed] [explosion proof] enclosures. Electrical controls for the unit shall be in accordance with paragraph ELECTRICAL WORK shall include a control transformer and shall be capable of interfacing with local and remote components.

2.6.1 Unit Casing

Casing shall be weatherproof and enclose all unit components. Structural members and sheet metal for the unit casing shall be constructed of galvanized steel or aluminum. Casing shall be fitted with lifting provisions, access panels, removable legs, and fan and heat rejection coil guards and screens.

2.6.2 Condenser Coil

Coil shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coils shall be protected with minimum 3 mils thick phenolicorvinyl coating. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ASHRAE 15 at the factory and shall be suitable for the working pressure of the installed system. Condenser may be used for refrigerant storage in lieu of separate receiver, provided that storage capacity is 20 percent in excess of fully charged system. Coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.7 UNIT COOLERS

Unit shall be forced circulation type, factory fabricated, assembled and tested, and packaged in accordance with ARI 420. Ammonia systems shall conform to IIAR 2. Fan shall be the centrifugal propeller type in accordance with paragraph Fans. Motors shall have opendripproof enclosures.

2.7.1 Construction

Casing shall be Type 300 stainless steel, aluminum, mill galvanized or hot-dip galvanized steel after fabrication. Zinc-coated carbon steel shall be provided with protective coating. Coils shall have copper tubes and aluminum fins. Drain pan shall be watertight, corrosion resistant. Drainage piping for units in spaces maintained at less than 35 degrees F shall be insulated.

2.7.2 Defrosting

Unit shall be defrosted with ambient space air. Defrost system shall be controlled by demand defrost controller. Controller shall include an automatic, solid-state circuitry to initiate defrost cycle based on sensing adjustable temperature difference of air moving across coil in direct proportion to frost build-up; thermostat to terminate defrost; adjustable lockout to prevent initiation of defrost during pull-down after defrost cycle; manual override switch; and status pilot light.

2.8 CONTROLS AND INSTRUMENTS

Refrigeration system controls, instruments and devices shall be industrial quality, and shall conform to applicable requirements of ASHRAE 15. Fluid containing surfaces shall be rated for the service and constructed of materials suitable for the fluid. Component electrical rating shall be 120 volt ac, unless otherwise indicated and shall be suitable for imposed loads. Ammonia systems shall conform to IIAR 2. Copper, copper alloy and white metals, except aluminum, shall not be used for ammonia service.

2.8.1 Refrigeration System Alarms

2.8.1.1 Audible Alarm

Audible alarm shall be surface-mounted, 4 inchvibrating bell type suitable for indoor or outdoor service.

2.8.1.2 Visual Alarm

Visual alarm shall be pilot light type. Alarm shall be 100 watt, incandescent, vapor-tight fixture with cast metal guard and [red] [green] [amber] lens.

2.8.2 Controllers

2.8.2.1 Differential Pressure Controller

Differential pressure controller shall be provided with high and low pressure sensing ports and shall be direct or reverse acting with calibrated proportional band and set point adjustments. Controller output shall be low voltage electric, proportional to the pressure differential sensed. Local and remote set point adjustments shall be included. Range shall meet system requirements.

2.8.2.2 Differential Temperature Controller

Differential temperature controller shall be provided with two filled, remote sensing bulbs connected to the controller by [capillary] [armored capillary] tubing. Controller shall be direct or reverse acting with calibrated proportional band and set point adjustments. Controller output shall be low voltage electric, proportional to the temperature differential sensed. Provisions for local and remote set point adjustments shall be included. Range shall be as required to meet system requirements. For immersion service, thermal wells shall be provided.

2.8.3 Pilot Lights

Panel-mounted pilot lights shall be NEMA Class 12 oil-tight, push-to-test transformer for 6-8 Vac lamps. Lamps shall be replaceable by removal of color cap. Cap color shall be as indicated.

2.8.4 Programmer, Demand Control/Load

Programmer shall be fully automatic, fail safe, field programmable, solid-state, demand control and load programmable for 16 loads. Demand control portion shall monitor power consumption by wattorcurrent transducers. Set point shall be field adjustable with adjustable dead band. Load shedding sequence time and differential time between load shedding shall be adjustable. Contacts shall store alarm condition. Meter readout shall indicate demand deviation from set point. Load profile recorder shall be strip-chart type with readily discernable event record. Load programmer shall permit programming of on/off time of each load for any time element within a week and shall equalize power demand over a preset time cycle. System shall include input override and time cycle accelerator for checkout. Alarm condition, status of all loads and time period shall be visually indicated and recorded. Each load shall include a H-O-A toggle switch. Alarm provisions shall include relay contacts for external, remote alarm functions and test provisions. Override thermostat shall be provided to restore shedded loads indicated. Control panel enclosure shall be NEMA ICS 6, Type 1, surface mounted type with key lock. Load profile recorder shall be flush panel mounted type. Load relays shall be plug-in type with critical load failure in "on" mode and contacts rated for pilot duty at 120 volt ac. Load shedding position switches shall shed loads on a first shed/last restore basis and remove loads from system logic for shedding cycle. Time clock shall be fitted with spring motor to maintain time in event of power failure.

2.8.5 Switches, Fluid Service

Switches shall be field adjustable SPDT type and shall have NEMA ICS 6, Type 1 enclosure with operating range specified or indicated. Circuits shall be as required for the applicable functions.

2.8.5.1 Air Flow Switch

Air flow switch shall have a service pressure range of 0.12 to 10 inches wg.

2.8.5.2 Water-Flow Switch

Water flow switch shall have a body rating suitable for the service, field-adjustable activating flow rate, and a pressure drop not in excess of 2 psi at maximum flow rate.

2.8.5.3 Pressure Switch

Pressure switch shall be factory set, one or two stage as indicated, with adjustable operating and differential pressure. Bourdon tube inlet shall be fitted with damper screw adjustment.

2.8.5.4 Differential Pressure Switch

Differential pressure switch shall be factory set, provided with high and low sensing ports, one or two stages and adjustable differential range and pressure.

2.8.5.5 Temperature Switch

Temperature switch shall be factory set, provided with [capillary] [armored capillary] tubing and filled sensing system, one or two stages as indicated, and operating adjustable differential range. For immersion service, thermal wells shall be provided.

2.8.5.6 Differential Temperature Switch

Differential temperature switch shall be factory set, provided with two separate capillary systems, one or two stages, and adjustable differential range and temperature. For immersion service, thermal wells shall be provided.

2.8.6 Push-Button Stations

Stations shall be NEMA Class 12 oil-tight, momentary or maintained-contact type, as indicated. Start push-buttons shall have a fully guarded or flush black operator button. Stop push-buttons shall have an unguarded or extended red operator button.

2.8.7 Selector

Switches shall be NEMA Class 12 oil-tight, momentary or maintained contact type, as indicated, with standard operator.

2.9 HEAT RECOVERY DEVICES

2.10 REFRIGERANT LEAK DETECTOR

Refrigerant leak detector shall be a halogen-specific type detector. Detector shall be appropriate for the refrigerant in use. Detector shall be specifically designed for area monitoring. Detector shall have an adjustable sensitivity such that it can detect refrigerant at or above 3 ppm. Detector shall be capable of energizing the local mechanical ventilation system and initiating an audible and visible alarm upon detecting a refrigerant level greater than 10 ppm.

2.11 SIGNS

Metal signs shall be provided having letters not less than 1/2 inch in height designating the main shutoff valves to each refrigerant vessel, the electrical control of the refrigeration equipment, and the pressure limiting device.

2.12 POWER TRANSMISSION COMPONENTS

Fan and open compressor drives shall be in accordance with the manufacturer's published recommendations, except as otherwise specified. Horsepower rating of V-belt drive shall be based on maximum pitch diameter of sheaves. Compressors shall be fitted with fixed sheaves and drives with a minimum service factor of 1.5. Where the number of unit starts exceeds 8 per 24 hours, add 0.1 to the required drive service factor. Sheaves shall be statically and dynamically balanced, machined ferrous metal, bushing type, secured by key and keyway. Pitch diameter of fixed pitch sheaves and adjustable sheaves, when adjusted to specific limits, shall be not less than that recommended by NEMA MG 1. Adjustable sheaves shall be selected to provide the required operating speed with the sheave set at mid-point of its adjustment range. The adjustment range for various size and type belts shall be 16 percent minimum for classical section belts and 12 percent minimum for narrow section belts. Belt drive motors shall be provided with slide rail or equivalent adjustable motor bases. Direct drive couplings for motors rated less than 3 hp shall be manufacturer's standard. Direct drive couplings for motors rated greater than 3 hp shall be elastomer-in-shear type. Each drive shall be independent of any other drive. Drive bearings shall be protected with water slingers or shields. V-belt drives shall be fitted with guards where exposed to contact by personnel.

2.13 DRAIN AND MISCELLANEOUS PIPING

Piping, fittings, valves and accessories for drain and miscellaneous services shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

2.14 PIPING AND FITTINGS, FLUOROCARBONS

Piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5, except as specified.

2.14.1 Steel Pipe

Steel pipe for fluorocarbon service shall conform to ASTM A 53, Schedule 40, Type E or S, Grades A or B. Type F pipe shall not be used.

2.14.2 Steel Pipe Joints and Fittings

Joints and fittings shall be steel butt-welding, socket-welding, or malleable iron threaded type. Pipe shall be welded except that joints on lines 2 inches and smaller may be threaded. Threads shall be tapered type conforming to ASME B1.20.1. The malleable iron threaded type fitting shall be of a weight corresponding to adjacent pipe. Flanges and flange faces of fittings shall be tongue-and-groove type with gaskets suitable for the refrigerant used; size 1 inch and smaller shall be oval, two-bolt type; size above 1 inch, up to and including 4 inch, shall be square four-bolt type; and sizes over 4 inch shall be round.

2.14.3 Steel Tubing

Steel tubing for refrigeration service shall be in accordance with ASTM A 334, Grade 1. Tubing with a nominal diameter of 3/8 inch or 1/2 inch shall have a wall thickness of 0.049 inches. Tubing with a nominal diameter of 3/4 inch through 2 inches shall have a wall thickness of 0.065 inches. Tubing with a nominal diameter of 2-1/2 through 4 inches shall have a wall thickness of 0.095 inches. Steel tubing shall be cold-rolled, electric-forged, welded-steel. One end of the tubing shall be provided with a socket. Steel tubing shall be cleaned, dehydrated, and capped.

2.14.4 Steel Tubing Joints and Fittings

Joints and fittings shall be socket type provided by the steel tubing manufacturer.

2.14.5 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared.

2.14.6 Copper Tube Joints and Fittings

Copper tube joints and fittings shall be flare joint type with short-shank flare, or solder-joint pressure type. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings will not be allowed for brazed joints.

2.15 PIPING AND FITTINGS, AMMONIA

At system application conditions to minus 20 degrees F piping system components including but not limited to piping, flanges, fittings, valves, and all accessories including flange bolts, nuts, and bolt patterns shall conform to ASME B31.5. Unions shall not be used in this piping system. Other requirements are as follows:

2.15.1 Pipe, Black Carbon Steel

ASTM A 53, Type E or S, Grade A or B, Schedule 40, standard weight, or Schedule 80, or extra strong as required.

2.15.2 Fittings, Threaded

ASTM A 105 or ASTM A 181 and ASME B16.11, 3000 psig WOG, forged steel.

2.15.3 Fittings, Welding

In sizes 1 inch and under, ASTM A 105 or ASTM A 181, and ASME B16.11, 3000 psig WOG, forged steel, socket weld, bored to match pipe wall thickness. Sizes exceeding 1 inch shall be wrought carbon steel, long radius, butt-weld, to match pipe wall thickness, conforming to ASTM A 234 and ASME B16.9.

2.15.4 Fittings, Flanged

High strength gray cast iron conforming to ASTM A 126, Class B, or ASTM A 278, Class 40, or malleable iron conforming to ASTM A 197, manufacturer's standard long radius. Flange configuration shall be as specified for flanges.

2.15.5 Flanges

Forged carbon steel conforming to ASTM A 181, with industry standard tongue and groove face finish, 2-bolt oval shape in sizes 3/4 inch and under; 4-bolt square shape in sizes 1 inch through 4 inches; round shape in sizes 5 inches and larger; weld neck, except in sizes 2 inches and under socket weld is acceptable. Threaded connection flanges are not acceptable. Flange template dimensional and shape criteria shall be identical and/or interchangeable with valve flanges specified in paragraph VALVES, AMMONIA AND FLUOROCARBON.

2.16 VALVES, FLUOROCARBON

Valves shall be pressure and temperature rated for contained refrigerant service and shall comply with ASME B31.1. Metals of construction shall be of Type 300 stainless steel, or ferrous or copper based. Atmosphere exposed valve stems shall be stainless steel or corrosion resistant metal plated carbon steel. Valve body connections shall be brazed or welded socket, flanged or combination thereof. Threaded connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Valves shall be suitable for or fitted with extended copper ends for brazing in-place without disassembly. Ferrous body valves shall be fitted with factory fabricated and brazed copper transitions. To minimize system pressure drops, where practicable, globe valves shall be angle body type, and straight line valves shall be full port ball type. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by manufacturer. Valves shall be cleaned and sealed moisture-tight.

2.16.1 Refrigerant-Stop Valves

Stop valves shall be designed for use with the refrigerant used and shall have pressure ratings compatible with system working pressures encountered. Gate valves will not be acceptable.

2.16.1.1 Fluorocarbon Service

Valves 5/8 inch and smaller shall be handwheel operated, straight or angle, packless diaphragm globe type with back-seating stem, brazed ends, except where SAE flare or retained seal cap connections are required. Valves larger than 5/8 inch shall be globe or angle type, wrench operated with ground-finish stems, or ball valves, packed especially for refrigerant

service, back seated, and provided with seal caps. Refrigerant isolation and shutoff valves shall have retained or captive spindles and facilities for tightening or replacement of the gland packing under line pressure as applicable. Stop valves shall have back-seating plated steel stem, bolted bonnet in sizes 1 inch OD and larger, integral or flanged transition brazed socket. Valves, in sizes through 2-1/2 inches shall be end-entry body assembly, full-port, floating ball type, with equalizing orifice fitted chrome plated ball, seats and seals of tetrafluoroethylene, chrome plated or stainless steel stem, and seal cap. In sizes 4 inch IPS and larger, and in smaller sizes where carbon steel piping is used, valve bodies shall be tongue and groove flanged and complete with mating flange, gaskets and bolting for socket or butt-weld connection. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.16.2 Check Valve

Valve shall be designed for service application, spring-loaded type where required, with resilient seat and with flanged body in sizes 1/2 inch and larger. Valve shall provide positive shutoff at [1-1/2] [2] [3] psi differential pressure.

2.16.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and shall be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moistureproof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.16.4 Expansion Valves

Expansion valves shall conform to the requirements of ARI 750. Valve shall be of the diaphragm and spring type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and liquid shall remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads. In direct-expansion unit cooler applications, thermostatic expansion valve discharge shall be through distributor and distributing tubes or through a single tube outlet leading

to an orificed header provided by the unit cooler manufacturer, supplying an evaporator coil with not more than four circuits. Distributor orifices shall be sized for application conditions and distributor shall be provided by the thermostatic expansion valve manufacturer as a matched combination to suit evaporator coil circuitry. Where indicated, distributor tube shall be fitted with side inlet for hot gas bypass or defrosting. In single compressor/evaporator combinations, where compressor capacity control is only by on-off cycling, and if recommended by the compressor manufacturer, thermostatic expansion valve shall be furnished with a small bleed passage between inlet and outlet to facilitate equalization of high and low side during off cycle.

2.16.5 Safety Relief Valve

Valve shall be the [two-way] [three-way] type. Single type valves shall be used only where indicated. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

2.16.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring power assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.16.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall conform to ARI 720.

2.16.8 Service Gauge Fittings

Fittings shall be designed for connecting a pressure gauge with a hose fitting. These fittings shall be provided in the suction pipe at each unit cooler.

2.17 REFRIGERANT ACCESSORIES

2.17.1 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated anti-friction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Forward curved fan wheels shall be limited to 10 inches.Direct-drive fan

motors shall be of the multiple-speed variety. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive shall be independent of any other drive. Propeller fans shall be direct-drive drive type with fixed pitch blades. V-belt driven fans shall be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated anti-friction block-type bearings, or permanently lubricated ball bearings.

2.17.2 Pressure Vessels

Pressure vessels shall conform to ASME BPV VIII Div 1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, pressure components shall be tested at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces shall be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed. Where service temperatures below 20 degrees F are encountered, materials of construction shall be low temperature alloy carbon steel.

2.17.2.1 Hot Gas Muffler

Unit shall be selected by the manufacturer for maximum noise attenuation. Units rated for 30 tons capacity and under may be field tunable type.

2.17.2.2 Liquid Receiver

Receiver shall be designed, filled, and rated in accordance with the recommendations of ARI 495, except as modified herein. Receiver shall be sized so that it is never filled beyond 80 percent of its total capacity. The remaining 20 percent shall allow for liquid expansion. Receiver shall be provided with a relief valve of capacity and setting in accordance with ASHRAE 15. Receiver shall be fitted to include an inlet pipe; an outlet drop pipe with oil seal and oil drain where necessary; two bulls-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; a float switch column; purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be factory insulated with not less than 1 inch thick, 100 percent adhesive bonded, vaportight, flexible, closed-cell elastomer and finished with two coats of solvent base PVC protective coating or 0.016 inch thick aluminum jacket.

2.17.2.3 Oil Separator

Separator shall be the high efficiency type, provided with removable flanged head for ease in removing float assembly and removable screen cartridge assembly. Pressure drop through a separator shall not exceed 10 psi during the removal of hot gas entrained oil. Connections to compressor shall be as recommended by the compressor manufacturer. Separator shall be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass, filter for removal of all particulate sized 0.01 mm and larger, and strainer.

2.17.2.4 Oil Reservoir

Reservoir capacity shall equal one charge of all connected compressors. Reservoir shall be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header shall be provided with a 5 psipressure differential relief

valve. Reservoir shall be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

2.17.3 Condenser and Head Pressure Control

Unit shall be capable of automatically operating without daily or seasonal adjustments in ambient temperature of 97 degrees F. Control shall be set for refrigerant condensing temperature of 95 degrees F. Controls shall permit proper operation of system with proper differential pressure across the thermostatic expansion valve. Control system shall be based on sensing of actual condensing pressure in conjunction with manufacturer's standard method of subcooling the saturated refrigerant. Controls shall be set to produce a minimum 5 degrees F subcooling. Subcooling circuit shall be liquid sealed. Air volume control will not be acceptable for ambient conditions below 35 degrees F. Necessary accessories shall be provided to maintain safe compressor discharge temperatures for low temperature systems.

2.17.4 Filter Driers

Driers shall conform to ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psig.

2.17.5 Sight Glass and Liquid Level Indicator

2.17.5.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

2.17.5.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.17.5.3 Bulls-Eye and Inline Sight Glass Reflex Lens

Bulls-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

2.17.5.4 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.17.6 Flexible Pipe Connectors

Connector shall be pressure and temperature rated for the service in

accordance with ASHRAE 15 and ASME B31.5. Connector shall be a composite of interior corrugated phosphor bronze or Type 300 series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.17.7 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y or angle pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than 10 times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.17.8 Brazing Materials

Brazing materials for refrigerant piping shall be in accordance with AWS A5.8, Classification BCuP-5.

2.17.9 Liquid and Suction Headers

Liquid and suction headers shall be provided on each multi-compressor system. Headers shall be sized according to manufacturer's recommendations. Each header shall be provided with service valves to permit servicing each unit cooler and forced circulation air coil. Each service valve shall have a gauge port which can be closed by back-seating the valve and a front seat which can close off the line connected to the manifold. Each service valve shall be provided with a removable, protective valve stem cap or cover.

2.17.10 Suction Accumulators

Accumulator shall be designed and installed within each suction header to provide a positive trap for liquid carry-over and to assure oil return to the compressors. An accumulator's internal liquid holding volume shall be at least 2 cubic feet. Design shall ensure that oil is not trapped in the accumulator.

2.18 FABRICATION

2.18.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 25 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.18.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 15190PAINTING, GENERAL.

2.18.2.1 Color Coding

Color coding for piping identification is specified in Section 15190 IDENTIFICATION OF PIPING.

2.18.2.2 Color Coding Scheme

A color coding scheme for locating hidden piping shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. The design, fabrication, and installation of the system shall conform to ASME BPV VIII Div 1 and ASME BPV IX as applicable. Where applicable, work shall be performed in accordance with ASHRAE 15 and IIAR 2 for ammonia systems.

3.1.1 Equipment

Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps and similar items. Compressors shall be isolated from the building structure. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.2 Building Surface Penetrations

Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53, [Schedule 30] [Schedule 20] [Standard weight]. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.1.2.1 Refrigerated Space

Refrigerated space building surface penetrations shall be fitted with sleeves fabricated from hand-lay-up or helically wound, fibrous glass reinforced polyester or epoxy resin with a minimum thickness equal to equivalent size Schedule 40 steel pipe. Sleeves shall be constructed with integral collar or cold side shall be fitted with a bonded slip-on flange or extended collar. In the case of masonry penetrations where sleeve is not cast-in, voids shall be filled with latex mixed mortar cast to shape of sleeve, and flange/external collar type sleeve shall be assembled with butyl elastomer vapor barrier sealant through penetration to cold side surface vapor barrier overlap and fastened to surface with masonry anchors.

Integral cast-in collar type sleeve shall be flashed with not less than 4 inches of cold side vapor barrier overlap of sleeve surface. Normally noninsulated penetrating round surfaces shall be sealed to sleeve bore with mechanically expandable seals in vapor tight manner and remaining warm and cold side sleeve depth shall be insulated with not less than 4 inches of foamed-in-place rigid polyurethane or foamed-in-place silicone elastomer. Vapor barrier sealant shall be applied to finish warm side insulation surface. Warm side of penetrating surface shall be insulated beyond vapor barrier sealed sleeve insulation for a distance which prevents condensation. Wires in refrigerated space surface penetrating conduit shall be sealed with vapor barrier plugs or compound to prevent moisture migration through conduit and condensation therein.

3.1.2.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07920 JOINT SEALING.

3.1.2.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and 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 troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproof Clamping Flange: 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. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproof clamping flange, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. 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/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The

Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameter.

3.1.2.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07270 FIRESTOPPING.

3.1.2.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.3 Access Panels

Access panels shall be provided for concealed valves, vents, controls, 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.

3.1.4 Refrigeration Piping

Unless otherwise specified, pipe and fittings installation shall conform to the requirements of ASME B31.5. Pipe shall be cut accurately to the measurements established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

3.1.4.1 Directional Changes

Changes 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 centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

3.1.4.2 Functional Requirements

Piping shall be sloped 1/2 inch per 10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

3.1.4.3 Brazed Joints

Brazing shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the

inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and shall not be sprung or forced.

3.1.4.4 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.4.5 Welded Joints

Welded joints in steel refrigerant piping shall be fusion welded. Changes in direction of piping shall be made with welded fittings only; mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. Branch connections shall be made with welding tees or forged welding branch outlets. Steel pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.4.6 Flanged Joints

Flanged joints shall be assembled square and tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled. When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, refrigeration equipment, control valves, and other similar items.

3.1.4.7 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.5 Piping Supports

Refrigerant pipe supports shall conform to ASME B31.5. 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.

3.1.5.1 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in-concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Material used for support shall be as specified in Section 05210STRUCTURAL STEEL.

3.1.6 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used and a parts shall be new.

3.1.6.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.6.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.6.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.6.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.6.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.6.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69. A support shall be installed not over 12 inches 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. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

3.1.6.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade,

and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.1.6.8 Pipe Guides

Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.6.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.6.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, then 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.

3.1.6.11 Multiple Pipe Runs

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.

3.1.7 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.8 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.1.9 Piping Identification

Each piping system and direction of fluid flow shall be identified in accordance with applicable provisions of ANSI A13.1 with color coded, water, moisture and broad-spectrum temperature resistant, plastic labels.

3.1.10 Manual Valves

Stop valves shall be installed on each side of each piece of equipment such as compressors, condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensible gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved. Drain valves shall be provided in bottom of risers and low points of ammonia piping.

3.1.11 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2 inches.The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb is installed in a vertical line, the bulb tubing shall be facing up.

3.1.12 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.1.13 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices and where indicated. Strainers may be an integral part of the expansion valve.

3.1.14 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located so that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations. A dryer shall be installed so that it can be isolated from the system, the isolated portion of the system evacuated, and the

filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.1.15 Sight Glass

A moisture indicating sight glass shall be installed in refrigerant circuits down stream of filter dryers and where indicated. Sight glass shall be full line size.

3.1.16 Thermometers

Thermometers shall be fitted with thermal well. Where test thermometer locations are indicated, only plugged thermal well shall be provided. Thermometers located within 5 feet of floor may be rigid stem type. Where thermal well is located above 5 feetabove floor, thermometer shall be universal adjustable angle type or remote element type to 7 feet above floor and remote element type where thermal well is 7 feet or more above floor. Thermometers shall be located in coolant supply and return or waste lines at each heat exchanger, at each automatic temperature control device without an integral thermometer, refrigerant liquid line leaving receiver, refrigerant suction line at each unit cooler, and where indicated or required for proper operation of equipment.

3.1.17 Flexible Connectors

Flexible metallic connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required. Connectors shall be provided in the suction and discharge lines on spring mounted compressors. Connectors shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.1.18 Power Transmission Components Adjustment

V-belts and sheaves shall be properly aligned and tensioned preliminary to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct-drive couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.1.19 Unit Cooler Drainage

Drain lines from product storage spaces maintained at 35 degrees F or lower shall be fitted with NSF approved connections and cleanout tee; shall be short as possible; shall not be trapped; and shall not be combined, unless all combined units are defrosted simultaneously and are controlled by a single timer. Drain lines may be combined in spaces maintained at nonfreezing temperatures after individual trapping. Drain lines shall be heat traced and insulated starting with drain pan fitting through the surface penetration into a nonfreezing space, a distance sufficient to ensure freedom from ice during defrost cycle. Drain line size shall be not less than drain pan outlet size. Drain line shall be pitched as shown, and not less than 1/4 inch per foot where not shown. Drain line heat tracing shall be as indicated. Hot gas supply line to the unit cooler shall be routed in contact with the drain line by banding with all stainless steel

worm drive hose clamps on not more than 12 inch centers and heat transfer area shall be increased by continuous tangential fillets of heat conducting paste.

3.1.20 Field Applied Insulation

Field applied insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.21 Factory Applied Insulation

Suction headers, liquid receivers, oil separators, and oil reservoirs shall be insulated with not less than 3/4 inch thick unicellular plastic foam as a standard manufacturer's process.

3.1.22 Framed Instructions

Framed instructions shall be framed under glass or laminated plastic and posted where directed. Instructions shall include equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The instructions shall be posted before acceptance testing of the system.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Utilities for testing shall be provided as specified in the SPECIAL CONTRACT REQUIREMENTS. Water and electricity required for the tests will be furnished by the Government. Material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform tests and procedures indicated. Field tests shall be coordinated with Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.2.1 Refrigerant System

After all components of the refrigerant system have been installed and connected, the entire refrigeration system shall be subjected to a pneumatic test as specified.

3.2.1.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.2.1.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage

test shall be at 10 psig with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ASHRAE 15 or IIAR 2 with a maximum test pressure of 25 percent greater than specified. Ammonia unloading lines shall be tested at 350 psig. Pressure above 100 psigshall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure shall be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding\brazing will not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.2.1.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 microns. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 microns after the 1 hour period, the system shall be evacuated again down to 300 microns and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 microns is maintained for a period of 1 hour without the assistance of a vacuum line. If, during the testing, the pressure continues to rise, the system shall be checked for leaks, repaired as required, and the evacuation procedure repeated. During evacuation, pressures shall be recorded by a thermocouple type, electronic type, or a calibrated-micron type gauge.

3.2.1.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure, and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors. Ammonia systems shall be tested with sulphur tapers. When charging and testing with ammonia under pressure, gas masks shall be provided.

3.2.1.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. The refrigerant shall not be discharged into

the atmosphere.

3.2.1.6 Contractor's Responsibility

The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. No more than 3 ounces of refrigerant shall be released to the atmosphere in any one occurrence. System leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government, including material, labor, and refrigerant, if the leak is the result of defective equipment, material, or installation.

3.2.2 System Performance

After the foregoing tests have been completed and before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's startup representative experienced in system startup and testing, at such times as directed. Tests shall cover a period of not less than 30 days for each system and demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Any refrigerant lost during the system startup shall be replaced. During the system performance tests, a report shall be maintained to document compliance with the specified performance criteria upon completion and testing of the system. The report shall include the following information at a minimum and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:
(1) The refrigerant used in the system.
(2) Condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Ambient, condensing and coolant temperatures.
(5) Running current, voltage and proper phase sequence for each phase of all motors.

c. The actual onsite setting of operating and safety controls.

d. Thermostatic expansion valve superheat-value as determined by field test.

e. Subcooling.

f. High and low refrigerant temperature switch set-points.

g. Low oil pressure switch set-point.

h. Defrost system timer and thermostat set-points.

i. Moisture content.

j. Capacity control set-points.

k. Field data and adjustments which affect unit performance and energy consumption.

l. Field adjustments and settings which were not permanently marked as an integral part of a device.

3.2.3 Acceptance Tests

Upon completion and prior to acceptance of the work, the Contractor shall perform pre-operational checkout, calibration and adjustment of system components to ensure and demonstrate stable, accurate, reproducible, energy efficient operation and optimum performance. Systems shall be operated for 48 hours after all major corrections have been made. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and system shall be retested. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. 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.

3.4 DEMONSTRATIONS

Demonstrations shall be conducted for the operating staff as designated by the Contracting Officer. Demonstrations shall start after the system is functionally completed but prior to final acceptance tests. Demonstrations shall be under the direction of a registered professional engineer who shall attest to installed systems and equipment compliance with the requirements of the contract documents. Demonstrations shall include operation of systems equipment and controls through normal ranges and sequences and simulation of abnormal conditions. Each device shall be caused to function manually and automatically in accordance with its purpose. The field instructions shall cover the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

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	(1993) Room Fan-Coil and Unit Ventilator
ARI 445	(1987; R 1993) Room Air-Induction Units
ARI 880	(1990) Air Terminals
ARI Guideline D	(1987) 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 (ABEMA)

ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.32	(1990) 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) Ferritic Malleable Iron Castings
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1994) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181	(1995b) Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 183	(1983; R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 193	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
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	(1994) 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	(1993) Seamless Copper Tube
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings of Ferrous Substrates
ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation

ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 1384	(1994) Corrosion Test for Engine Coolants in Glassware
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(1994) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1990 R 1994) Rubber Products in Automotive Applications
ASTM D 2466	(1994a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM E 84	(1994) 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 1993) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1993) 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 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	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1991) 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	(1989) 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 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1995) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IX	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) 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-01	(1993) 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	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1992) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1991) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev 1; Rev 2) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(1994) Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA-01	(1993) Fibrous Glass Duct Construction Standards

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-01	(1975) Accepted Industry Practice for Industrial Duct Construction
SMACNA-05	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA-06	(1995) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-10	(1985) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL-01	(1996; Supple) Building Materials Directory
UL-03	(1996; Supple) Electrical Construction Materials Directory
UL-05	(1996; Supple) Fire Resistance Directory (3 Vol.)
UL 94	(1991; R thru Apr 1995) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	(1996; Rev Oct 1996) Factory-Made Air Ducts and Air Connectors
UL 214	(1993) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1995) Fire Dampers
UL 586	(1996) High-Efficiency, Particulate, Air Filter Units
UL 705	(1994; Rev thru Mar 1996) Power Ventilators
UL 723	(1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994) Test Performance of Air Filter Units
UL 1995	(1995) Heating and Cooling Equipment

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

e. Energy Recovery Devices

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

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 1 inch and smaller shall be threaded; piping larger than 1 inch and smaller than 3 inches shall be either threaded, grooved, or welded; and piping 3 inches and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Welded Joints and Fittings

Welded fittings shall conform to ASTM A 234, and shall be identified with the appropriate grade and marking symbol. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11.

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181 and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Unions and Flanges

Dielectric unions shall have the tensile strength and dimensional requirements specified. Unions shall have metal connections on both ends threaded to match adjacent piping. Metal parts of dielectric unions shall be separated with a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation.

2.5.2.5 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 125 psig 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; or steel conforming to ASTM A 106, Grade B or ASTM A 53. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up

to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.5.3 Copper Tube

Copper tube shall conform to ASTM B 88, Type K or L.

2.5.4 Joints and Fittings For Copper Tube

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 10 feet or higher above the floor. Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.6 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71 and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.7 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.8 Ball Valves

Ball valves 1/2 inch and larger shall conform to [MSS SP-72] [or] [MSS SP-110], and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.5.9 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting

steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.10 Balancing Valves

Balancing valves 2 inches or smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves 1 inch or larger may be all iron with threaded or flanged ends. The valves shall have a square head or similar device and an indicator arc and shall be designed for 250 degrees F. Iron valves shall be lubricated, nonlubricated, or tetrafluoroethylene resin-coated plug valves. In lieu of plug valves, ball valves may be used. Plug valves and ball valves 8 inches or larger shall be provided with manual gear operators with position indicators. [In lieu of balancing valves specified] [Where indicated], automatic flow control valves may be provided to maintain constant flow, and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psig or 150 percent of the system operating pressure, whichever is the greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be appropriately increased. Where flow readings are provided by remote or portable meters, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter furnished with accessory kit as recommended by the automatic valve manufacturer shall be provided. Automatic flow control valve specified may be substituted for venturi tubes or orifice plate flow measuring devices.

2.5.11 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for pressure rating of piping system and furnished with threaded plugs or caps. Automatic air vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for pressure rating of piping system.

2.6 Strainers

Strainer shall be in accordance with ASTM F 1199, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 22 gauge[brass sheet,] [monel,] [corrosion-resistant steel,] with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3,300 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.7 Chilled Water System Accessories

Chilled water system accessories such as pumps, combination strainer and suction diffusers, and expansion tanks shall be as specified in Section 15650 CENTRAL REFRIGERATED AIR CONDITIONING SYSTEM.

2.8 Water Heating System Accessories

Water heating accessories such as expansion tanks shall be as specified in Section 15569 WATER HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH.

2.9 Glycol

The glycol shall be tested according to ASTM D 1384 and shall cause less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicon based inhibitors shall not be used. The solution shall be compatible with all wetted items within the system.

2.10 Backflow Preventers

Backflow preventers shall be according to Section 15400 PLUMBING, GENERAL PURPOSE.

2.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F, 230 degrees F for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.12 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter and shall have a range from 0 psig to approximately 1.5 times the maximum system working pressure.

2.13 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and shall have rigid stems with straight, angular, or inclined pattern.

2.14 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or

setscrews.

2.15 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.16 Expansion Joints

2.16.1 Slip Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for working temperature and pressure suitable for the application, but not less than 150 psig, and shall be according to applicable requirements of EJMA-01 and ASME B31.1. End connections shall be flanged or beveled for welding as indicated. Joint shall be provided with an anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 2 mils of hard chrome according to ASTM B 650. All joint components shall be suitable for the intended service. Initial setting shall be made according to the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall be not more than 5 feet from expansion joint except that in lines 4 inches or smaller, guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

2.16.2 Flexible Ball Joints

Flexible ball joints shall conform to EJMA-01 and ASME B31.1 and be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. The joint ends shall be threaded to 2 inches only, grooved, flanged, or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360 degree rotation. Balls and sockets shall be suitable for the intended service. The exterior spherical surface of carbon steel balls shall be plated with mils of hard chrome according to ASTM B 650. The ball type joints shall be designed and constructed according to EJMA-01 and ASME B31.1 where applicable. Where required, flanges shall conform to ASME B16.5.

2.16.3 Bellows Type Joints

Bellows type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows type expansion joints shall conform to the applicable requirements of EJMA-01 with internal sleeves. Guiding of piping on both sides of expansion joint shall be according to the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but not less than 150 psig.

2.17 Insulation

Shop and field applied insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.18 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section 15400 PLUMBING, GENERAL PURPOSE.

2.19 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.

2.20 CONTROLS

Controls shall be provided as specified in Section 15974 BUILDING AUTOMATION AND CONTROLS SYSTEMS FOR LACKLAND AFB (HVAC) CONTROL SYSTEMS.

2.21 DUCTWORK COMPONENTS

2.21.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA-06 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 inchshall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15250 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-06. 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.

2.21.1.1 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.

2.21.1.2 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.

2.21.1.3 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 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.21.1.4 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-01.

2.21.1.5 High Temperature Service Duct Connections

Material shall be approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

2.21.3 Ductwork Accessories

2.21.3.1 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-06. 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.

2.21.3.2 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. 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-05. Fire dampers shall be curtain type with damper bladesout 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-05 and in manufacturer's instructions for fire dampers shall be followed.

2.21.3.3 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.

2.21.3.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, 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 may 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.

2.21.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.21.4.1 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 inchclearance between the duct and the sleeve or 1 inch clearance between the insulation and the sleeve for insulated ducts.

2.21.4.2 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.

2.21.4.3 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.

2.21.5 Plenums and Casings for Field-Fabricated Units

2.21.5.1 Plenum and Casings

Plenums and casings shall be fabricated and erected as shown in SMACNA-06, as applicable. Unless otherwise indicated, system casing shall be constructed of not less than 16 gaugegalvanized sheet steel. Cooling coil drain pans with 1 inchthreaded outlet shall be provided to collect condensation from the cooling coils. Drain pans shall be fabricated of not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A 167, Type 304, welded and stiffened. Drain pans exposed to the atmosphere shall be thermally insulated to prevent condensation. Insulation shall be coated with a flame resistant waterproofing material. Separate drain pans shall be provided for each vertical coil section, and a separate drain line shall be provided for each pan. Pans shall be generously sized to ensure capture of entrained moisture on the downstream-air side of the coil. Openings in the casing, such as for piping connections, shall be sealed and covered to prevent air leakage. Water seal for the drain shall provide at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.21.5.2 Casing

Casings shall be terminated at the curb line and anchored by the use of galvanized angle iron sealed and bolted to the curb, as indicated in SMACNA-06.

2.21.5.3 Access Doors

Access doors shall be provided in each section of the casing. Door frames shall be welded in place, and each door shall be neoprene gasketed, hinged with minimum of two brass hinges, and fastened with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, doors shall be 36 x 18 inches located 18 inches above the floor. Where the space available will not accommodate doors of this size, doors as large as the space will accommodate shall be provided. Doors shall swing so that fan suction or pressure holds door in closed position, and shall be airtight. A push-button station to stop the supply fan shall be located inside the casing where indicated.

2.21.5.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components may be used for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Panels shall be of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Panel joints shall be sealed and insulated access doors shall be provided and gasketed to prevent air leakage. Panel construction shall be not less than 20 gauge galvanized sheet steel and shall be assembled with fasteners treated against corrosion. Standard length panels shall deflect not more than 1/2 inch under operation. Details of construction, including joint sealing, not specifically covered shall be as indicated in SMACNA-06. The plenums and casings shall be constructed to withstand the specified internal pressure of the air systems.

2.21.7 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. 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.

2.21.7.1 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-03for 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.

2.21.7.2 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.

2.21.8 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.

2.21.9 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel or aluminum sheets with galvanized or aluminum structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA-06. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.21.10 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 0.031inch diameter stainless steel wire. Frames shall be removable type or stainless steel or extruded aluminum to allow ease of cleaning.

2.22 AIR SYSTEMS EQUIPMENT

2.22.1 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 150 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.

2.22.1.1 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 blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 30 inches. Fan blades for wheels over 30 inches in diameter

shall be backward-inclined or airfoil design. 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 ABEMA 9 and ABEMA 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 opendripproof enclosures. Motor starters shall be magneticacross-the-line type with general-purpose enclosure.

2.22.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, 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 ABEMA 9 and ABEMA 11. Motors shall have open dripproof enclosure. Motor starters shall be magnetic across-the-line with general-purpose enclosures.

2.22.1.3 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 open dripproof type. Motor operated backdraft dampers shall be provided where indicated.

2.22.1.4 Centrifugal Type Power Wall Ventilators

Fans shall be directorV-belt driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an stainless steel wall grille,manufacturer's standard motor-operated damper, an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be opendripproof type. Lubricated bearings shall be provided.

2.22.1.5 Centrifugal Type Power Roof Ventilators

Fans shall be directorV-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, motorized dampers,roof curb, and extended base. Motors enclosure shall be opendripproof type. Grease-laden kitchen exhaust fans shall be centrifugal type according to UL 705 and fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, motor and power transmission components located in outside positively air ventilated compartment. Lubricated bearings shall be provided. All existing vertical ducts must be cleaned prior to the attachment of new ducts or devices such as fans, dampers, exhaust fans, louvers, duct extensions,...etc. The method of cleaning shall include as a minimum the removal of deposits of soap, oil, calcium compounds, dirt, dust, and other foreign matter which has a deleterious effect on the flow of air.

2.22.1.6 Propeller Type Power Roof Ventilators

Fans shall be directorV-belt driven. Fan housing shall be hinged or removable weathertight, fitted with framed rectangular base constructed of aluminum or galvanized steel. Motors shall be totally enclosed fan cooled type. Motors shall be provided with nonfusible, horsepower rated, manual disconnect mount on unit. Fans shall be provided with motor operated dampers, birdscreenroof curb. Lubricated bearings shall be provided.

2.22.1.7 Air-Curtain Fans

Air curtains shall be provided with a weatherproof housing constructed of high impact plastic or minimum 18 gauge rigid welded steel. Fan wheels shall be backward curved, non-overloading, centrifugal type and accurately balanced statically and dynamically. Motors shall have totally enclosed fan cooled enclosures. Motor starters shall be remote manual type with weather-resistant enclosure actuated when the doorway served is open. The air curtains shall attain the air velocities specified within 2 seconds following activation. Air intake and discharge openings shall be protected by bird screens. Air curtain unit or a multiple unit installation shall be at least as wide as the opening to be protected. The air discharge openings shall be so designed and equipped as to permit outward adjustment of the discharge air. Adjustment and installation placement shall be according to the manufacturer's written recommendation. Directional controls on air curtains for service windows shall be designed to be easily cleanable or readily removable. Air curtains shall be designed to prevent the adjustment of the air velocities specified. The interior surfaces of the air curtain units shall be accessible for cleaning. Certified test data indicating that the fan will provide the air velocities required when fan is mounted as indicated shall be furnished. Air curtains designed as fly fans shall be provided where indicated. Air curtains designed for use in service entranceways shall develop an air curtain not less than 3 inches thick at the discharge nozzle. The air velocity shall be not less than 1600 fpm across the entire entryway when measured 3 feet above the floor. Air curtains designed for use on customer entranceways shall develop an air curtain not less than 8 inches thick at the discharge opening. The velocity shall be not less than 600 fpm across the entire entryway when measured 3 feet above the floor. Recirculating type air curtains shall be equipped with readily removable filters, or the filters shall be designed for in-position cleaning. The air capture compartment shall be readily accessible and easily cleanable or designed for in-position cleaning.

2.22.1.8 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type,

direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be U.L. listed.

2.22.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and aluminumorcopper fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.024 inches. [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.

2.22.2.2 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 and cleanable from either end.

2.22.3 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.

2.22.3.1 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.

2.22.3.2 Sectional Cleanable Filters

Cleanable filters shall conform to ASTM F 872, and shall be 1 inches thick. Viscous adhesive shall be provided in 5 gallon containers in sufficient quantity for 12 cleaning operations and not less than one quart for each filter section. One washing and charging tank shall be provided for every 100 filter sections or fraction thereof. Each washing and charging unit shall consist of a tank and [single] [double] drain rack mounted on legs. Drain rack shall be provided with dividers and partitions to properly support the filters in the draining position. Initial pressure

drop for clean filters shall not exceed the applicable values listed in ASTM F 872.

2.22.3.3 Replaceable Media Filters

Replaceable media filters shall be the dry-media type, of the size required to suit the application. Filtering media shall be not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Pad shall be enclosed in a holding frame of not less than 16 gauge galvanized steel, and equipped with quick-opening mechanism for changing filter media. The air flow capacity of the filter shall be based on net filter face velocity not exceeding 300 feet per minute, with initial resistance of 0.13 inches water gauge. Average efficiency shall be not less than 95 percent when tested according to ASHRAE 52.1.

2.22.3.4 Range and Griddle Hood Service

Filter shall be sectional, permanent, washable, all metallic media type, nominal 50 mm (2 inches) 2 inches thick, with suitable metal frames, designed for extraction of grease from grease-laden air. Clean filter static pressure drop shall not exceed 0.03 inch water gauge when handling 1680 to 2800 cfm air.

2.22.3.5 Holding Frames

Frames shall be fabricated from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.22.3.6 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 shall be graduated in 0.01 inch, 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.

2.23 AIR HANDLING UNITS

2.23.1 Field-Fabricated Air Handling Units

Built-up units shall be as specified in paragraph DUCTWORK COMPONENTS. Fans, coils spray-coil dehumidifiers, and air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.23.2 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type or single-zone blow-through type as indicated. Units shall include fans, coils, airtight insulated casing, prefilters, secondary filter sections,anddiffuser 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.

2.23.2.1 Casings

Casing sections shall be 2 inch double] wall typeas indicated, 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. A minimum 8 inches by 8 inchessealed glass window suitable for the intended application shall be installed in all access doors. 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 15250 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 if necessary to access all parts.

2.23.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.23.2.3 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for

types and thickness indicated.

2.23.2.4 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 ABEMA 9 and ABEMA 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 across-the-line 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.

2.23.2.5 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.

2.23.2.6 Diffuser Sections

Diffuser sections shall be furnished between the discharge of all supply fans [and cooling coils of blow-through single zone units] [and] [filter sections of those units with high efficiency filters located immediately downstream of the air handling unit fan section]. Diffuser sections shall be fabricated by the unit manufacturer in a manner identical to the remainder of the unit casing, shall be designed to be airtight under positive static pressures up to 8 inches water gauge, and shall have an access door on each side for inspection purposes. Diffuser section shall contain a perforated diffusion plate, fabricated of galvanized steel, Type 316 stainless steel, aluminum, or steel treated for corrosion with manufacturer's standard corrosion-resisting finish. The diffusion plate shall be designed to accomplish uniform air flow across the down-stream

[coil] [filters] while reducing the higher fan outlet velocity to within plus or minus 5 percent of the required face velocity of the downstream component.

2.23.2.7 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.24 TERMINAL UNITS

2.24.1 Room Fan-Coil Units

Base units shall include galvanized coil casing, coil assembly drain pan valve and piping package,outside air damper,wall intake box, air filter, fans, motor, fan drive, and motor switch, plus an enclosure for cabinet models and casing for concealed models. Leveling devices integral with the unit shall be provided for vertical type units. Sound power levels shall be as indicated. Sound power level data or values for these units shall be obtained according to test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Each unit shall be fastened securely to the building structure. Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440, and shall meet the requirements of UL 1995.

2.24.1.1 Enclosures

Enclosures shall be fabricated of not lighter than 18 gauge steel, reinforced and braced. Front panels of enclosures shall be removable and provided with 1/2 inchthick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 4,500 fpm. Discharge grille shall be adjustable and shall be of such design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material shall comply with the heat deflection criteria specified in UL 1995. Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access doors or removable panels shall be provided for piping and control compartments. Duct discharge collar shall be provided for concealed models. Enclosures shall have easy access for filter replacement.

2.24.1.2 Fans

Fans shall be galvanized steel or aluminum, multiblade, centrifugal type. In lieu of metal, fans and scrolls may be non-metallic materials of suitably reinforced compounds. Fans shall be dynamically and statically balanced. Surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and re-assembly shall be by means of mechanical fastening devices and not by epoxies or cements.

2.24.1.3 Coils

Coils shall be constructed of not less than 3/8 inch outside diameter

seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Coils shall be provided with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Coils shall be tested hydrostatically at 300 psi or under water at 250 psi air pressure and suitable for 200 psi working pressure. Provisions shall be made for coil removal.

2.24.1.4 Drain Pans

Drain and drip pans shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pans shall be constructed of not lighter than 21 gauge steel, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and shall be of a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans may be constructed of die-formed 22 gauge steel, formed from a single sheet, galvanized after fabrication, insulated and coated as specified for the 21 gauge material or of die-formed 21 gauge type 304 stainless steel, insulated as specified above. Drain pans shall be pitched to drain through an insulated copper line no smaller than 1 inch in diameter.. Auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages, may be plastic; if metal, the auxiliary pans shall comply with the requirements specified above. Insulation at control and piping connections thereto shall extend 1 inch minimum over the auxiliary drain pan.

2.24.1.5 Manually Operated Outside Air Dampers

Manually operated outside air dampers shall be provided according to the arrangement indicated. Dampers shall be parallel airfoil type and of galvanized construction. Blades shall rotate on stainless steel or nylon sleeve bearings.

2.24.1.6 Filters

Filters shall be of the fiberglass disposable type, 1 inch thick, conforming to CID A-A-1419. Filters in each unit shall be removable without the use of tools.

2.24.1.7 Motors

Motors shall be of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Motor switch shall be two or three speeds and off, manually operated, and shall be mounted on an identified plate adjacent to the room thermostat. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent may be provided. Motors shall have permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity shall not exceed the following values:

Unit Capacity (cfm)	Maximum Power Consumption (Watts)
200	55
300	60
400	65
600	80
800	130
1000	130
1200	130

2.25 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123or ASTM A 924 shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatised 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 conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 4 inchesand smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inch or less in diameter, and with flanges for pipe 3 inchesand larger. Connections between ferrous and copper piping shall be

electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90Arequirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded.

3.1.1.1 Joints

a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.

b. Soldered Joints: Joints in copper tubing shall be cut square with ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with 95/5 solder or brazed with silver solder applied and drawn through the full fitting length. Care shall be taken to prevent annealing of tube or fittings when making connections. Joints 2-1/2 inch and larger shall be made with heat uniformly around the entire circumference of the joint with a multi-flame torch. Connections in floor slabs shall be brazed. Excess solder shall be wiped from joint before solder hardens.

c. Welded Joints: Welding shall be according to qualified procedures using qualified welders and welding operators. Procedures and welders shall be qualified according to ASME BPV IX. Welding procedures qualified by others and welders and welding operators qualified by another operator may be permitted by ASME B31.1. Structural members shall be welded according to Section 05055 WELDING, STRUCTURAL. All welds shall be permanently identified by imprinting the welder's or welding operator's assigned symbol adjacent to the weld. Welded joints shall be fusion welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. Electrodes shall be stored and dried according to AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.1.2 Grooved Mechanical Joints

Grooves 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 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.

3.1.1.3 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.2 Supports

3.1.2.1 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.

3.1.2.2 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Types 5, 12, and 26 shall not be used.

a. Hangers: Type 3 shall not be used on insulated piping.

b. Inserts: 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.

c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.

f. Type 39 saddles shall be used on all insulated pipe 4 inches and larger when the temperature of the medium is above 60 degrees F. Type 39 saddles shall be welded to the pipe.

g. Type 40 shields shall:

(1) be used on all insulated pipes less than 4 inches.

(2) be used on all insulated pipes 4 inches and larger when the temperature of the medium is 60 degrees or less.

(3) have a high density insert for pipe 2 inches and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or when the insulation or jacket shows visible signs of distortion at or near the type 40 shield. High density inserts shall have a density of 9 pcf or greater.

h. Horizontal Pipe Supports: 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. [Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.]

i. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

j. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

k. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger with medium 60 degrees F or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

l. High Temperature Guides with Cradles: 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.

m. Insulated Pipe: Insulation on horizontal pipe shall be continuous through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

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 wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated,

sleeves shall provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07920 JOINT SEALING. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed as indicated.

3.1.4.1 Roof and Floor Sleeves

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve or a 0.032 inchthick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and 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 troweled coating of bituminous cement. Unless otherwise shown, the flashing sleeve shall extend up the pipe a minimum of 2 inches above highest floor level or a minimum of 10 inches above the roof. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. 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. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. 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/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07270 FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 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 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.7 Air Vents and Drains

3.1.7.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.9 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.

3.1.10 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.

3.1.11 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.

3.1.12 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 07270 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07920 JOINT SEALING.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 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.

3.1.14 Kitchen Exhaust Ductwork

3.1.14.1 Ducts Conveying Smoke and Grease Laden Vapors

Ducts conveying smoke and grease laden vapors shall conform to requirements of NFPA 96. Seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid tight continuous external weld. Duct material shall be minimum 18 gauge, Type 304L or 316L, stainless steel. Duct construction shall include external perimeter angle iron welded joint reinforcement on 24 inch centers; continuously welded companion angle bolted flanged joints with flexible ceramic cloth gaskets where indicated; pitched to drain at low points; welded pipe coupling-plug drains at low points; welded fire protection and detergent cleaning penetration; steel framed, stud bolted, and flexible ceramic cloth gasketed cleaning access provisions where indicated.

3.1.14.2 Exposed Ductwork

Exposed ductwork shall be fabricated from minimum 18 gauge, Type 304L or

316L, stainless steel with continuously welded joints and seams. Ducts shall be pitched to drain at hoods and low points indicated. Surface finish shall match hoods.

3.1.14.3 Concealed Ducts Conveying Moisture Laden Air

Concealed ducts conveying moisture laden air shall be fabricated from minimum 18 gauge, Type 300 series, stainless steel . Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated. Transitions to other metals shall be liquid tight, companion angle bolted and gasketed.

3.1.15 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unitorup to the point where the outdoor air mixes with the outside air stream.

3.1.16 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.

3.1.17 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.

3.1.18 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 PIPING IDENTIFICATION

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise and identification for piping are 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 air distribution and exhaust system, including fans, coils, filters, etc. designated as static pressure Class 3 inch water gauge through Class 10 inch water gauge. Test procedure, apparatus, and report shall conform to SMACNA-10. The maximum allowable leakage rate is 3.0 % of the total cfm. 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 temporary bypass shall be provided for 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 room fan-coil 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 21 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 40 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 --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004

SECTION 15974

BUILDING AUTOMATION & CONTROL SYSTEMS FOR LACKLAND AFB

PART 1 GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500	1991 Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.4	(1988; R 1992) Information Systems - Coded Character Sets 7-Bit American National Standard Code for Information Interchange
ANSI X3.64	(1979; R 1990) Additional Controls for Use with American National Standard Code for Information Interchange
ANSI X3.154	(1988) Office Machines and Supplies - Alphanumeric Machines-Keyboard Arrangement

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 269	(1996) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM B 32	(1996) Solder Metal
ASTM B 75	(1995) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM D 635	(1996) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM D 638	(1996) Tensile Properties of Plastics
ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM D 1238	(1995) Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	(1997) Environmental Stress-Cracking of Ethylene Plastics

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

ASHRAE HDBK	(1997) Handbook - Fundamentals
ASHRAE 135	(1995) A Data Communication Protocol for Building Automation and Control Networks (BACnet)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	1988 (Errata 1988) Pipe Flanges and Flanged Fittings
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B31.1	(1995) Power Piping
ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII	(1995) Boiler and Pressure Vessel Codes: Section VIII Pressure Vessels
ASME PTC 19.3	(1974; R 1986) Part 3: Temperature Measurement Instruments and Apparatus (Performance Test Codes)

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	(1996) Radio Frequency Devices
47 CFR 68	(1996) Connection of Terminal Equipment to the Telephone Network

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90.1	(1989; R 1994) Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C57.13	(1993) Requirements for Instrument

	Transformers
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEE 142	(1991) Recommended Practice for Grounding of Industrial and Commercial Power Systems

INTERNATIONAL SOCIETY FOR MEASUREMENT AND CONTROL (ISA)

ISA S7.0.01	

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1	(1995) American National Standard for Electric Meters - Code for Electricity Metering
NEMA ICS	(1993) Industrial Controls and Systems
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. SMACNA)

SMACNA TAB	(1993) HVAC Systems - Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES (UL)

UL 94	(1996) Test for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 268A	(1993) Smoke Detectors for Duct application
UL 506	(1994) (R 1993) Specialty Transformers
UL 555S	(1996) Leakage Rated Dampers for Use in Smoke Control Systems
UL 916	(1994) Energy Management Equipment
UL 1449	(1996) Transient Voltage Surge Suppressors

1.2 SYSTEM DESCRIPTION

The Building Automation & Control System (BACS) shall utilize intelligent distributed control modules which communicate over a controller network in accordance with ANSI/ASHRAE 135, herein after referred to as "BACnet". The system shall provide the Direct Digital Control (DDC), Energy Management,

and Building Automation functions for complete operation of heating, ventilating and air conditioning (HVAC) systems. Provide new BACS consisting of Notebook computers, DDC controllers, routers, Local Area Networks (LANs), software, and associated equipment and accessories using BACnet as the native communication protocol. The system is to control all mechanical equipment, including terminal unit equipment (VAV boxes, fan coil units, heat pumps, etc.), fans, pumps, central plant machinery and other specified equipment, directly without intervening electric, analog electronic, controls. A non-BACnet system meeting the functional requirements of this Specification shall be an acceptable alternative; the non-BACnet system shall include bi-directional protocol translators (gateways) that convert the non-BACnet system communication protocol to the BACnet protocol which will interoperate with BACnet Ethernet over twisted pair 10BaseT and Fiber Optic cabling systems.The system shall have two way communications capability with Lackland AFB EMCS.

1.2.1 Basic Features

1.2.1.1 System Hardware

All hardware Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the U.L. standard for safety 916, with integral labels showing rating. All hardware complies with Code of Federal Regulation 47 CFR 15, Radio Frequency Devices.

1.2.1.2 Fully Programmable

System designed for high-speed data processing; fully programmable, using advanced graphical programming tools.

1.2.1.3 Communications Network

The communication network between controllers utilize BACnet over EIA-485 MS/TP, at least 76 Kbaud, and/or BACnet over ARCNET 156 KBaud at the Data Link Layer.

1.2.1.4 System Auto-restart

Auto-restart of complete system, including DDC controllers, network controllers and routers, without operator intervention, on resumption of power after a power failure.

1.2.1.5 Zone Control Functions

Zone by zone DDC control of space temperature, scheduling, optimum starting, equipment alarm reporting, and override timers for after-hours usage. A zone is the area served by one controller for each terminal unit.

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

Equipment Data; GA.

The equipment data shall be in booklet form, indexed to the unique identifiers, shall consist of data sheets that document compliance with the specification and shall include a copy of each control system bill of materials. Catalog cuts shall be in booklet form indexed by device type. Where multiple components are shown on a catalog cut, the application specific component shall be marked. Data shall include but not limited to the following:

a. BACnet routers, converters and gateways.

b. Auto-dial/auto-answer modems.

c. Notebook computer(s).

d. Hand-held terminal(s).

e. Digital controllers and controller cabinets.

f. Input and output (I/O) devices.

g. Surge and transient protection.

Software; GA.

Descriptions of software, including but not limited to operating systems and utility software; diagnostic routines; DDC software; communications programs; and user interface software.

Training; GA.

A training course in the maintenance and operation of the BACS, approved 60 days prior to the start of training. The training shall be oriented to the specific systems being installed under this contract. One training manual shall be furnished for each trainee, plus two additional copies delivered for archival storage at the project site. The manuals shall include the agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Two copies of audiovisual materials shall be delivered for archival storage at the project site, either as a part of the printed training manuals or on the same media as that to be used during the training session.

SD-04 Drawings

System Drawings; GA.

The system drawings shall include the following:

a. A drawing index.

b. A list of symbols.

c. A series of drawings for each HVAC control system using abbreviations, symbols, nomenclature and identifiers as shown on the contract drawings. Each control-system element on a drawing shall have a unique identifier as shown.

Each series of drawings for an HVAC control system shall include a schematic as shown on the contract drawings, a wiring diagram, a list of equipment with manufacturer and model number, controller/control panel

arrangement drawing and an HVAC control-system sequence of operation. The sequence of operation for each HVAC control system shall be in the language and format of this specification. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. The sequence of operation shall refer to each device by its unique identifier.

The wiring diagram shall show the interconnection of wires and cables to controller terminal blocks and to the identified terminals of starters and packaged equipment, with all necessary jumpers and ground connections. The wiring diagram shall show the labels of all conductors. All sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panelboard circuit breaker number, controller, magnetic starter, or packaged control equipment circuit. Each power supply and transformer not integral to a starter or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

d. A system block diagram.

e. Controller/control panel installation, block diagrams, and wiring diagrams.

f. Controller/control panel physical layout and schematics.

g. Details of surge protection device installations.

h. Valve schedules.

The valve schedule shall include each valve's unique identifier size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, positive-positioner range, and actuator size, supported by close-off pressure data, dimensions, operation rate, and access and clearance requirements data.

i. Damper schedules.

The damper schedule shall contain each damper's each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive-positioner ranges, location of actuators and damper end switches, arrangement of sections in multisection dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum expected velocity through the damper at the intended location and the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers; and access and clearance requirements.

j. NOT USED

SD-06 Instructions

Service Organization; FIO.

Two copies of a list of service organizations qualified to service the BACS. The list shall include the service organization name and telephone

number.

SD-08 Statements

Site Testing; GA.

Two copies of the test procedures for the site testing. The site testing procedures shall identify each item to be tested and shall clearly describe each test. The test procedures shall include a list of the test equipment to be used for site testing, manufacturer and model number, and the date of calibration and accuracy of calibration, within 6 months of the test date.

Performance Verification Testing; GA

Two copies of the test procedures for the performance verification test. The test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the specified requirements. Written approval by the Government of the performance verification test procedures shall be one of the prerequisites for commencing the performance verification test.

Commissioning Procedures; GA

Commissioning procedures for each HVAC control system, and for each type of terminal unit control system. The procedures shall reflect the language and format of this specification. The commissioning procedures shall refer to the devices by their unique identifiers as shown and shall include step-by-step configuration procedures for each system. The configuration procedures shall include a configuration check sheet showing all configuration parameters.

Two copies of Commissioning Procedures, in booklet form and indexed, for each system, 60 days prior to system commissioning. Commissioning procedures shall include general instructions on how to set control parameters including setpoints; proportional, integral, and derivative mode constants; contact output settings for the specific devices provided. Commissioning procedures shall be specific to each HVAC system, shall detail the steps involved, and shall refer to the procedures in the booklet for specific devices.

SD-09 Reports

Test Reports; GA

Two copies of the site testing data. Original copies of all data produced during site testing , including results of each test procedure, after approval of the site tests.

Performance Verification Report; GA

Two copies of the performance verification test report after completion of a successful test.

Documentation of test results for the entire HVAC control system complete, in booklet form and indexed, within 30 days after each test.

Control System Calibration, Adjustments, and Commissioning; GA

Two copies of the calibration, adjustment and commissioning report which

shall include setpoints and proportional, integral and derivative mode constant settings, calibration data for all I/O devices, and all the data resulting from adjusting the control system devices and commissioning HVAC control systems.

SD-19 Operation and Maintenance Manuals

Technical Data Package; GA

Operation and maintenance data in manual format. Final copies of the manuals bound in hardback, loose leaf binders, at least 2 weeks prior to training course. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. Each manual's contents shall be identified on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the nearest service representatives for each item of equipment and each system. The draft copy used during site testing shall be updated with any changes required, prior to final submission of the manual. The final copies delivered after completion of the endurance test shall include modifications made during installation checkout and acceptance. Manuals shall include:

Functional Design Manual; GA

Two copies of the functional design manual which shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

Hardware Manual; GA

Two copies of the hardware manual which shall describe equipment furnished, including:

a. General description and specifications.

b. Installation and checkout procedures.

c. Equipment electrical schematics and layout drawings.

d. System schematics and I/O device wiring lists.

e. Alignment and calibration procedures.

f. Manufacturer's repair parts list indicating sources of supply.

Software Manual; GA

Two copies of the software manual which shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation including, but not limited to the following:

a. Definitions of terms and functions.

b. Operator commands.

c. System access requirements.

d. Data entry requirements.

e. Descriptions of application software.

f. Description of database structure and interface with programs.

g. Alarms.

Operator's Manual; GA

Four complete copies of operation manuals for each HVAC control system, in booklet form and indexed, outlining the step-by-step procedures required for each HVAC control system's startup, operation, and shutdown. The manuals shall include all detail drawings, equipment data, and manufacturer supplied operation manuals for all equipment.

Maintenance Manual; GA

Four complete copies of maintenance manuals, indexed in booklet form listing maintenance procedures. The maintenance instructions shall include a maintenance check list for each HVAC control system. Maintenance manuals shall include spare parts data and recommended maintenance tool kits for all control devices. Maintenance instructions shall include recommended repair methods, either field repair, factory repair, or whole-item replacement. The manual shall contain a list of service organizations qualified to service the HVAC control system, including the service organization name and telephone number. If operation and maintenance manuals are provided in a common volume, they shall be clearly differentiated and separately indexed.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 TESTING

1.5.1 Site Testing

Personnel, equipment, instrumentation, and supplies shall be provided as necessary to perform site testing, adjusting, calibration and commissioning. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Ground rods installed by the Contractor shall be tested as specified in IEEE 142. Written Government approval of the specific site testing procedures shall be obtained prior to any test. Written notification of any planned site testing, commissioning or tuning shall be given at least 14 calendar days prior to any test.

1.5.2 Control System Calibration, Adjustments, and Commissioning

Instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST

standards. Mechanical control devices shall be adjusted to operate as specified. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Control system commissioning shall be performed for each HVAC system. The report describing results of functional tests, diagnostics, and calibrations, including written certification, shall state that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

1.5.3 Performance Verification Test

Compliance of the HVAC control system with the contract documents shall be demonstrated. Using test plans and procedures previously approved, physical and functional requirements of the project, including communication requirements shall be demonstrated. The performance verification test procedures shall explain, step-by-step, the actions and expected results that will demonstrate that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt of written permission by the Government, based on the Contractor's written certification of successful completion of site testing and training.

1.5.4 Coordination with HVAC System Balancing

The HVAC control system shall be tuned after all air-system and hydronic-system balancing has been completed, minimum damper positions set and a report issued. Commissioning may be performed prior to or simultaneous with HVAC system balancing.

1.5.5 Posted Instructions

Instructions on letter-size sheets and half-size plastic laminated drawings for each system, showing the final installed conditions, shall be placed in each HVAC control panel. The posted instructions shall include the control sequence, control schematic, ladder diagram, wiring diagram, valve schedules, damper schedules, commissioning procedures, and preventive maintenance instructions.

1.6 TRAINING

1.6.1 General

The training course shall be conducted for 5 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The course shall be taught at the project site for a period of 10 training days. A training day is defined as 8 hours of classroom instruction, including breaks and lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that the attendees will have a high school education or equivalent, Some experience using Windows-based software, and are familiar with HVAC systems. No training shall be scheduled until training manuals and O&M manuals have been approved by the Government.

1.6.2 Operator Training

The operator's course shall be taught for a total of 7 training days.

Training shall be classroom, but have hands-on operation of similar digital controllers. Upon completion of this course, students should be fully proficient in the operation of each system function. This course shall include but not be limited to:

a. Theory of operation

b. Hardware architecture

c. Operation of the system

d. Operator commands

e. Control sequence programming

f. Data base entry to be accomplished by controls manufacturer with limited assistance (without responsibility) by Base Operators.

g. Reports and logs

h. Alarm reports

i. Diagnostics

1.6.3 Maintenance Personnel Training

a. The system maintenance course shall be taught for a period of 3 training days. The course shall include but not be limited to:

(1) Physical layout of each piece of hardware.

(2) Troubleshooting and diagnostics procedures.

(3) Repair instructions.

(4) Preventive maintenance procedures and schedules.

(5) Calibration procedures.

b. Troubleshooting, checkout and calibration of the working system shall be accomplished in a classroom setting and repeated on-site.

1.7 QUALITY ASSURANCE

1.7.1 Standard Products

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components.

1.7.2 Single-source Responsibility

The HVAC Controls Contractor shall have single-source responsibility for

the complete acquisition, installation, and proper operation of the BACS. The equipment items shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations and qualifications. These service organizations shall be reasonably convenient to the equipment on a regular and emergency basis during the warranty period.

1.7.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.7.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, and shall furnish all work necessary to meet such conditions.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Conformance to BACnet

All controllers and network devices shall conform to the BACnet protocol. Each type device shall have a protocol implementation conformance statement (PICS) that identifies all of the portions of BACnet that are implemented in each device. Each PICS shall include device description and manufacturer, supported functional groups, supported application services and object types, data link layer options, and supported segmented requests and responses.

2.1.2 Electrical and Electronic Devices

Electrical, electronic devices not located within an HVAC control panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown. Control panels shall have ambient condition ratings of plus 35 to 120 degrees F and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to 150 degrees F. I/O devices shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.1.3 Multiple Controller Requirement

Where the system to be controlled by the BACS is located in multiple mechanical rooms, each mechanical room shall have at least one digital controller. Digital controllers shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room. Each mechanical system shall have its own dedicated controller or group of controllers.

2.1.4 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device

unique identifiers as shown shall be engraved or stamped characters. Nameplates shall be permanently attached to HVAC/DDC control panel doors. For each field device and equipment item not in a finished area, a plastic or metal tag with equipment name and point identifier shall be attached. Each air flow measurement station shall have a tag showing flow rate range for signal output range, duct size and identifier as shown.

2.2 BACNET ROUTERS, CONVERTERS, AND GATEWAYS

2.2.1 Routers

BACnet routers shall be conformance class 6 devices interconnecting two or more BACnet networks to form a internetwork. Routers shall have the routing functionality of interconnecting BACnet Ethernet high speed LAN, to BACnet MS/TP LAN or BACnet ARCNET high speed LAN. BACnet PTP (RS-232 point-to-point) communication shall be available on routers by including modems; PTP/modem shall operate under the BACnet half-router communication protocol.

2.2.2 Converters

A converter shall be provided to interface notebook computers and hand held terminals from its RS-232 serial port to system controllers on the BACnet LANs (Ethernet, MS/TP, ARCNET).

2.2.3 Gateways

BACnet gateways shall be microprocessor based protocol translators performing bi-directional translation between BACnet and non-BACnet protocols. Gateways shall be BACnet conformance class 4 devices. Each gateway shall have a database containing local and global data. Local data shall be unique from gateway to gateway, and global data shall be the same type in every gateway. Implement analog and digital point data, descriptors, time and trend schedule data, and network data for all mechanical/electrical systems connected to the DDC system. Points shall be viewed and commanded on the BACnet side of the gateway in the same manner as those points connected to non-BACnet controllers. Provide on additional gateway complete with documentation per 200 points. Gateway features and connections shall include but not limited to the following:

a. Full and transparent translation of any point data on the non-BACnet LAN to the BACnet format.

b. Communications and alarm processing software.

c. Operating system and utility software.

d. Nonvolatile memory/battery-backed RAM for storage of system items.

e. Built-in 10BaseT Interface for communications via BACnet Ethernet LAN.

f. RS-232 port for notebook computer, or modem to remote site.

g. Configuration tool software, a Windows-based program to create device application and data files that define controllers and points, and provide point data information between the two networks.

2.3 DIRECT DIGITAL CONTROL (DDC) DEVICES

DDC controllers shall be stand-alone microprocessor-based devices with sufficient memory and point capacity to perform specified functions and operations. Controllers shall be BACnet conformance class 3 or class 4 devices. Total number of I/O hardware points connected to a single digital controller shall not exceed 85 percent of the controller's point capacity; I/O expansion units and multiplexing of I/O are not permitted. All digital controllers shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. Provide real time clock with each controller on the highest level LAN. Backup power shall be provided to each controller's clock and randon access memory (RAM) by a battery or capacitor with sufficient capacity to maintain operation for a minimum of 72 hours during a line power outage. Closed-loop control functions shall include proportional, proportional plus integral, and proportional plus integral plus derivative (PID) control capability. Controllers shall have communication ports for connection to BACnet MS/TP or ARCNET LAN.

2.3.1 I/O Functions

I/O functions shall be integral to each digital controller, and shall include the following:

a. Analog Inputs: Allowable input types are 2 or 3 wire 1000 ohm (or higher) platinum resistance temperature detectors (RTDs), stable 10,000 ohm thermistors, and 4 to 20 mAdc. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall be a minimum of 10 bits resolution.

b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications. Input device contacts shall be nonpowered.

c. Pulse Accumulator: The pulse accumulator function shall have the same characteristics as the digital input function, except that, in addition, a buffer shall be provided to totalize pulses and allow for interrogation by the controller. The pulse accumulator shall accept rates up to 10 pulses per second.

d. Analog Outputs: Analog outputs shall be 2-10 Vdc or 4-20 mAdc. Digital-to-analog (D/A) conversion shall be a minimum of 8 bits resolution.

e. Digital Outputs: Digital outputs shall provide contact closures for momentary and maintained operation of output devices. Outputs shall have a minimum closure duration of 0.1 second with contacts rated for a minimum of 1 ampere at 24 Vac.

2.3.2 Digital Controller Cabinet

Each digital controller cabinet shall protect the controller from dust and be rated NEMA 1, unless specified otherwise. Controller cabinets or enclosures shall be lockable with common keying. Provide door switch wired to input of controller for intrusion alarm annunciation. A 120 Vac, 15 amp, 60 Hz duplex outlet shall be provided for each separate location of controller cabinet on the highest level LAN. The duplex outlet shall be on a separate circuit from the digital controllers.

2.3.3 Terminal-Unit Controls

Terminal-unit controllers shall be manufactured by the same company as the digital controllers. Unit controllers shall be conformance class 3, stand-alone, microprocessor-based controllers connected to a lower level LAN; controllers shall communicate with the digital controllers. Unit controllers may deviate from stand-alone only in receiving energy management and time information from a stand-alone digital controller. Unit controllers may be used for the control of variable air volume (VAV) boxes, fan coil units, and heat pumps. Controls for VAV boxes shall consist of a velocity-sensing device in the primary air entering the box, a room temperature sensing element, a damper actuator, and a unit controller; a duct pressure switch shall be included when VAV box is provided with recirculation fan. Each controller shall operate the damper for cooling and the recirculation fan and duct coil for heating. Terminal units shall be as specified in Section 15895 AIR SUPPLY AND DISTRIBUTION SYSTEM FOR AIR-CONDITIONING SYSTEM.

2.4 DDC SOFTWARE

Each digital controller shall contain an operating system, self-test diagnostic routines, start-up software, and application programs and routines as specified. The operating system shall control and schedule controller activities, and maintain a point database that includes all parameters and constraints. Controllers shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a controller or host workstation on the higher level LAN. In addition to specified programs and routines, provide software in respective controllers required to perform the indicated "control sequences of operation". The sequence of control shall be written to include all conventional control operations (e.g. temperature and pressure control loops), time event operations, energy management functions (night setback, reset schedules, and optimum start-stop routines), demand limiting, safeties, and emergency conditions.

2.4.1 Database Modification

Software shall be provided to modify the control program database. Database modification shall be accomplished through connected computer or hand-held terminal or through a keypad integral to the controller.

2.4.2 Runtime Accumulation

Resettable runtime accumulation shall be provided for each controlled /enabled electrical motor.

2.4.3 Scheduled Start-Stop

Programs shall be provided to start and stop equipment based on time-of-day schedules for each day of the week, and on holiday schedules. Programs shall automatically adjust for leap years, and make daylight savings time and standard time adjustments.

2.4.4 Optimum Start-Stop

Programs shall be provided to start and stop equipment as specified for the scheduled start-stop program, but shall include a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the

thermal characteristics of the structure, indoor and outdoor air conditions using predictive software to determine the minimum time of HVAC system operation required to satisfy space enviromental conditions at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end.

2.4.5 Demand Limiting

Software shall be provided to shed electrical loads when the building or base is near peak demand. The program shall continuously monitor pulses from a building's electric meter and with predictive software, calculate a predicted power demand. When the predicted demand exceeds a preset target, the program shall shed loads on a prescheduled priority basis to reduce the connected load before the actual peak exceeds the target. Program demand limiting routines into the sequence of control.

2.4.6 Point Override

I/O and virtual points shall be able to be software overridden in the software and commanded to any possible value.

2.4.7 Alarming

I/O points and virtual points shall be alarmable. Alarm limits shall be adjustable on analog points.

2.4.8 Messages

Messages shall be operator defined and assigned to alarm points. Messages shall be displayed when a point goes into alarm.

2.4.9 Trending

DDC system shall have the capability to trend I/O and virtual points. Points associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes as a minimum. Trend data type shall be selectable as either averages over the logging period or instantaneous values at the time of logging. The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to workstation computer. Trend data shall be available on a real time basis; trend data shall appear either numerically or graphically on a connected notebook computer screen as the data is being processed from the DDC system data enviroment. Trend reports shall be capable of being uploaded to workstation disc and archived.

2.4.10 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.4.11 Power Loss

In event of a power outage, each controller shall assume a disabled status and outputs shall go a user-definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.4.12 Program Transfer

Control programs and database shall be capable of being down-loaded from workstation computer to controllers and uploaded to workstation from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded through a single controller on the highest level LAN.

2.5 PORTABLE COMPUTERS AND TERMINALS

The BACS primary operator/maintenance terminals shall be notebook computers and hand-held terminals used to perform command entry, database and alarm management, system monitoring and control setpoint adjustment, and other related functions.

2.5.1 Notebook Computer

Notebook computer with instruction manual and universal carrying case shall be provided. Computer shall include but not limited to:

a. 266 MHz Pentium II Processor, 64MB RAM.

b. 4GB Hard Drive, 20X CD-ROM Drive, 3.5" Diskette Drive.

c. 13.3" Color Display, Parallel and Serial Ports.

d. Windows NT or Windows 95 Operating System.

e. Network Management, Communications and Utility Software.

2.5.2 Hand-Held Terminals

Hand-held terminal or communications-and-programming device with instruction manual and direct connection cable to communicate with controllers shall be provided. Hand-held terminal shall connect to high and low level LAN controllers directly or to a jack at room-temperature-sensing element locations. Provide one additional hand-held device, manual, and cable per 60 controllers. Notebook computers with the required functionality may be provided as an alternative to hand-held terminals.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same section will not be located directly in the air stream. Damper axles shall be 0.5-inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not

exceed 0.04-inch water gauge at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

2.6.1.1 Operating Links

Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

2.6.1.2 Damper Types

Dampers shall be parallel or opposed blade type. Parallel blades shall be used for on-off dampers and opposed blades shall be used for modulating dampers.

2.6.2 Outside-Air, Return-Air, and Relief-Air Dampers

The dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity.

2.6.3 Mechanical and Electrical Space Ventilation Dampers

The dampers shall be as shown. Dampers shall not leak in excess of 80 cfm per square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1500 fpm air velocity.

2.7 AUTOMATIC CONTROL VALVES

2.7.1 Valve Assembly

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure of 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be .01 percent of rated Cv.

2.7.2 Butterfly-Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service, and for modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 degrees to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.7.3 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.7.4 Three-way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.7.5 Duct-coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

2.7.6 Valves for Chilled-Water, Condenser-Water, and Glycol Service.

Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze or iron. Bodies for 2-inch valves shall have threaded ends. Bodies for valves from 2-1/2 inches to 3 inches shall have flanged-end connections. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Internal valve trim shall be brass or bronze except that valve stems may be type 316 stainless steel. Valves 4 inches and larger shall be butterfly valves.

2.7.7 Valves for Hot-Water Service Below 250 Degrees F

Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for 2-inch valves shall have threaded ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies or valves 4 inches and larger shall be iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature or 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

2.8 ACTUATORS

2.8.1 General Requirements

Actuators shall fail to their spring-return positions as shown on signal or power failure and shall have a visible position indicator. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale input signal change. Electric or electronic actuators operating in parallel or in sequence shall have an auxiliary actuator driver. Actuators shall be , electric or electronic as shown.

2.8.2 Damper Actuators

Actuators shall smoothly operate the devices to which they are applied. Actuators shall fully open and close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. The actuator stroke shall be limited by an adjustable stop in the direction of power stroke. The actuators shall be provided with mounting and connecting

hardware.

2.8.3 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.9 INPUT AND OUTPUT (I/O) DEVICES

2.9.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4 to 20 mAdc:

a. Room/space temperature, 40 to 100 degrees F.
b. Duct temperature, 0 to 150 degrees F.
c. Chilled-water temperature, 30 to 100 degrees F.
d. Condenser-water temperature, 40 to 140 degrees F.
e. Dual-temperature water, 30 to 230 degrees F.
f. Heating hot water temperature, 40 to 240 degrees F.
g. Outside-air temperature, 0 to 130 degrees F.
h. Relative humidity, 5 to 95 percent.
i. Room static pressure control, inches water differential range: select minimum required for the application.
j. Duct static pressure, inches water differential range: select minimum required for the application.
k. Air-flow measurement station, feet per minute (fpm) range: select minimum required for the application.
l. Fluid and gas pressure or differential pressure range: select minimum required for the application.

2.9.2 Resistance Temperature Detectors (RTDs)

RTD sensors shall be 1000 ohm, or higher, platinum elements that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degree F cumulative. When 2 or 3 wire RTDs are connected directly to the controller, keep lead resistance error to 0.25 degree F or less. Total error for a RTD circuit shall not exceed 0.5 degree F, which includes sensor error, lead resistance error or 4 to 20 milliampere transmitter error, and A/D conversion resolution error. Provide manufacturer documentation and the Contractor's engineering calculations which support that the proposed RTD circuit will have a total error of 0.5 degree F or less for the specified application. Provide 4 to 20 milliampere transmitters for RTDs where digital controllers do not meet temperature resolution requirementof 0.25 degree F or do not support direct connection of RTDs.

2.9.3 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 32 to 150 degrees F. Sensor manufacturer shall utilize 100 percent screening to verify accuracy. Thermistors shall be pre-aged, and inherently stable. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative.

Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F, which includes sensor error and digital controller A/D conversion resolution error. Provide thermistor and digital controller manufacturer documentation and the Contractor's engineering calculations which support that the proposed thermistor input circuit will have a total error of 0.5 degree F or less.

2.9.4 Temperature Sensor Details

a. Room Type: Conceal element behind protective cover matched t the room interior.

b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be 1 foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of 1 foot length minimum are acceptable in ducts 12 feet square and less.

c. Immersion Type: Total immersion depth (3 to 6 inches) as required for the application for use with thermowells, unless otherwise indicated.

d. Outside Air Type: Sensor shall have weatherproof housing, and sunshield to minimize solar effects. Mount element at least 3 inches from building outside wall.

2.9.5 Transmitters

Transmitters shall have 4 to 20 ma output linearly scaled to the temperature, pressure, humidity, or flow range being sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent of 20 milliampere (0.02 milliampere) at any point across the 4 to 20 ma span. Supply voltage shall be 24 Vdc. Transmitters shall have noninteractive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

2.9.6 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2-inch lagging neck and extension-type well, and inside diameter and insertion length as required for the application.

2.9.7 Sunshields

Sunshields for outside-air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The sunshields shall be PVC, or painted white or shall be unpainted aluminum.

2.9.8 Relative Humidity Instruments

The instrument (humidity sensor and transmitter) shall be a 2 wire loop-powered device and have an output of 4 to 20 mAdc proportional to 5 to 95 percent relative humidity input. Accuracy shall be plus or minus 2 percent of full scale within the range 20 to 80 percent relative humidity.

Sensing element shall be chilled mirror type, polymer, or thin film polymer type. Supply voltage shall be 24 Vdc. Transmitter shall include offset and span adjustments. Provide instrument with weather-proof housing for outdoor applications.

2.9.9 Pressure and Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument overpressure rating shall be 300 percent of the operating pressure. Sensor-transmitter assembly accuracy shall be plus or minus 1 percent of full scale. The transmitter shall be a 2 wire, loop-powered device and have an output of 4 to 20 mAdc proportional to the input pressure range. Each transmitter shall have offset and span adjustments.

2.9.10 Air-Flow-Measurement Stations

Each station shall contain an array of velocity sensing elements inside a flanged sheet-metal casing. The velocity sensing elements shall be RTD or thermistor type with linearizing means, or multiple pitot-tube type with averaging manifolds. The sensing elements shall be distributed across the duct cross-section in the quantity and pattern set forth for measurements and instruments of of ASHRAE-03 and SMACNA-07 for the traversing of ducted air flows. The resistance to air flow through the air-flow-measurement station shall not exceed 0.08-inch water gauge at an air flow of 2000 fpm. Station construction shall be suitable for operation at air flows up to 5000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2500 fpm scaled to the air volume. Pitot-tube type elements will not be used if the required velocity measurement is below 700 fpm. Each station shall be furnished with a transmitter as specified, except output error of transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.9.11 Flow Switches

Flow switches shall have a repetitive accuracy of plus or minus 1 percent of full scale. Switch actuation shall be adjustable over the flow operating flow range. The switch shall have a snap-action Form C contact rated for the application.

2.9.12 Pressure and Differential Pressure Switches

Each switch shall have an adjustable trip setpoint, and single pole double throw contacts rated for the application. Provide taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure; fittings shall be of the angled-tip type with tips pointing into the air stream. Switches shall withstand pressure surges up to 150 percent of rated pressure. Each pressure switch shall be selected so that operating pressure trip point is approximately midpoint of pressure switch adjustable range. Repetitive accuracy shall be 2 percent.

2.9.13 Insertion Freeze Protection Switch

Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 20 feet in length for coil face areas up to 40 square feet. Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the

rate of 1 foot length of element per 4 square feet of coil. Serpentine entire airflow. A freezing condition at 18 inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.

2.9.14 Current-Sensing Switches

Current-sensing switches shall be of a design that provides a normally-open single pole single throw contact rated for the application. Switches shall be single unit construction with provisions for firm mounting. Each current-sensing switch shall have a single thru-hole for passage of current-carrying conductors, selected for operation at a nominal 50 percent of current rating of sensed device. The Contractor shall use multiple turns of sensed leads for higher rate loads.

2.9.15 Energy Metering Devices

2.9.15.1 Electric Meters

Watthour meters with pulse initiators shall be as specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Pulse initiator shall be connected to respective digital controller.

2.9.15.2 Gas Meters

Gas meters with pulse switches shall be as specified in Section 02685 GAS DISTRIBUTION SYSTEM. Pulse switch shall be connected to respective digital controller.

2.9.15.3 Water Meters

Water meters with pulse switches shall be as specified in Section 02660 WATER LINES. Pulse switch shall be connected to respective digital controller.

2.11 Thermostats

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or low-voltage electric. Modulating room and modulating capillary thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application; each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards). Low-temperature-protection thermostats shall be low-temperature safety thermostats, with normally-open and normally-closed contacts and a 20-foot element which shall respond to the coldest 18-inch segment.

2.12 Control Relays

Relays shall be double pole, double throw (DPDT), UL listed, with contacts rated for the application, and enclosed in a dustproof enclosure. Equip with a light indicator which is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed

base, and be replaceable without need of tools or removing wiring.

2.13 Solenoid Air Valves

Each valve shall have three port operation: common, normally-open, and normally-closed. Internal parts shall be brass, bronze, or stainless steel. Valves shall be rated at 50 psig minimum when used in a control system operating at 25 psig or less, or 150 psig when used in a control system operating in the range 25 to 100 psig.

2.14 INDICATING DEVICES

2.14.1 Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9-inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern. All stems shall have expansion heads as required to prevent breakage at extreme temperatures; the space between bulb and stem shall be filled with a heat-transfer medium. Non-averaging air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism. Averaging air-duct thermometers shall have no less than 3-1/2-inch dial, with black legend on white background, and pointer traveling through a 270-degree arc. Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Select thermometer ranges so normal temperatures are approximately equal to midpoint readings on the scale, unless otherwise specified.

2.14.2 Pressure Gauges

Gauges shall be 2-inch (nominal) size, back-connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 2 percent of scale range. Select gauge ranges so normal pressures are approximately equal to the midpoint readings on the scale, unless, otherwise specified. Gauges shall conform to ANSI/ASME B40.1. Provide gauges as specified for the following applications:

a. NOT USED

b. Air-Storage Tank, Filter and Dryer: Gauges for air-storage tanks and gauge for use before and after dirt and oil filters or dryers, shall have a scale of 0 to 160 psig with 2-psig graduations.

c. Hydronic System: Gauges for hydronic-system applications shall have ranges and graduations as shown.

d. Control Panel Main Air: Panel mounted gauge for control system main air shall have a scale of 0 to 30 psig with 1-psig graduations.

e. Low Differential Pressure: Gauges for low differential-pressure measurements shall be 4-1/2-inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown.

2.15 ELECTRICAL POWER AND DISTRIBUTION

Wiring and cable circuits shall be provided for all DDC apparatus, including wiring to transformer. Provide circuit and wiring protection in accordance with NFPA 70. A source 120 volts or less, 60 hz, two-pole, three wire with ground shall be provided. Devices shall be UL listed or FM approved. All electrical, electronic devices not located within a DDC panel shall have an enclosure NEMA 1 in accordance with NEMA 250 unless otherwise shown.

2.15.1 Nonconducting Wiring Duct

Nonconducting wiring duct in control panels shall have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

2.15.2 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable panel and rail mounting, and shall have end plates and partition plates for seperation or shall have enclosed sides.

2.15.3 Transformers

Transformers shall conform to UL 506. Power digital controllers on the highest level LAN from dedicated circuit breakers. Transformers for digital controllers serving terminal equipment on lower level LANs shall be fed from the fan motor leads or fed from the nearest distribution panel board or motor control center, using circuits provided for the purpose. Provide a fuse cutout on the secondary side of the transformer.

2.15.4 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.15.4.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, and have clamping voltage ratings below the following levels:

a. Normal Mode (Line to Neutral): 350 Volts

b. Common Mode (Line to Ground): 350 Volts

2.15.4.2 Communications Line Surge Protection

Protected from surges. metal oxide varistor (MOV) protection, rated for the application, shall be installed at the equipment. Additional protection, gas tubes rated for the application, shall be installed within 3 feet of the building cable entrance.

2.15.4.3 Sensor and Control Wiring Surge Protection

Controllers shall have sensor and control wiring surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.15.5 Wiring

2.15.5.1 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be insulated copper 18 AWG minimum and shall be rated for 300-volt service.

2.15.5.2 Wiring for 120-volt Circuits

Wiring for 120-volt circuits shall be 14 AWG minimum and shall be rated for 600-volt service.

2.15.5.3 Analog Signal Wiring Circuits

Analog signal wiring for analog inputs and analog outputs shall be 18 AWG, single or multiple twisted pair. Each pair shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 volts.

2.15.5.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single or multiple-twisted, minimum 2-inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20-AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20-AWG tinned-copper cable drain wire, and overall cable insulation.

2.16 FIRE PROTECTION DEVICES

Smoke detectors shall be as specified in Section 16721 FIRE DETECTION AND ALARM SYSTEM.

2.17 2.14 FIBER OPTIC (FO) CABLE & APPARATUS

2.17.1 FO Cable

The FO cable shall be totally dielectric, with a minimum of 12 optical fibers unless otherwise indicated. The fibers shall be multimode, graded index, solid glass waveguides, and shall have a nominal core diameter of 62.5 micrometers. The outside diameter of the glass-cladded fiber shall be nominally 125 micrometers, and shall be concentric with the fiber core. FO cable for outdoor applications shall be of loose tube construction with a maximum of four fibers per tube. Cable may be of loose tube or tight buffer construction for indoor applications. Plenum cable shall meet UL 910, and riser cable shall meet UL 1666. FO cable shall be continuous with no factory splices.

2.17.2 FO Connectors

FO connectors shall be ST style, multimode, field installable, self-aligning and centering. Provide ST style connectors for FO cables and patchcords. Connectors shall not require polishing or epoxy during installation, with no compromise in performance.

2.17.3 Fiber Interconnect Center

The fiber interconnect center shall be an enclosure unit designed to terminate, store, and protect up to 24 FO connections. Equip unit with 24

ST style multimode adapters. Interconnect center design features shall include easy access to individual connections, ample room for feed-through cables, and strain-relief provisions for multiple cables within unit. Furnish labels to document fiber connections and routing.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems. Provide components for a complete and operational DDC system. Post operating instructions for the air compressor, and refrigerated air dryer.

3.1.1 Wiring Criteria

a. Input/output identification: Permanently label each field wire, cable at each end with the identification specified.

b. Surge Protection: Install surge protection no more than three feet from where communication cable enters building.

c. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Grounding of the green ac ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.

d. Signal Wiring: Install analog signal wiring in conduit separate from AC power circuits.

e. Contractor is responsible for correcting all associated ground loop problems.

3.1.2 Digital Controllers

a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller or master/slave controllers shall manage control functions for a single mechanical system.

b. Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings.

c. Provide a main power switch at each highest level LAN digital controller within controller cabinet.

d. No multiplexing of points is allowed.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application such as replacing a duct sensor with a room sensor.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center line of sensor at 5 feet above finished floor.

3.1.3.2 Duct Temperature Sensors

a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.

b. String duct averaging sensors between two rigid supports in a serpentine position to sense average conditions. Thermally isolate temperature sensing elements from supports. Provide duct access doors to averaging sensors.

c. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification.

3.1.3.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to effect proper flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material.

3.1.3.4 Outside Air Temperature Sensors

Provide outside air temperature sensor on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sunshields to protect outside air sensor from direct sunlight.

3.1.3.5 Low Temperature Protection Temperature Switch

For each 40 square feet of coil-face area, provide a temperature switch to sense the temperature at the location shown. Provide temperature switch sensing element in a serpentine pattern.

3.1.4 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.5 Thermometers

Provide thermometers at locations indicated. Mount thermometers to allow readability when standing on the floor.

3.1.6 Pressure Sensors

3.1.6.1 Differential Pressure

a. General: Install pressure sensing tips in locations to sense appropriate pressure conditions.

b. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.

c. Pumping Proof with Differential Pressure Switches: Install high pressure side between pump discharge and check valve.

3.1.7 Pressure Gages

Install pressure gages at locations indicated. Mount pressure gages to allow readability while standing on the floor.

3.1.8 Control Drawings

a. Post laminated copies of as-built control system drawings in each mechanical room.

b. Provide 6 sets of as-built drawings to the activity.

3.2 COMMISSIONING PROCEDURES

3.2.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control-system corrections to ensure that the systems function as described in the sequence of operation.

3.2.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirement shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC controller (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational-mode signal change, controller output relay contacts shall be observed to ensure that they function.

3.2.1.2 Weather-Dependent Test Procedures

Weather-dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.2.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system

sensing element and transmitter shall be performed by comparing the controller readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-controller readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-controller readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.2.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-controller readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.2.1.5 Averaging Temperature

Averaging-temperature sensing element and transmitter-to-controller readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.2.2 Zone System - Without Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. The system shall be checked to see that power is available where required, the outside air and relief air dampers are closed, the return air damper is open, and the supply-fan inlet vanes and cooling coil valve are closed.

b. Step 2 - Calibration Accuracy Check with HVAC System in Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the controller, and the thermometer and controller display readings logged. The calibration accuracy of the sensing element-to-controller readout for outside air, return air, mixed-air, and the cooling-coil discharge air temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the controller. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) The two-point calibration accuracy check for sensing

element-to-controller readout for the static pressure in the supply duct shall be performed.

(2) The two-point calibration accuracy check of the sensing element-to-controller readout for outside air, return air, and mixed-air temperatures shall be performed.

(3) The two-point calibration accuracy check of sensing element-to-controller readout for the fan discharge temperature shall be performed. The setpoint for the fan discharge temperature shall be set as shown. A change shall be simulated in the discharge air temperature through an operator entered value and it shall be verified that the control valve is modulated.

(4) The system shall be placed in the unoccupied-mode and it shall be verified that the occupied-mode light turns off, the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be artificially changed to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(5) With the HVAC system running, a smoke-detector trip input signal shall be simulated at each detector, and control-device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false alarming any Life Safety systems. It shall be verified that the HVAC system shuts down and the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

(6) Velocity setpoints shall be set for minimum and maximum flow and temperature setpoints for the heating/cooling dead band, for each VAV terminal unit. The actions of the controller, the operation of the damper, and the operation of heating shall be verified. It shall be verified that space temperature is maintained.

3.3 SITE TESTING

3.3.1 General

a. Demonstrate compliance of the BACS with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform site testing. Ensure that tests are performed by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems.

b. Tests are subject to oversight and approval by the Contracting Officer. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.

c. Obtain approval of the plan for each phase of testing before beginning that phase of testing. Give to the Contracting Officer written notification of planned testing at least 30 days prior to test. Notification shall be accompanied by the proposed test procedures. In

no case will the Contractor be allowed to start testing without written Government approval of test procedures. The test procedures shall consist of detailed instructions for complete testing to prove performance of the heating, ventilating and air-conditioning system and digital control system. Conduct performance verification test during one week of continuous HVAC and DDC systems operation and before final acceptance of work.

3.3.2 Performance Verification Test

Test procedures shall include tests outlined in the following paragraphs.

a. Check the operation of each output to verify correct operation. Command digital outputs on and off. Command analog outputs to minimum range, such as 4 mA, and maximum range, such as 20 mA, measure and record commanded and actual output values. Document each command and result for the test report.

b. With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

c. Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

d. Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

e. Furnish the Government graphed trends to show the sequence of operation is executed in correct order. Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, warm-up. Demonstrate proper control system response for abnormal conditions for which there is a specified response by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

f. Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes and stabilize in 1 minute. Control loop trend data shall be instantaneous and the time between data points shall not be greater than one minute.

3.3.3 Test Reporting for Performance Verification Tests

a. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken.

b. After the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and deliver a written report to the Government.

c. Provide a written report containing test documentation after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Government. As part of this

test review meeting, demonstrate by performing all portions of the performance verification test that each failure has been corrected. Based on the report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not commence retesting until after receipt of written notification by the Government. At the conclusion of retesting, assessment will be repeated.

-- End of Section --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004
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 1990) Mechanical Demand Registers
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformer for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)
ANSI C37.16	(1988; C37.16a) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements forElectrical 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 Changing; and 3750/4687 Through 60 000/80 000/100 000 kVA With Load Tap Changing
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 C80.5	(1990) Rigid Aluminum Conduit
ANSI C82.1	(1985; C82.1a; C82.1b; C82.1c; R 1992) 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	(1990) Hard-Drawn Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992) Laminated Thermosetting Materials
ASTM D 4059	(1991) 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) 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	(1978; R 1992) 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) 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	(1990) Recommended Practice for 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 Controls and Systems
NEMA ICS 2	(1993) Industrial Control and Systems, Controllers, Contactors Overload Relays Rated not More Than 2,000 Volts AC or 750 DC
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility

NEMA MG 1	(1993; Rev 1) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1989) 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	(1990) Panelboards
NEMA PB 2	(1989) Deadfront Distribution Switchboards
NEMA PE 5	(1985; R 1991) Utility Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1990) Low-Voltage Power Circuit Breakers
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	(1991) Metallic 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	(1996) National Electrical Code
NFPA 101	(1994) Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES (UL)

UL-03	(1996) Electrical Construction Materials Directory
UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 4	(1986; Rev thru Nov 1990) Armored Cable

UL 5	(1995) Surface Metal Raceways and Fittings
UL 6	(1993; Rev March 96) Rigid Metal Conduit
UL 20	(1995) General-Use Snap Switches
UL 44	(1991; Rev thru Jun 1996) Rubber-Insulated Wires and Cables
UL 50	(1995) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Dec 1993) Panelboards
UL 83	(1991; Rev thru Jun 1996)Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R Oct 1995) Enclosed and Dead-Front Switches
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Jun 1993) 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	(1986; Rev thru Dec 1995) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Oct 1996) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; Rev thru Oct 1996) Splicing Wire Connectors
UL 486E	(1994; Rev Aug 95) Equipment Wiring Terminal for Use with Aluminum and/or Copper Conductors
UL 489	(1996) Molded-Case Circuit Breakers and

	Circuit-Breaker Enclosures
UL 498	(1991; Rev thru Oct 1995) Attachment Plugs and Receptacles
UL 506	(1994; Rev Jul 1994) Specialty Transformers
UL 508	(1993) Industrial Control Equipment
UL 510	(1994) Insulating Tape
UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1991; Rev Jun 1996) Metallic Outlet Boxes
UL 514B	(1989; Rev thru Apr 1995) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; Rev thru Jul 1996) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 674	(1994; Rev thru Jul 1996) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Jul 1996) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1996) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev May 1995) Electrical Metallic Tubing
UL 817	(1994; Rev thru May 1996) Cord Sets and Power-Supply Cords
UL 844	(1995; Rev thru Aug 1996) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996) Service-Entrance Cables
UL 857	(1994; Rev Oct 1994) Busways and Associated Fittings
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment

UL 877	(1993; Rev Jul 1995) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Jul 1995) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 924	(1995; Rev May 1995) Emergency Lighting and Power Equipment
UL 935	(1995; Rev Jun 1995) Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru Sep 1996)Ground-Fault Circuit Interrupters
UL 1004	(1994; Rev thru May 1996) Electric Motors
UL 1010	(1995; Rev thru Jul 1996)Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1994) Line Isolation Monitors
UL 1029	(1994; Rev Sep 1995) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995) Isolated Power Systems Equipment
UL 1236	(1994; Rev thru Apr 1996) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit
UL 1449	(1985; Errata Apr 1986) Transient Voltage Surge Suppressors
UL 1564	(1993; Rev Apr 1994) Industrial Battery Chargers
UL 1569	(1995) Metal-Clad Cables
UL 1570	(1995) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Mar 95) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Sep 96) High Intensity Discharge Lighting Fixtures
UL 1660	(1994) Liquid-Tight Flexible Nonmetallic Conduit

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 herein 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 located to avoid interference with mechanical or structural features; 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 electrical work with the HVAC and electrical drawings and specifications and provide power related wiring.

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 70 unless 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	
Switchboards	
Motors	

Each panel, section, or unit in motor control centers 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 two sets of as-built drawings to the Contracting Officer.

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; _GA_.

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; _GA_.

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, 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; __GA _.

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.

c. Battery system including calculations for the battery and charger.

d. Voltage regulators.

e. Grounding resistors.

f. Motors and rotating machinery.

g. Motor control centers.

i. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

j. Sway bracing for suspended luminaires.

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

On-Site 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 on-site test submitted 20 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; GA.

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. 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 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. All conductors shall be copper.

2.1.1 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.

2.1.2 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], 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.

2.1.3 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.

2.1.5 Non-metallic Sheathed Cable

UL 719, type NM or NMC.

2.1.6 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.1.7 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.1.8 Mineral-Insulated, Metal-Sheathed Cable

UL listed NFPA 70, type MI cable. Sheathing containing asbestos fibers shall not be used.

2.1.9 Flat Conductor Cable

UL listed NFPA 70, type FCC.

2.1.10 Cord Sets and Power-Supply Cords

UL 817.

2.2 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 as indicated. Fuses shall not be used as surge suppression.

2.3 CIRCUIT BREAKERS

2.3.1 MOLDED-CASE CIRCUIT BREAKERS

Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.3.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only 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.

2.3.1.2 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.

2.3.1.3 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.3.1.4 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."

2.3.2 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.

2.4 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.

2.4.1 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.

2.4.2 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

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 4	A-W
NEMA 5	A-Y

2.5 CONDUIT AND TUBING

2.5.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.5.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.5.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.5.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.5.5 Intermediate Metal Conduit

UL 1242.

2.5.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.5.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.5.8 Rigid Metal Conduit

UL 6.

2.5.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.5.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.6 CONDUIT AND DEVICE BOXES AND FITTINGS

2.6.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.6.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.6.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.6.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.8 CONNECTORS, WIRE PRESSURE

2.8.1 For Use With Copper Conductors

UL 486A.

2.9 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.9.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.9.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.10 ENCLOSURES

NEMA ICS 6 or NEMA 250 unless otherwise specified.

2.10.1 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.

2.10.2 Circuit Breaker Enclosures

UL 489.

2.11 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings, if any. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.11.1 Fixture, Auxiliary or Emergency

UL 924.

2.11.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. 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.

b. Ballasts:

(1) Electronic Ballast. Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway, and are identically controlled.

(a) Light output regulation shall be +/- 10%.

(b) Voltage input regulation shall be +/- 10%.

(c) Lamp current crest factor shall be no more than 1.6.

(d) Ballast factor shall be not less than 85% nor more than 100%, unless otherwise indicated.

(e) A 60 Hz filter shall be provided. Flicker shall be no more than 10% with any lamp suitable for the ballast.

(f) Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.

(g) Total harmonic distortion shall be in the range of 10-20%.

(h) Power factor shall not be less than 0.95.

(i) Ballasts shall operate at a frequency of 20 kHz or more.

(j) Operating filament voltage shall be 2.5 to 4.5 volts.

(k) Warranty. Three year full warranty including a $10 labor allowance.

(l) Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If

32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL INPUT VOLTAGE	NUMBER OF LAMPS	MIN. BALLAST EFFICACY FACTOR
40W F40 T12	rapid start	120 or 277 V	1	2.3
			2	1.2
			3	0.8
			4	0.6
34W F40 T12	rapid start	120 or 277 V	1	2.6
			2	1.3
			3	1.0
			4	0.7
40W F40 T10	rapid start	120 or 277 V	1	2.2
			2	1.1
			3	0.8
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

c. Lampholders, Starters, and Starter Holders: UL 542.

2.11.4 High-Intensity-Discharge

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

b. Ballasts: ANSI C82.4 for multiple supply types and UL 1029.

2.12 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.12.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.12.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.12.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.12.4 Fuses, Class H

UL 198B.

2.12.5 Fuses, Class R

UL 198E.

2.12.6 Fuses, Class T

UL 198H.

2.12.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.12.8 Fuses, D-C for Industrial Use

UL 198L.

2.12.9 Fuseholders

UL 512.

2.13 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.14 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors; and UL 674 for use of motors in hazardous (classified) locations.

2.14.1 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.

2.14.2 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. 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 Motor Efficiencies

HP	Std. Efficiency	High Efficiency
1	77.0	85.5
1.5	78.5	85.5
2	78.5	85.5
3	78.5	88.5
5	82.5	88.5
7.5	84.0	90.0
10	85.5	90.0
15	85.5	91.0
20	87.5	92.0
25	88.5	92.0
30	88.5	92.0
40	88.5	92.0
50	89.0	92.5
60	89.0	92.5
75	89.0	95.5
100	90.0	93.5
125	91.0	94.5
150	91.0	94.5
200	91.0	94.5
250	91.0	94.5
300	91.0	94.5
350	91.0	94.5
400	91.0	94.5
500	91.0	94.5

2.15 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.15.1 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.

2.15.2 Motor Starters

Combination starters shall be provided with circuit breakers.

2.15.2.1 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.

2.15.3 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.

2.15.4 Low-Voltage Motor Overload Relays

2.15.4.1 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. Standard units shall be used for motor starting times up to 7 seconds. Slow units shall be used for motor starting times from 8 to 12 seconds. Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.

2.15.4.2 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.

2.15.4.3 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.

2.15.5 Automatic Control Devices

2.15.5.1 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 horsepowerrating.

2.15.5.2 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.

2.15.5.3 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.

2.15.6 Motor Control Centers

Control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class 1, Type A. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar, bus bar shall be copper.

2.16 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.17 RECEPTACLES

2.17.1 Commercial Grade

UL 498.

2.17.2 Ground Fault Interrupters

UL 943, Class A or B.

2.17.3 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.

b. 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R, locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R, locking: NEMA type L15-15R.

2.18 Service Entrance Equipment

UL 869A.

2.19 SPLICE, CONDUCTOR

UL 486C.

2.20 SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose 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.

2.20.1 Circuit Breakers

Circuit breakers shall be stationary molded-case circuit breakers.

2.20.2 Auxiliary Equipment

2.20.2.1 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 600 volts, complete with selector switch having off position and positions to read each phase to phase voltage.

2.20.2.2 Control Switch

A control switch with indicating lights shall be provided for each electrically operated breaker.

2.21 SNAP SWITCHES

UL 20.

2.22 TAPES

2.22.1 Plastic Tape

UL 510.

2.22.2 Rubber Tape

UL 510.

2.23 TRANSFORMERS

Three-phase transformers shall have two windings per phase. Copper windings shall be provided. 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.

2.23.1 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 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 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. Provide transformers in NEMA 1 enclosure.

2.23.2 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

2.24 ISOLATED POWER SYSTEM EQUIPMENT

UL 1047, with monitor UL 1022.

2.25 WATTHOUR METERS, UTILITY REVENUE

Watthour meters shall conform to ANSI C12.1 and ANSI C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15-minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than two and one-half stators. Watthour demand

meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.1. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of one pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.27 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.28 Ceiling Fans

Fan shall be 1050-1350 mm (42-52 inch) paddle type, variable speed, reversible, low profile. Fans shall be provided with 4 blades balanced and shaped to assure smooth operation. Motor shall be induction type, permanently bubricated, direct drive, capable of 225 RPM. at high speed. Motor shall be three speed reversable, with air volume range between 613 and 2832 LPS (1300 and 7000 CFM)and speeds between 75 and 225 rpm. Motors shall be sufficiently isolated to provide quiet operation. Maximum power consumption shall be 80 watts and 0.7 amps. For finish and blade type, see SECTION 09000 BUILDING COLOR AND FINISH SCHEDULE. Each fan shall be provided with a wall control for on/off operation and to provided selection of speeds . Manufacturer's warranty shall be not less than 20 years.

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 boxes for receptacles, 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 rigid aluminum conduit, rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, electrical nonmetallic tubing, intermediate metal 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. Nonmetallic-sheathed cables or metallic-armored cables may be installed in areas permitted by NFPA 70. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

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 07270FIRESTOPPING. 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. Wiring installed in underfloor duct system shall be suitable for installation in wet locations.

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 254 mm 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 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. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.5 Supports

Except where otherwise permitted by NFPA 70, conduits and tubing shall be securely and rigidly fastened in place 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 will 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.

3.2.1.6 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 70definitions.

3.2.1.7 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.

3.2.1.8 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirement 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 size or larger.

3.2.2 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.

3.2.2.1 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.

3.2.2.2 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.

3.2.2.3 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.

3.2.2.4 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.

3.2.2.5 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 three-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).

.

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 must not exceed the maximum specified for that box in UL-03. Only boxes listed in UL-03 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, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal 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 inchinto 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 Floor Outlets

Floor outlets shall be nonadjustable and each outlet shall consist of a cast-metal body with threaded openings for conduits, flange ring, and cover plate with 1/2 inch or 3/4 inch threaded flush plug. Gaskets shall be used where necessary to ensure a watertight installation. Plugs with installation instructions shall be delivered to the Contracting Officer at the job site for capping outlets upon removal of service fittings.

3.5.3 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.

3.5.3.1 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.

3.5.3.2 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.

3.5.4 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

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-ampere277 -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. 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 used as a motor disconnecting means shall be capable of being locked in the open position. 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 or fusible switch 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, Class G J K L RK1 RK5 RK9 T CC 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 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.

3.11 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 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class 1, Type A. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with circuit breakers. Motor control centers shall be provided with a full-length ground bus bar.

3.12.3 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.

3.12.4 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 when required by NFPA 70 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. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. 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 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

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 in the fixtures just prior to the completion of the project.

3.15.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall be as indicated and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved. Fluorescent lamps for electronic ballasts shall be as indicated.

3.15.1.3 High-Intensity-Discharge

High-intensity-discharge lamps shall be the high-pressure sodium type unless otherwise indicated, shown, or approved.

3.15.2 Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on Standard Drawing No. 40-06-04, Sheet Nos. 3, 9, 11, 16, 17, 19, 20, 25, 26, 31, 33, 56, 66, which accompany and form a part of this specification for the types indicated. Illustrations shown on these sheets 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. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.15.2.2 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers in order to ensure a plumb installation. Pendants, rods, or chains 4 feetor longer excluding fixture, shall be braced to limit swinging. Bracing shall be 3 directional, 120 degrees apart. Single unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing or stems shall be 10 feet. Rods shall be of not less than 3/16 inch diameter. Flexible raceway shall be installed to each fixture from an overhead junction box. Fixture to fixture wiring installation is allowed only when fixtures are installed end to end in a continuous run.

3.15.2.3 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on, or from the suspended ceiling provided under other sections of these specifications. Installation and support of fixtures shall be in accordance with the NFPA 70 and manufacturer's recommendations. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive type of suspended 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 panels, in conformance with UL-03. Surface-mounted fixtures shall be suitable for fastening to the structural support for ceiling panels.

3.15.2.4 Sockets

Sockets of industrial, strip, and other open type fluorescent fixtures shall be of the type requiring a forced movement along the longitudinal axis of the lamp for insertion and removal of the lamp.

3.16 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.17 EQUIPMENT CONNECTIONS

All 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.

AM#5
3.22.4.1 Not Used.

3.21.3.2 Low Voltage Cable Tests

a. Continuity test.

b. Insulation resistance test.

3.21.4 Phase Matching And Phase Rotating Test

Phase matching and phase rotation shall be finally checked immediately prior to energizing all power equipment covered by these specifications.

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 .

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, Low Voltage

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 and electrical operation of the breaker.

3.21.7.2 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.

3.21.8 Motor Control Centers

a. Insulation resistance test phase-to-phase, all combinations.

b. Insulation resistance test phase-to-ground, each phase.

c. Manual and electrical operational tests.

3.21.9 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. These tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to insure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

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 40 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 --

ACCOMPANYING AMENDMENT NO. 0005 TO SOLICITATION NO. DACA63-99-B-0004
SECTION 16710

PREMISES DISTRIBUTION SYSTEM
04/97

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/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-569	(1990) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA-606	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607	(1994) Commercial building Grounding and Bonding Requirements for Telecommunications
EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems

IBM PUBLICATION CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
IBM GA27-3773-1	(1987) Cabling System Technical Interface Specifications

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
ICEA S-83-596	(1994) Fiber Optic Premises Distribution Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORY (UL)

UL 50	(1995) Enclosures for Electrical Equipment

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. With the exception of furnishing and installing conduit, electrical boxes, and pullwires, this work shall not be done by the Electrical Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the premises distribution system cables and associated hardware.

c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

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

Spare Parts; FIO.

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 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, and a list of spare parts recommended for stocking.

SD-04 Drawings

Premises Distribution System; GA.

[AM#5]
Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; GA.

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-06 Instructions

Manufacturer's Recommendations; GA.

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

SD-08 Statements

Test Plan; GA.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; GA.

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-09 Reports

Test Reports; FIO.

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on 3-1/2 inchdiskettes in ASCII format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

SD-13 Certificates

Premises Distribution System; FIO.

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-A, EIA ANSI/TIA/EIA-569, and EIA ANSI/TIA/EIA-606 standards.

Materials and Equipment; FIO.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; GA.

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

SD-18 Records

Record Keeping and Documentation; GA.

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606.

1.6 DELIVERY AND STORAGE

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

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8 RECORD KEEPING AND DOCUMENTATION

1.8.1 Cables

A record of all installed cable shall be provided in hard copy format per EIA ANSI/TIA/EIA-606. The cable records shall include only the required data fields per EIA ANSI/TIA/EIA-606.

1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format per EIA ANSI/TIA/EIA-606. The hardware records shall include only the required data fields per EIA ANSI/TIA/EIA-606.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Cable Insulation

For each individual Category 5 cable, the insulation, material used on each pair shall be exactly the same in all physical, electrical, and chemical respects. The use of Teflon insulated, plenum rated Category 5 cable is acceptable for both plenum and non-plenum applications. If Teflon insulated plenum rated cable is used by the Contractor, it shall be Type 4x0, where all four pairs are Teflon insulated. Type 3x1 and 2x2 are not acceptable.

2.2.2 Riser Cable

Riser cable shall meet the requirements of ICEA S-80-576 and EIA ANSI/TIA/EIA-568-A for Category 5 100-ohm unshielded twisted pair cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMR per NFPA 70.

2.2.3 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-A for Category 5 horizontal cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMG per NFPA 70.

2.2.4 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with and EIA ANSI/TIA/EIA-568-A.

2.2.4.1 Telecommunications Outlets

Wall and desk outlet plates shall come equipped with four modular jacks, with the top jacks labeled "voice" and the bottom jacks labeled "data". Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-A. Modular jack

pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be ivory in color, impact resistant plastic. Mounting plates shall be provided for system furniture and shall match the system furniture in color. Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as indicated on the drawings. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-A, Category 5.

2.2.4.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted insulation displacement connectors, arranged in rows or columns on 19 inch rack mounted panels. Jack pin/pair configuration shall be T568B per EIA ANSI/TIA/EIA-568-A. Jacks shall be unkeyed. Panels shall be labeled with alphanumeric x-y coordinates.

[AM#5]
2.2.4.3 Not Use.

2.2.4.4 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 66 which meet the requirements of EIA ANSI/TIA/EIA-568-A for category 5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.11 EQUIPMENT RACKS

2.11.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be steel relay racks to mount equipment 19 inches wide with standoff brackets for wall mounting.

Uprights shall be drilled and tapped 12-24 in a 1/2 inch pattern. Standoff brackets shall be of sufficient length for a 6 inch clearance between rack and wall.

2.11.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.12 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, finished with two coats of insulating vanish or painted with white or light colored paint.

2.13 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 3/4 inch conduit.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07270 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-A and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Copper cable not in a wireway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches

shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

3.1.3.2 Cables

Unshielded twisted pair cables shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper

distance from the termination as specified in EIA ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607 and Section 16415ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

a. 10 of each type outlet.

b. 10 of each type cover plate.

c. 1 of each type terminal block for each telecommunications closet.

d. Not used.

e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

3.5 ADMINISTRATION AND LABELING

3.5.1 Labeling

3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606.

3.5.1.2 Cable

All cables will be labeled using color labels on both ends with unencoded identifiers per EIA ANSI/TIA/EIA-606.

3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels with unencoded identifiers per EIA ANSI/TIA/EIA-606.

3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

3.6.2 Category 5 Circuits

All category 5 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TSB 67standard. Testing shall use the Basic Link Test procedure of EIA TSB 67. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

-- End of Section --