

SECTION TABLE OF CONTENTS

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13080

SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 General
 - 1.2.2 Mechanical/Electrical Equipment
 - 1.2.3 Mechanical/Electrical Systems
 - 1.2.4 Equipment and Systems
 - 1.2.5 Pipes and Ducts Requiring No Special Seismic Restraints
 - 1.2.6 All Other Interior Piping, Conduit, and Ducts
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Bolts and Nuts
 - 2.1.2 Sway Bracing
 - 2.1.3 Flexible Couplings
 - 2.1.3.1 Flexible Ball Joints
 - 2.1.3.2 Flexible Mechanical Joints
 - 2.1.4 Lighting Fixture Supports

PART 3 EXECUTION

- 3.1 BRACING AND COUPLING
- 3.2 BUILDING DRIFT
- 3.3 FLEXIBLE COUPLINGS OR JOINTS
 - 3.3.1 Building Piping
 - 3.3.2 Underground Piping
- 3.4 PIPE SLEEVES
- 3.5 SPREADERS
- 3.6 ANCHOR BOLTS
 - 3.6.1 Cast-In-Place
 - 3.6.2 Minimum Bolt Sizes, Cast-In-Place Anchor Bolts
 - 3.6.3 Expansion or Chemically Bonded Anchors
 - 3.6.3.1 General Testing
 - 3.6.3.2 Torque Wrench Testing
 - 3.6.3.3 Pullout Testing
- 3.7 RESILIENT VIBRATION ISOLATION DEVICES
 - 3.7.1 Resilient and Spring-Type Vibration Devices
 - 3.7.2 Multidirectional Seismic Snubbers
- 3.8 SWAY BRACES FOR PIPING
 - 3.8.1 Transverse Sway Bracing
 - 3.8.2 Maximum Span for Transverse Sway Braces in Seismic Zone 4
 - 3.8.3 Longitudinal Sway Bracing
 - 3.8.4 Vertical Runs

- 3.8.5 Anchor Rods, Angles, and Bars
- 3.8.6 Maximum Length for Anchor Braces
- 3.8.7 Clamps and Hangers
- 3.8.8 Bolts
- 3.9 SWAY BRACES FOR DUCTS
 - 3.9.1 Braced Ducts
 - 3.9.2 Unbraced Ducts
 - 3.9.3 Transverse Sway Bracing
 - 3.9.4 Longitudinal Sway Bracing
 - 3.9.5 Bracing Angles
- 3.10 SWAY BRACES FOR CONDUIT
- 3.11 EMERGENCY GAS SUPPLY CONNECTIONS
- 3.12 EQUIPMENT SWAY BRACING
 - 3.12.1 Suspended Equipment
 - 3.12.2 Floor or Pad Mounted Equipment
 - 3.12.2.1 Shear Resistance
 - 3.12.2.2 Overturning Resistance
- 3.13 MISCELLANEOUS EQUIPMENT
 - 3.13.1 Rigidly Mounted Equipment
 - 3.13.2 Nonrigid or Flexibly-Mounted Equipment
- 3.14 LIGHTING FIXTURES IN BUILDINGS
 - 3.14.1 Pendant Fixtures
 - 3.14.2 Recessed Fluorescent Fixtures
 - 3.14.3 Assembly Mounted on Outlet Box
 - 3.14.4 Surface-Mounted Fluorescent Fixtures
 - 3.14.5 Wall-Mounted Emergency Light Unit
 - 3.14.6 Lateral Force
 - 3.14.7 Tests
 - 3.14.7.1 Test Equipment
 - 3.14.7.2 Test Equipments
 - 3.14.7.3 Acceptance
- 3.15 SUSPENDED CEILING ASSEMBLIES
- 3.16 BRIDGE CRANES AND MONORAILS
- 3.17 SCHEDULES
- 3.18 SEISMIC PROTECTION FOR ELEVATORS

-- End of Section Table of Contents --

SECTION 13080

SEISMIC PROTECTION FOR MECHANICAL, ELECTRICAL EQUIPMENT

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 36	(1997a) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153	(1998) Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996) Strength of Anchors in Concrete and Masonry Elements

ASME INTERNATIONAL (ASME)

ASME A.17.1	Seismic Protection for Elevators.
-------------	-----------------------------------

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-099S94	(1994) Uniform Building Code
-------------	------------------------------

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-12	(1991; Appx E, 1993) Seismic Restraint Manual Guidelines for Mechanical Systems
-----------	---

UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995; Rev thru Jun 1997) Fluorescent
Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 General

The work covered in this section consists of furnishing all labor, equipment and materials required to add seismic bracing and supports to equipment in the access tower, gate room and control room and valve vault which require seismic support.

The requirements for seismic protection measures to be applied to mechanical/electrical equipment and system specified herein are in addition to any other item called for in other sections of these specifications.

The requirements for seismic protection measures described in this section shall be applied to mechanical/electrical equipment and systems specified herein and in addition to any other items called for in other Sections of these specification. Seismic protection requirements shall be in accordance with ICBO-099S94 using an importance factor of 1.5 and shall be provided in addition to any other requirements called for in other sections of these specifications. This facility shall be designed as being in seismic zone 4; no other zone values shall be used to establish bracing requirements. Lateral support against earthquake induced forces shall be accomplished by positive attachments without consideration of friction resulting from gravity loads.

1.2.2 Mechanical/Electrical Equipment

Mechanical/electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

- Accumulator Tank
- Bridge Cranes and Monorails
- Control Panels
- Ducts and Fans
- Expansion Air Separator Tanks
- Flash Tanks
- Pumps with Motors
- Light Fixtures
- Motor Control Centers
- Storage Racks
- Storage Tanks for Oil and Water
- Switchboards (Floor Mounted)
- Switchgear
- Transformers
- Unit Heaters
- Conduit and Boxes
- Diesel Engine Generators
- Drain, Waste, and Vent Piping
- Emergency Closure Gates and Storage Facilities
- Hydraulic Control Units
- Hydraulic Hoist Cylinders and Mountings
- Maintenance Bulkhead and Storage Facilities
- Regulating Outlet Gates

Panel Boards (Wall Mounted)
Under Hung Crane
Water, Oil and Gas Piping

These mechanical systems shall be seismically protected in accordance with this specification and to the extent required on the drawings and other specifications included in this contract.

This facility is located in Seismic Zone 4. The zones indicated in NFPA 13 have no bearing on the requirements of this specification

1.2.3 Mechanical/Electrical Systems

The following mechanical and electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building in Accordance With This Specification
All Water Supply Systems
Storm and Sanitary Sewer Systems
All Process Piping

1.2.4 Equipment and Systems

The bracing for mechanical/electrical equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification.

1.2.5 Pipes and Ducts Requiring No Special Seismic Restraints

Seismic restraints may be omitted from the following installations:

- a. All piping less than 2-1/2 inches inside diameter.
- b. Electrical conduit less than 2-1/2 inches inside diameter.
- c. Rectangular air handling ducts less than 4 square feet in cross sectional area.
- d. Round air handling ducts less than 18 inches in diameter.
- e. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- f. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions e. and f. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced.

1.2.6 All Other Interior Piping, Conduit, and Ducts

Interior piping, conduit, and ducts not covered by paragraphs Exclusion or Pipes and Ducts Requiring No special Seismic Restraints shall be seismically protected in accordance with the provisions herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Bracing and Coupling; G
- Flexible Couplings or Joints; G
- Resilient Vibration Isolation Devices; G
- Bridge Cranes and Monorails; G
- Lighting Fixtures in Buildings
- Sway braces for duct work, piping, and other equipment; G
- Day tank and skid base fuel tank seismic restraints; G
- Electrical cabinets mounting brackets; G
- Ventilation duct and diesel engine-generator set exhaust duct brackets; G

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-05 Design Data

- Bridge Cranes and Monorails; G
- Bracing and Coupling; G
- Lighting Fixtures in Buildings; G
- Miscellaneous Equipment; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

SD-07 Certificates

- Crane, hoist equipment, and day tank
- Flexible Ball Joints

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer, based on not less than 2 years' satisfactory operation in a similar application.

Certify that crane, hoist equipment, and day tank meet the seismic loading conditions specified herein.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the requirements specified below.

2.1.1 Bolts and Nuts

Squarehead and hexhead bolts, and heavy hexagon nuts, ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153.

2.1.2 Sway Bracing

Material used for members listed in the Schedules of this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36.
- b. Wire rope, ASTM A 603.
- c. Tubes and steel pipes, ASTM A 500, grade B.
- d. Pipes, ASTM A 53 Type E or S, Grade B.
- e. Light gauge angles, less than 1/4 inch thickness, ASTM A 653.

2.1.3 Flexible Couplings

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe specified in section 15400.

2.1.3.1 Flexible Ball Joints

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation plus not less than 15-degree angular movement.

2.1.3.2 Flexible Mechanical Joints

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be high-strength type as specified above.

2.1.4 Lighting Fixture Supports

Fixture supports shall be malleable iron. Lighting fixtures and supports shall conform to UL 1570 as applicable.

PART 3 EXECUTION

3.1 BRACING AND COUPLING

Bracing and coupling shall conform to the arrangements shown. Provisions

of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. No trapeze-type hanger shall be secured with less than two 1/2 inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Sway braces for a run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Joints capable of accommodating seismic displacements shall be provided where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, swing joints shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets or no-hub fittings may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to comply with these requirements.

3.3.2 Underground Piping

Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 3 inches of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in

accordance with the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 ANCHOR BOLTS

If the size and number of the anchor bolts are not shown on the drawings then anchor bolts shall conform to the schedule for the various equipment weights or the manufacturer's installation recommendations, whichever is the most stringent. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the table at the end of this section.

3.6.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. Two nuts shall be provided on each bolt. Anchor bolts shall conform to the following tabulation for the various equipment weights and specified seismic zone or the manufacturer's installation recommendations, whichever is the most stringent, unless otherwise shown on the drawings. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.6.2 Minimum Bolt Sizes, Cast-In-Place Anchor Bolts

Maximum Equipment Weight (Pounds)	Minimum Bolt Sizes (Inches)* Zone 4
500	1/2
1,000	1/2
5,000	1/2
10,000	1/2
20,000	1/2
30,000	5/8
50,000	7/8
100,000	**

*Based on four bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Equivalent total cross-sectional area shall be used when more than four bolts per item are provided. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt.

**Equipment weighing more than 50,000 lb shall have at least six bolts per item.

3.6.3 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. The expansion anchor size shall be not less than that required in paragraph: Minimum Bolt Sizes, Cast-In-Place Anchor Bolts. Expansion and chemically bonded anchors shall be installed

in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.6.3.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.6.3.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.6.3.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than three per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.7 RESILIENT VIBRATION ISOLATION DEVICES

Selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph: ANCHOR BOLTS except that an equipment weight equal to five times the actual equipment weight shall be used.

3.7.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.7.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on all floor- or slab-mounted equipment. These snubbers shall provide 0.25 inches free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.8 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

Sway braces shall be installed on piping, conduit, and duct to preclude damage during seismic activity. All bracing shall conform to the equipment arrangements shown. Provisions of this paragraph apply to all piping within a 5-foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. Do not fasten sway braces to 2 dissimilar parts of a building that may respond in a different mode during an earthquake; for example, a wall and a roof. No trapeze-type hanger shall be secured with less than two 1/2-inch bolts. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.8.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those given in the tabulation below as modified for each seismic zone. All runs shall have a minimum of two transverse braces.

Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400 PLUMBING, GENERAL PURPOSE.

3.8.2 Maximum Span for Transverse Sway Braces in Seismic Zone 4

Pipe Diameter (in.)	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
	L(ft.)	F(lbs.)	L(ft.)	F(lbs.)	L(ft.)	F(lbs.)
1	22	70	22	80	11	17
1-1/2	25	140	26	180	12	35
2	29	220	30	290	14	70
2-1/2	32	380	33	460	15	110
3	34	550	35	710	17	150
3-1/2	36	730	38	930	18	220
4	39	960	40	1,200	19	300
5	41	1,440	44	1,900	20	470
6	45	2,120	46	2,750	22	730
8	49	3,740	54	5,150	26	1,550

Pipe Diameter (in.)	Std. Wgt. Steel Pipe - 40S		Ex. Strong Steel Pipe - 80S		Copper Tube Type L	
	L(ft.)	F(lbs.)	L(ft.)	F(lbs.)	L(ft.)	F(lbs.)
10	54	6,080	59	7,670	28	2,630
12	58	8,560	61	10,350	31	3,950

NOTE: Bracing shall consist of at least one vertical angle 2 x 2 x 16 gauge and one diagonal angle of the same size.

3.8.3 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals except when the location of sway braces is shown on the drawings for the particular piping system. All runs shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.8.4 Vertical Runs

Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. For tubing, bracing shall be provided at no more than 4 foot spacing. Vertical braces shall be above the center of gravity of the span being braced. All sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.8.5 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.8.6 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum length* (Feet/Inches)	Allowable Loads* (kips)
Angles	1-1/2 x 1-1/2 x 1/4	4-10	5.7
	2 x 2 x 1/4	6-6	7.8
	2-1/2 x 1-1/2 x 1/4	8-0	9.8
	3 x 2-1/2 x 1/4	8-10	10.8
	3 x 3 x 1/4	9-10	11.9
Rods	3/4	3-1	3.7
	7/8	3-8	5.0
Flat Bars	1-1/2 x 1/4	1-2	3.1
	2 x 1/4	1-2	4.1
	2 x 3/8	1-9	6.2
Pipes (40S)	1	7-0	4.1

Type	Size (Inches)	Maximum length* (Feet/Inches)	Allowable Loads* (kips)
	1-1/4	9-0	5.5
	1-1/2	10-4	6.6
	2	13-1	8.9

*Based on the slenderness ratio of $l/r = 200$ and ASTM A 36 steel, where l is the length of the brace and r is the least radius of gyration of the brace.

3.8.7 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.8.8 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.9 SWAY BRACES FOR DUCTS

3.9.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA-12, including Appendix E, using Seismic Hazard Level A and connection level 1.

3.9.2 Unbraced Ducts

Hangers for unbraced ducts shall be positively attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

3.9.3 Transverse Sway Bracing

Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each duct run, and otherwise at each 30-foot interval. Walls which ducts penetrate may be considered transverse braces.

3.9.4 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 60-foot intervals. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and it is sized for the larger duct.

3.9.5 Bracing Angles

Bracing angles for rectangular ducts shall be in accordance with schedule "Bracing for Rectangular Ducts."

3.10 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe.

3.11 EMERGENCY GAS SUPPLY CONNECTIONS

Not used.

3.12 EQUIPMENT SWAY BRACING

3.12.1 Suspended Equipment

Equipment sway bracing shall be provided for items supported from overhead floor or roof structures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Braces shall conform to paragraph: Maximum Length for Anchor Braces. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 1.50 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.12.2 Floor or Pad Mounted Equipment

3.12.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph: ANCHOR BOLTS.

3.12.2.2 Overturning Resistance

The ratio of the height of the equipment (measured from the base to the center of gravity of the equipment) to the minimum distance between anchor bolts shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. If this ratio is greater than 1.67 the bolt values in paragraph: Minimum Bolt Sizes, Cast-In-Place Anchor Bolts shall not be used and calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

3.13 MISCELLANEOUS EQUIPMENT

3.13.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand a horizontal lateral force of 0.30 times the operating weight of the equipment, at vertical center of gravity of the equipment without causing permanent deformation, dislocations, separation of components, or other damage, which would render the equipment inoperative for significant periods of time following an earthquake.

Rigidly Mounted Equipment

Free Standing Electric Motors
Motor Control Centers
Surge Tanks
Switchboards
Transformers
Diesel Engine-Generators (package unit with subbase tank)
Diesel Fuel Vault
Incinerating Toilet
Miscellaneous Equipment

3.13.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 0.9 times the operating weight of the equipment at the vertical center of gravity of the equipment.

3.14 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.14.1 Pendant Fixtures

Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

3.14.2 Recessed Fluorescent Fixtures

Not used.

3.14.3 Assembly Mounted on Outlet Box

A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4 inchboxes, 3 inch plaster rings, and fixture studs.

3.14.4 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking-type scissor clamp or a full loop band that will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.

3.14.5 Wall-Mounted Emergency Light Unit

Each wall-mounted emergency light unit shall be secured to remain in place during a seismic disturbance.

3.14.6 Lateral Force

In lieu of the above test requirements, lighting fixtures shall be designed to resist a lateral force of 150 percent of the fixture weight.

Light fixture bracing shall be designed to resist a lateral force of 1.50 times the fixture weight.

3.14.7 Tests

In lieu of the requirements for equipment supports, lighting fixtures and the complete fixture-supporting assembly may be tested as specified hereinafter. Such tests shall be conducted by an approved and independent testing laboratory, and the results of such tests shall specifically state whether or not the lighting fixture supports satisfy the requirements given herein.

3.14.7.1 Test Equipment

To simulate earthquake motion, fixtures and supports shall be attached to a carriage suspended on rollers from an overhead track. A gear motor and crank assembly shall be used to provide oscillatory motion of approximately one cycle per second. The exact number of cycles per second and the actual dimensions of the crank apparatus shall be adjusted to produce a minimum carriage acceleration of 0.375 g. The actual fixture mounting surface shall be on the underside of the carriage and shall provide capacity for orienting the fixture in a horizontal plane in various positions, ranging from parallel to perpendicular to the line of traverse.

3.14.7.2 Test Equipments

All tests shall be conducted with the maximum fixture weight so as to produce the most severe loading conditions. Fixtures having stems shall be tested with the actual stem lengths to be used. Tests shall be of 1 minute duration with the mounting surface in the line of traverse, at 45 degrees to the line of traverse, and at 90 degrees to the line of traverse. A total of two fixtures shall be tested in each of the above positions. After each of the 6 tests, the complete stem assemblies shall be subjected to a tensile strength test. The sample shall withstand, without failure, a force of not less than 4 times the weight it is intended to support.

3.14.7.3 Acceptance

No component of a fixture nor its supports shall be accepted individually. For acceptance, the fixture and its supports shall exhibit no undue damage, and no component of the fixture shall fail or fall from the fixture during testing.

3.15 SUSPENDED CEILING ASSEMBLIES

Not used.

3.16 BRIDGE CRANES AND MONORAILS

Bridges cranes and monorails shall be designed to accommodate the following horizontal lateral force coefficient of 0.60 times weight, applied in any direction to the center of gravity of the equipment. The weight of such equipment need not include any live load, and the equivalent static force so computed will be assumed to act nonconcurrently with other prescribed nonseismic horizontal forces when considering the design of the crane and monorails. The crane design shall be suitable for the forces previously

specified in addition to the normal horizontal loads prescribed by standards cited in other sections of these specifications. The manufacturer shall submit a proper certification that the hoist and crane have been checked for seismic forces as specified herein and found satisfactory.

3.17 SCHEDULES

*Duct Size	Vertical and Longitudinal Angles	Diagonal Angles	Horizontal Angles	Bolt Size (Inches)
30	2x2x16 gage	2x2x16 gage	2x2x16 gage	1/4
42	2-1/2x2-1/2x16 gage	2-1/2x2-1/2x16 gage	2-1/2x2-1/2x16 gage	1/4
54	2-1/2x2-1/2x16 gage	2-1/2x2-1/2x14 gage	2-1/2x2-1/2x16 gage	3/8
60	3x3x16 gage	3x3x14 gage	3x3x16 gage	3/8

* Duct size unit: in/sq ft.

The duct's maximum dimension shall govern what bracing is required.

Example: A 36 by 60 inch duct shall be braced as a 60 inch square duct.

3.18 SEISMIC PROTECTION FOR ELEVATORS

Seismic protection for elevators shall be provided to conform to ASME A.17.1 Rule XXIV.

-- End of Section --

SECTION TABLE OF CONTENTS
DIVISION 13 - SPECIAL CONSTRUCTION
SECTION 13120
DIGITAL PHOTO DOCUMENTATION

PART 1 GENERAL

- 1.1 CONTRACTOR PHOTOS
- 1.2 BASIS FOR PAYMENT
- 1.3 CONTRACTOR'S RESPONSIBILITY
 - 1.3.1 Contractor Shall Supply
- 1.4 SUBMITTALS

PART 2 PRODUCTS

- 2.1 DIGITAL CAMERA
- 2.2 SECURE DIGITAL PHOTO MANAGEMENT SYSTEM

PART 3 EXECUTION

- 3.1 PHOTO REQUIREMENTS
- 3.2 TRANSFERRING PHOTOS

-- End of Section Table of Contents --

SECTION 13120

DIGITAL PHOTO DOCUMENTATION

PART 1 GENERAL

1.1 CONTRACTOR PHOTOS

The Contractor shall take regular photos of the Project as indicated in Part 3, Subpart 3.1. These photos, used in conjunction with the approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

1.2 BASIS FOR PAYMENT

The digital photos and the schedule shall be the basis for measuring Contractor progress. Lack of digital photos and an approved, updated schedule shall result in an inability of the owner's representative to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the owner's representative to evaluate Contractor progress for payment purposes.

1.3 CONTRACTOR'S RESPONSIBILITY

The Contractor is responsible for visually documenting the entire project using a digital camera and a secure digital photo management system similar to the LYNX Digital Photo Management System. The Contractor shall designate an authorized representative who shall:

- a. Take the digital photos.
- b. Download them into a secure digital photo management system.
- c. Add captions, full descriptions and keywords to each photo.
- d. Link each photo to the project's schedule by attaching the appropriate activity id to each photo.
- e. Transfer a copy of all photos and their related notes, keywords, captions, activity id's to the owner's representative on a weekly basis.

1.3.1 Contractor Shall Supply

- a. A single user master digital photo management system on the jobsite. This master system shall include the hardware and software necessary to operate the digital photo management system. The digital photo management system may be operated on the contractor's jobsite computer providing the jobsite computer meets the minimum hardware requirements of the digital photo

management system and it has adequate hard disk space available. Adequate hard disk space will be 500 megabytes of space reserved for the digital photo management system software and the digital photos.

- b. Maintenance and support for the digital photo management software for the duration of the project.
- c. A digital camera.
- d. 4 copies of the digital photo management system viewer software to be utilized by the owner's representative, architect, engineer, etc.

The digital camera and the master digital photo management software shall be turned over to the owner at the end of the project.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Digital Camera
Photo Management System

Seven (7) copies of product brochures of the digital camera and the secure digital photo management system

PART 2 PRODUCTS

2.1 DIGITAL CAMERA

The digital camera shall be a Kodak DC50 or equal and shall meet the following minimum specifications:

- a. Resolution - 756x504 pixels.
- b. Color - 24 bit color.
- c. Storage capacity - 48 photos.
- d. Removable memory card - 4 megabytes.
- e. Flash - 14 foot range.
- f. Aperture range - f/2.8 to f/24.
- g. Shutter speed - 1/16 to 1/500 second.
- h. Focusing method - Auto-focus using multi-infrared beam, spot or close-up.
- i. Zoom - 3:1 from 29 inches to infinity.

2.2 SECURE DIGITAL PHOTO MANAGEMENT SYSTEM

The computer software system utilized by the Contractor to document the Project with digital photos shall be capable of providing all of the requirements of this specification. The photos shall be downloaded by and stored in the LYNX Digital Photo Management System (800-873-0700) or approved equal. The digital photo management system shall:

- a. Be a commercially available product that has been on the market for at least one year.
- b. Download the camera directly into a high-speed database.
- c. Keep an unchangeable log of each download, and document the exact date and time of the download.
- d. Automatically compress the photos to an average of approximately 30k per photo.
- e. Secure the photos as soon as they are downloaded so that they cannot be modified.
- f. Provide a mechanism for verifying the integrity of the photos each time they are viewed to ensure that they haven't been modified.
- g. Provide visual indicators that the photos are secure.
- h. Automatically store the date and time with each photo where it cannot be modified.
- i. Automatically identify each photo with the serial number of the system that downloaded it, the download number, the photo number from the roll, and the person's name that took the photo. This information must be protected so that it can't be modified.
- j. Allow a caption of up to 30 characters to be attached to each photo. This caption shall appear automatically in the photo browser when the mouse pointer passes over the thumbnail of the photo.
- k. Allow a permanent description of up to 5,000 characters to be placed on each photo. Once the photo is filed this is permanent.
- l. Provide a file management system that allows an unlimited number of photos to be archived and retrieved easily. The system must be capable of automatically splitting its image database into multiple files that can be relocated by the system to removable media if desired (zip drives, read-write optical drives, etc.).
- m. Automatically store the photos in reverse date and time order.
- n. Allow the photos to be retrieved by date range instantly.
- o. Allow the photos to be located by keywords.
- p. Include built-in file transfer capabilities that will allow photos to be transferred easily from system to system using built-in modem software, floppy disk, Internet, etc. This file transfer system shall have the ability to automatically select all new

photos from the database, place a copy of these photos in a secure transfer packet along with their notes, keywords, etc., and send this secure packet to other systems.

- q. Include the ability to link the digital photos directly to the project's schedule (Primavera P3, SureTrak or Microsoft Project), and view all of the photos for a given activity instantly directly from the schedule.
- r. Include the ability to share the photos and their descriptions with parties that don't have a digital photo management system by creating diskettes with photos and their text descriptions. A royalty free viewer shall be placed on each of these diskettes that will allow the receiving party to view the photos and their descriptions.

PART 3 EXECUTION

3.1 PHOTO REQUIREMENTS

The Contractor shall document the Project by taking the following photos:

- a. Each Friday the Contractor shall take at least one photo of each item listed on the schedule that is a) in progress or b) supposed to be in progress.
- b. Each Friday one photo shall be taken from the same 16 locations around the jobsite. These locations will be determined at the beginning of the job by the owners representative. They shall be identified in the keywords field as directed by the owner's representative. For example, one of the photos may be taken each week from the north property line and it would be identified NI in the keywords field, WI would identify the photo taken from the west property line, etc. This will allow the project to be viewed from that point instantly by calling up all photos with the keyword NI, WI, etc.
- c. Each day photos shall be taken of the large items of equipment as they are delivered to the job site (chillers, generators, etc.)
- d. Once a week at least one photo shall be taken on any item that is considered to be a delay by the Contractor or Owner. The keyword DELAY shall be attached to these photos and a description of the delay shall be typed in the permanent description field.
- e. Immediately prior to the submission of the requisition each month, one photo shall be taken of each work activity and stored material line item in the requisition that is being requested. These photos shall be identified with a caption that is the same as the requisition's description, and the keyword shall be REQxxx where xxx is the line number from the requisition.
- f. Photos shall be taken immediately of all problem areas.
- g. Where possible, photos shall be taken of all items that are included in a Request for Information (RFI). These photos shall be identified in the keyword field of the photo as RFIxxx where xxx is the RFI number.

- h. Other miscellaneous photos shall be taken of other items as directed by the owner's representative (up to 50 photos per week).

3.2 TRANSFERRING PHOTOS

A packet transfer of all the new Project photos shall be sent to the owner's representative each week by one of the following methods as required:

- a. Floppy diskette (1.44 meg - Windows 95 format)
- b. Internet e-mail attachment.
- 3. Direct modem connection.

Packets may be sent on a more frequent basis if requested by the owner's representative.

-- End of Section --

SECTION TABLE OF CONTENTS
DIVISION 13 - SPECIAL CONSTRUCTION
SECTION 13210
MONUMENTATION AND INSTRUMENTATION

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL
 - 1.2.1 Other Instruments
 - 1.2.2 Contracting Officer's Instrumentation Specialist

PART 2 PRODUCTS

- 2.1 SETTLEMENT MONUMENTS
 - 2.1.1 Metals
 - 2.1.1.1 General
 - 2.1.2 Concrete
 - 2.1.2.1 Settlement Monument

PART 3 EXECUTION

- 3.1 SETTLEMENT MONUMENTS
 - 3.1.1 General
 - 3.1.1.1 Settlement Monuments
- 3.2 IDENTIFICATION
- 3.3 PROTECTION OF WORK
- 3.4 QUALITY CONTROL

-- End of Section Table of Contents --

SECTION 13210

MONUMENTATION AND INSTRUMENTATION

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 36	(1997a) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

1.2 GENERAL

The Contractor shall furnish and install settlement monuments. The Contractor shall provide all supportive equipment, labor, and materials for installation, data collection, protection and maintenance. All instruments, data collection equipment and accessories, will become the property of the Government at the end of the contract period.

1.2.1 Other Instruments

If the contractor proposes to furnish instruments other than those specified herein, proof of prior successful performance in similar application shall be required.

1.2.2 Contracting Officer's Instrumentation Specialist

The Government reserves the right to have an instrumentation specialist present during installation of each instrument. The Contractor shall notify the Contracting Officer at least seven (7) calendar days in advance of the date he expects to install any instrument so the Contracting Officer can arrange to have an instrumentation specialist present. The presence of a Government instrumentation specialist will not relieve the Contractor of the responsibility to have a manufacturer's representative present.

PART 2 PRODUCTS

2.1 SETTLEMENT MONUMENTS

2.1.1 Metals

2.1.1.1 General

Unless otherwise specified herein, workmanship, galvanizing, welding and materials shall conform to the applicable requirements of SECTION: 05120

STRUCTURAL STEEL AND MISCELLANEOUS METAL WORK.

- a. Steel plates and shapes shall be structural steel conforming to ASTM A 36, galvanized or treated with a high ratio zinc silicate compound.
- b. Pipe for the settlement monuments shall conform to ASTM A 53.

2.1.2 Concrete

Concrete shall conform to the applicable requirements of SECTION 03305: CONCRETE.

2.1.2.1 Settlement Monument

Concrete shall be thoroughly consolidated and finished in a dome at the top of the pipe.

PART 3 EXECUTION

3.1 SETTLEMENT MONUMENTS

3.1.1 General

Monuments shall be installed at the locations indicated. Exact locations of monuments will be determined by the Contracting Officer. Gages and monuments shall not be installed until all pavement, slope protection and related work has been completed. Surveys to determine elevations for settlement monuments will be accomplished by the Government. Excavation for concrete footings shall be of the dimensions indicated. If bedrock is encountered before reaching the required depth, the excavation shall be continued to the depth indicated or 18 inches into the bedrock, whichever is less. Prior to placing concrete, the excavation shall be cleared of loose material. Waste material shall be disposed of as directed.

3.1.1.1 Settlement Monuments

The Contractor shall furnish and install settlement monuments on the embankment as shown on the drawings. Surveying shall be to the same controls, vertical - nearest 1/1,000 ft., horizontal - nearest 1/1,000 ft., accuracy and precision as indicated in paragraph: Survey Monuments. The Contractor shall furnish to the Contracting Officer the horizontal and vertical location of each settlement monument with respect to established survey monuments at the time of installation and every 30 calendar days thereafter until completion of the contract. Readings shall be submitted on approved forms to the Contracting Officer no later than 24 hours after completion of a set of readings. The Contractor shall conduct his operations in such a manner that the settlement monuments will not be disturbed or damaged. Any settlement monument disturbed or damaged due to negligence on the Contractor's part shall be replaced or repaired and the correct horizontal and vertical locations shall be reestablished and furnished, all at the Contractor's expense. Monuments shall be installed as soon as final grade of the slope in their location is completed.

3.2 IDENTIFICATION

The Contractor shall furnish and install identification for each instrumentation installation. Settlement monuments shall have an identification plate. The plate shall be brass or stainless steel and

shall be attached to the protective covers as shown on the drawings. The plate shall identify the instrument number assigned by the Government, installation date, and tip or base elevation as appropriate. The information shall be stamped into the plate in letters and numbers not less than 1/2 inch in height. The Contractor shall submit a plan of identification, including sample identification tags and plates to the Contracting Officer for approval thirty (30) calendar days prior to installation.

3.3 PROTECTION OF WORK

The Contractor shall be responsible for protection of the instrumentation devices during the contract period until final acceptance of the system, and shall conduct his operations in such a manner that the devices will not be damaged. Suitable barricades or other means of protection shall be provided around the instruments for protection during construction of the embankment to prevent displacement of protective casing by earthmoving or compacting equipment. Every precaution shall be taken during installation and testing of the piezometers to keep moisture and any other foreign matter from contaminating the system. A penalty of \$5,000 will be assessed the Contractor for each instrument and/or instrumentation equipment damaged or rendered inoperative as a result of the Contractor's operations and shall be repaired or replaced by the Contractor at no additional cost to the Government.

3.4 QUALITY CONTROL

Upon completion of the entire instrumentation system as specified herein and before final acceptance by the Government, the Contractor shall test the entire instrumentation system and monitoring equipment in the presence of the Contracting Officer's instrumentation specialist to ensure the instrumentation system and equipment are installed as specified herein and in good operating condition. Any instrumentation and equipment not installed or operating properly shall be replaced or corrected as directed by the Contracting Officer at no additional cost to the Government.

-- End of Section --

SECTION TABLE OF CONTENTS
DIVISION 13 - SPECIAL CONSTRUCTION
SECTION 13310
ULTRASONIC MULTI-PATH FLOWMETER

PART 1 GENERAL

- 1.1 GENERAL INFORMATION
- 1.2 SUBMITTALS
- 1.3 EQUIPMENT TO BE FURNISHED
- 1.4 EQUIPMENT FUNCTION REQUIRED
- 1.5 EXPERIENCE AND QUALIFICATIONS
- 1.6 OPERATING CONDITIONS
- 1.7 WARRANTY

PART 2 PRODUCTS

- 2.1 TRANSDUCER ASSEMBLIES
- 2.2 FLOWMETER CONSOLE
- 2.3 TRANSDUCER CABLE

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 13310

ULTRASONIC MULTI-PATH FLOWMETER

PART 1 GENERAL

1.1 GENERAL INFORMATION

The contractor shall furnish an ultrasonic flowmeter for measurement in the channel, at the locations shown on the drawings, complete in accordance with these specifications. The flowmeter shall measure flow in the channel and shall display and output flowrate. The method used for velocity measurement shall be the acoustic transit time method which measures velocity by transmitting acoustic pulses between pairs of transducers mounted on the channel walls. There shall be sixteen acoustic paths used for velocity measurement in the channel. The velocity data from these paths shall be used, together with water level data provided by a level sensor, to calculate the flow through the channel. Transducer placement shall be determined by the flowmeter manufacture, Water depth in the channel shall range from 0.0' to 15.0'.

The flowmeter system shall be the Accusonic Series 7500 as manufactured by ORE International, Inc., P.O. Box 709, Falmouth, MA, 02541. Tel. (508) 548-5800. Fax. (508) 540-3835 or an approved equal.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Flowmeters and Console

Manufacturer's catalog data and descriptive literature shall be submitted for standard equipment and products to be incorporated in the work.

SD-10 Operation and Maintenance Data

Flowmeters and Console; G

The operation and maintenance manual (O&M) shall contain all information which may be needed for the operation, maintenance, repair, dismantling or assembling, and for identification of parts for ordering replacements. The manual will be subject to approval by the Contracting Officer.

1.3 EQUIPMENT TO BE FURNISHED

Equipment to be furnished shall include the following:

1. One 8-path flowmeter console and one 8-path remote transmitter in NEMA 4 wall-mount enclosures.
2. Thirty-two velocity transducer assemblies and cable. The approximate distance between the flowmeter console and the transducers ranges from 60 feet to 250 feet.
3. One downlooking acoustic transducer for water level measurement.

1.4 EQUIPMENT FUNCTION REQUIRED

The ultrasonic flowmeter will be required to perform the following:

1. Indicate and totalize flow through the channel. The measurements shall meet the following accuracy requirements:

<u>Discharge</u>	<u>Accuracy</u>
<600 cfs	2 percent
600-2000 cfs	4 percent
>2000 cfs	5-10 percent

2. Provide analog 4-20mA output of flowrate and water level for the channel.

1.5 EXPERIENCE AND QUALIFICATIONS

The flowmeter manufacturer shall have a minimum of ten years experience manufacturing and installing flowmeters of the multiple parallel path type specified. The flowmeter manufacturer shall have conducted tests at an independent laboratory, using a multiple-parallel-path flowmeter, which verify the accuracy of the proposed flowmeter. The report shall bear the signature of an authorized representative of the laboratory.

1.6 OPERATING CONDITIONS

The ultrasonic flowmeter will be used for measuring the flow of water in the channel as shown on the drawings. The system shall be capable of being powered by a 105-125 volts, 57-63 Hz source. A transformer shall be supplied if the power source is 230 volts.

The flowmeter console shall be suitable for operation in an environment with temperature ranging from 0 degrees C to 50 degrees C and relative humidity ranging from 0% to 95% (non-condensing).

1.7 WARRANTY

For a period of 1 year following delivery of the flowmeter system, the manufacturer shall repair or replace any part which fails due to defects in materials or workmanship. Failed parts shall be returned to the manufacturer's factory, freight prepaid, for repair replacement.

PART 2 PRODUCTS

All of the equipment described below shall be furnished by one supplier. Component devices which perform similar functions in each system shall be purchased from the same manufacturer.

2.1 TRANSDUCER ASSEMBLIES

Each transducer shall be suitable for mounting on the side of a trapezoidal channel. The operating frequency of the transducers shall be 200 kHz and 500 kHz (8 of each). Each transducer shall be constructed such that all surfaces contacting the flow are of PVC or CPVC.

2.2 FLOWMETER CONSOLE

The flowmeter console shall be a multi-path acoustic transit time type system. The flowmeter console shall measure discrete acoustic travel times to arrive at an average velocity for each of the acoustic paths. These velocity data points shall be integrated over the cross-sectional area of flow to determine the flowrate through the channel. The method of measuring and computing water velocity shall be independent of the speed of sound in water. The flowmeter shall be capable of operating up to 16 acoustic paths. The system shall be capable of bidirectional flow measurement.

The console shall evaluate each acoustic signal received and shall reject those which are distorted by reflections or reverberations or whose amplitude is below a minimum value. Each travel time resulting from accepted signals shall be checked to ensure that the measured time is within user-selectable limits. Flowrate and rate-of-change-of-flow limits shall be user selectable and adjustable on-site.

The flowmeter console shall be equipped with an Automatic Gain Control (AGC) feature to ensure that all received acoustic signals are continuously amplified to usable levels without noise interference.

The flowmeter shall have an alphanumeric keypad for user interface with the flowmeter. The user shall be able to enter all site-specific and operational parameters via the keypad. The system shall also be capable of communication via a PC.

The console shall be installed in a NEMA 4 enclosure suitable for wall mounting. The keypad/display shall be mounted inside the enclosure.

The system shall have the capability to display flowrate and totalized flow through each channel. At the user's option the system shall display a message that indicates the type and path location of a signal interruption or transducer failure.

Analog Outputs - 4-20 mA outputs of flowrate and water level in the channel shall be provided.

The flowmeter console shall have a self-test routine that periodically checks for proper operation of the flowmeter transceiver, processor and timing functions. The flowmeter shall indicate the type of failure and path location of any acoustic path failures.

The flowmeter shall be designed to return to full operation following a short-term power interruption, with all stored values retained.

2.3 TRANSDUCER CABLE

The contractor shall furnish all cable between the transducers and the electronic console. The cable shall be of the type specified by the

flowmeter manufacturer. Any connectors to the transducers that may be required shall be supplied by the flowmeter manufacturer.

PART 3 EXECUTION

The flowmeter manufacturer shall provide a qualified Field Engineer to supervise installation of the transducer assemblies, placement and connection of the flowmeter console, and commissioning of the system.

-- End of Section --

SECTION TABLE OF CONTENTS
DIVISION 13 - SPECIAL CONSTRUCTION
SECTION 13851
FIRE DETECTION AND ALARM SYSTEM

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS
 - 1.3.1 Standard Products
 - 1.3.2 Nameplates
 - 1.3.3 Keys and Locks
 - 1.3.4 Tags
 - 1.3.5 Verification of Dimensions
 - 1.3.6 Compliance
 - 1.3.7 Manufacturer's Services
- 1.4 SYSTEM DESIGN
 - 1.4.1 Operation
 - 1.4.2 Operational Features
 - 1.4.3 Alarm Functions
 - 1.4.4 Primary Power
 - 1.4.5 Battery Backup Power
- 1.5 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 CONTROL PANEL
 - 2.1.1 Visual Annunciators
 - 2.1.2 Cabinets
 - 2.1.3 Remote System Audible/Visual Display
 - 2.1.4 Circuit Connections
- 2.2 STORAGE BATTERIES
- 2.3 BATTERY CHARGER
- 2.4 MANUAL FIRE ALARM STATIONS
- 2.5 FIRE DETECTING DEVICES
 - 2.5.1 Smoke Detectors
 - 2.5.1.1 Photoelectric Detectors
- 2.6 NOTIFICATION APPLIANCES
 - 2.6.1 Alarm Bells
 - 2.6.2 Visual Notification Appliances
 - 2.6.3 Combination Audible/Visual Notification Appliances
- 2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT
 - 2.7.1 Conduit
 - 2.7.2 Wiring
 - 2.7.3 Special Tools and Spare Parts

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Power Supply for the System

- 3.1.2 Wiring
- 3.1.3 Control Panel
- 3.1.4 Detectors
- 3.1.5 Notification Appliances
- 3.1.6 Annunciator Equipment
- 3.2 OVERVOLTAGE AND SURGE PROTECTION
- 3.3 TESTING
 - 3.3.1 Preliminary Tests
 - 3.3.2 Acceptance Test
- 3.4 TRAINING

-- End of Section Table of Contents --

SECTION 13851

FIRE DETECTION AND ALARM 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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in
Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 72 (1996; Errata Oct 96, Dec 96; TIA 96-1,
96-2, 96-3) National Fire Alarm Code

NFPA 90A (1999) Installation of Air Conditioning
and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 38 (1994; Rev Nov 1994) Manually Actuated
Signaling Boxes for Use with
Fire-Protective Signaling Systems

UL 268 (1996; Rev thru Jun 1998) Smoke Detectors
for Fire Protective Signaling Systems

UL 464 (1996; Rev May 1997) Audible Signal
Appliances

UL 521 (1993; Rev Oct 1994) Heat Detectors for
Fire Protective Signaling Systems

UL 797 (1993; Rev thru Mar 1997) Electrical
Metallic Tubing

UL 864 (1996) Control Units for Fire-Protective
Signaling Systems

UL 1242 (1996; Rev Mar 1998) Intermediate Metal
Conduit

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G

Detail drawings, prepared and signed by a Registered Professional Engineer, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries; G

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; G

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts; G

Spare parts data for each different item of material and equipment specified, not later than 6 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated

government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing; G

Detailed test procedures, prepared and signed by a Registered Professional Engineer, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing

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

SD-07 Certificates

Equipment; G

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications; G

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G

Six copies of operating manual outlining 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 complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be 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 can provide service within 24 hours.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

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

1.3.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC) to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z in accordance with NFPA 72. A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all IAC or SLC on that circuit shall remain functional. A two-loop system is not applicable to the central fire alarm communication center from the local panels. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.
- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors
- c. Capability of each addressable device being individually disabled or enabled from the panel.

1.4.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of SLC, and IAC. Smoke detectors shall have combined alarm initiating and power circuits.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble lamp (light emitting diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.
- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. All fire alarm devices other than smoke detectors shall be prohibited on circuits controlled by confirmation or verification modules.
- n. Zones for alarm SLC shall be as follows:

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission over the station telephonic fire reporting system. The signal shall be common for all zones.
- b. Visual indications of the alarmed zones on the fire alarm control panel annunciator.
- c. Continuous sounding of alarm notification appliances throughout the building.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph: Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with all the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices. Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each SLC initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

2.1.1 Visual Annunciators

Visual annunciators shall be provided for each active zone and spare zone. Spare zones shall be provided as shown on the drawing. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone.

2.1.2 Cabinets

Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units. Cabinets shall be painted red.

2.1.3 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel's integral trouble signal. The audible device shall be silenced by the system trouble silence switch. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Trouble" shall be provided at the audible appliance. The visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.1.4 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities. Battery cabinet shall be a separate compartment within the control panel. Batteries in the control panel shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 12 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface mounted outlet boxes. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors shall be connected into alarm initiating circuits. Installed devices shall conform to the classification of the area. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel.

2.5.1 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base

contains terminals for making all wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.1.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating between 1.9 and 2.4 percent per foot when tested in accordance with UL 268.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Devices shall have manufacturer's standard finish and color.

2.6.1 Alarm Bells

Bells shall be surface mounted with the matching mounting back box surface mounted. Bells shall be suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a minimum output rating of 85 dBA at 10 feet. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles. Single stroke, electrically operated, supervised, solenoid bells shall be used for coded applications.

2.6.2 Visual Notification Appliances

Visual notification appliances shall have high intensity optic lens and flash tubes. Strobes shall flash at approximately 1 flash per second and a minimum of 1 candela (8,000 peak candle power). Strobe shall be surface mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible indicating appliance employed in the fire alarm systems shall be approved by the authority having jurisdiction.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242, and UL 797.

2.7.2 Wiring

Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used

for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.7.3 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. All manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems.

Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.5 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 TESTING

The Contractor shall notify the Contracting Officer at least 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish instruments and personnel required for the tests.

3.3.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

3.3.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The test shall include the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.

- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

3.4 TRAINING

Training course shall be provided for the operations and maintenance staff.

The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 3 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13853

CENTRAL FIRE ALARM SYSTEM, DIGITAL ALARM COMMUNICATOR TYPE

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
 - 1.2.1 Standard Products
 - 1.2.2 Nameplates
 - 1.2.3 Keys and Locks
 - 1.2.4 Tags
 - 1.2.5 Verification of Dimensions
 - 1.2.6 Compliance
- 1.3 SYSTEM DESIGN
 - 1.3.1 Operation
 - 1.3.2 Alarm Functions
 - 1.3.3 Supervisory Functions
 - 1.3.4 Primary Power
 - 1.3.5 Battery Backup Power
- 1.4 SUBMITTALS
- 1.5 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 FIRE ALARM MONITORING CENTER
 - 2.1.1 Digital Alarm Communicator Receiver (DACR)
 - 2.1.2 Audible Alarm
 - 2.1.3 Receiver Code Format
 - 2.1.4 Visual Display
 - 2.1.5 Receiver Memory
 - 2.1.6 Receiver Supervision
 - 2.1.7 Manual Battery Test
 - 2.1.8 Telephone Line Connection
 - 2.1.9 Power Supply
 - 2.1.10 External Connections
 - 2.1.11 Self-Contained Printer
- 2.2 MONITORING CENTER TERMINAL
- 2.3 MONITORING CENTER PRINTER
- 2.4 MONITORING CENTER POWER SUPPLIES
- 2.5 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)
 - 2.5.1 Functional Requirements
 - 2.5.1.1 Interfacing Indicators and Controls
 - 2.5.1.2 Signal Transmission
 - 2.5.2 Enclosure
- 2.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER POWER SUPPLY
 - 2.6.1 Battery Power
 - 2.6.2 Battery Duration
 - 2.6.3 Battery Supervision
- 2.7 PERIPHERAL EQUIPMENT

- 2.7.1 Conduit
- 2.7.2 Wiring
- 2.7.3 Special Tools and Spare Parts
- 2.7.4 DACT Programmer

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Power Supply for the System
 - 3.1.2 Wiring
- 3.2 OVERVOLTAGE AND SURGE PROTECTION
- 3.3 TESTING
 - 3.3.1 Performance Testing
 - 3.3.2 Acceptance Test
- 3.4 TRAINING

-- End of Section Table of Contents --

SECTION 13853

CENTRAL FIRE ALARM SYSTEM, DIGITAL ALARM COMMUNICATOR TYPE

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 ALLIANCE (EIA)

EIA ANSI/EIA/TIA-570 (1991) Residential and Light Commercial
Telecommunications Wiring Standard

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in
Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 72 (1996; Errata Oct 96, Dec 96; TIA 96-1,
96-2, 96-3) National Fire Alarm Code

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 797 (1993; Rev thru Mar 1997) Electrical
Metallic Tubing

UL 1242 (1996; Rev Mar 1998) Intermediate Metal
Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of digital alarm communicator systems and shall be 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 can provide service within 24 hours.

1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the

equipment.

1.2.3 Keys and Locks

Locks shall be keyed alike.

1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.2.5 Verification of Dimensions

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

1.2.6 Compliance

The central fire alarm system shall be configured in accordance with NFPA 72.

The transmitting equipment shall be compatible with receiving equipment and shall be UL listed or FM approved or shall be approved or listed by a nationally recognized testing laboratory, in accordance with the applicable NFPA standards.

1.3 SYSTEM DESIGN

1.3.1 Operation

The central fire alarm system shall be a complete, supervised system consisting of remote digital transmitters connected to building fire alarm panels and a digital receiver system at a central monitoring location. The system shall be activated into the alarm mode when an abnormal condition occurs in any building fire alarm system. The system shall remain in the alarm mode until the alarm is acknowledged and reset by the operator.

1.3.2 Alarm Functions

An alarm, trouble or supervisory condition in any building which reports to the fire alarm monitoring center shall automatically initiate the following functions:

- a. Transmission of a signal by the digital alarm communicator transmitter (DACT). The DACT shall dial the programmed telephone number of the digital alarm communicator receiver (DACR) at the fire alarm monitoring center, and upon completion of the connection shall transmit the abnormal condition information. Upon failure to connect with the DACR, the DACT shall attempt to connect via the secondary telephone line.
- b. Upon receipt of the signal at the fire alarm monitoring center the signal shall be decoded and status information shall be displayed on the monitoring center visual display indicating the nature of the status change.
- c. An audible signal shall sound at the monitoring center until the alarm is acknowledged.
- d. The alarm information shall be printed on the system printer at the monitoring center.

1.3.3 Supervisory Functions

Each DACT shall transmit a test signal a minimum of once every 24 hours. A trouble signal indicating that the test signal from any DACT is delinquent shall be annunciated at the monitoring center for any DACT test signal which is not received within 24 hours of its previous signal.

1.3.4 Primary Power

Operating power shall be provided as required by paragraph: Power Supply for the System. Where emergency power is available at transmitter locations, transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of ac power at transmitter locations shall not prevent transmission of a signal to the monitoring center upon alarm from any building fire alarm system. Loss of ac power at the monitoring center shall not prevent reception and annunciation of received signals.

1.3.5 Battery Backup Power

Battery backup power for transmitting equipment and receiving equipment shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Central Fire Alarm System; G.

Detail drawings, signed by the registered professional engineer, consisting of a complete list of transmitting and receiving equipment, auxiliary equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, description of the procedure for switching from the primary DACR to the backup DACR, and installation instructions. The detail drawings shall also contain transmitting equipment panel layout, monitoring center equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Wiring Diagrams; G.

Detailed point-to-point wiring diagram, signed by the registered professional engineer, showing all points of connection. Diagram shall include connections between monitoring center devices, transmitter location appliances, control panels, supervised devices, interfaces between building fire alarm equipment and transmitting equipment, and all equipment that is activated or controlled by the monitoring center equipment.

SD-03 Product Data

Battery; G.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each monitoring center system component and each transmitter panel component; and the battery recharging periods shall be included. Battery calculations shall substantiate both NFPA 72 and specification requirements.

Spare Parts; G.

Spare parts data for each different item of material and equipment specified, not later than 6 months prior to the date of beneficial use. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Central Fire Alarm System; G.

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of the equipment and basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs and troubleshooting guide. The instructions shall include conduit layout, equipment layout, simplified wiring control diagrams of the system as installed, and programming of DACT and DACR equipment. Instructions shall be approved prior to training.

Training

Lesson plans and training data, in manual format, for the training course. The operations training shall familiarize designated Government personnel with proper operation of the system. The maintenance training course shall provide the designated Government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Test Procedures; G.

Detailed test procedures, signed by the registered professional engineer for the central fire alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing; G.

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

SD-07 Certificates

Equipment; G.

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Installer; G.

Documentation demonstrating that the central fire alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of 3 years immediately preceding commencement of this contract. Documentation shall include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. Data shall be submitted 30 days prior to commencement of installation. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" or under "Protective Signaling Services - Central Station (UUFY)" of the UL Fire Protection Equipment Directory will be accepted as equivalent proof of compliance with the foregoing experience requirements.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

PART 2 PRODUCTS

2.1 FIRE ALARM MONITORING CENTER

2.1.1 Digital Alarm Communicator Receiver (DACR)

Two identical DACR systems shall be provided. The system shall be completely assembled, wired and tested at the factory, and delivered ready for installation. The DACR shall be solid state design with receiver, signal to message decoder, audio alarm signaling devices, audio alarm silence switch, visual display, alarm reset switch, alarm recording printer, primary and emergency power supplies, power supply monitors, memory devices and necessary interconnecting cables. The DACRs shall be configured as one active unit and one backup unit. Provide programming, connections and switching such that the backup unit may be switched into service within 30 seconds of detection of failure of the active unit.

2.1.2 Audible Alarm

The audible alarm signaling devices used to indicate the receipt of fire alarm messages shall produce a unique sound. The device shall be internally mounted in the DACR and shall be activated upon receipt of all fire alarm signals. The audible device shall also be used to indicate the

receipt of DACT trouble messages, including fire alarm system trouble and supervisor signals. The audible device shall continue to sound until acknowledged with the silence switch by the operator.

2.1.3 Receiver Code Format

The DACR shall be capable of receiving and decoding any of the following code formats:

Code Format	Speed (pulses per second)
3 X 1	20
4 X 1	20
4 X 2	20
3 X 1	10
3 X 1	40

2.1.4 Visual Display

Visual display shall be alphanumeric LED type. Display shall indicate as a minimum the originating transmitter identity code number and shall include the following message designations:

- a. Fire
- b. Trouble
- c. Battery
- d. Test
- f. Zone 1 thru 8.

2.1.5 Receiver Memory

Receiver shall have a history buffer capable of retaining a minimum of 64 Digital Alarm Communicator Transmitter (DACT) codes, together with the specific message designations associated with each DACT. The system shall annunciate any received message not matching the programmed DACT codes where such message identification code is not stored in the system. Upon command, the console shall display and print a summary of DACT which have transmitted a low-battery or trouble message, or failed to transmit a message during the previous 24 hour test period. Any incoming DACT signal shall pre-empt the command display and printout function, and shall be processed, displayed, and printed. The memory shall not be purged and shall always be current and available. Transmitter data memory shall not be lost in the event of a total loss of operating or emergency power supplies.

2.1.6 Receiver Supervision

The supervisory system shall provide constant supervision of the operating conditions of the DACR. Indicators shall be provided for each major component, and an audible signal shall be produced in the event of failure of any major component. A switch shall be provided to silence the audible trouble signal.

2.1.7 Manual Battery Test

A self-contained or externally-mounted switch shall manually place the receiver on emergency battery power for test purposes.

2.1.8 Telephone Line Connection

The DACR shall have connections for a minimum of 2 incoming telephone lines. Connections shall be 6-position, 4-conductor modular jacks as described in EIA ANSI/EIA/TIA-570.

2.1.9 Power Supply

The operating power for the DACR shall be single phase taken from the building electric service as specified in paragraph: Power Supply for the System. Emergency backup power shall be provided by sealed lead-calcium type batteries requiring no additional water. The charging system shall recharge fully discharged batteries within 12 hours and maintain the batteries in the fully charged state. The battery shall have the capacity to operate the system for not less than 48 hours under maximum normal load with the power supply to the charger disconnected.

2.1.10 External Connections

The DACR shall be provided with connections for an external printer and CRT terminal or personal computer (PC).

2.1.11 Self-Contained Printer

The DACR shall include a self-contained printer. Printer shall output a minimum of 32 characters per line and shall record all displayed transaction information including time and date.

2.2 MONITORING CENTER TERMINAL

The monitoring center terminal shall be PC based and shall be provided with an applications program to allow it to be connected to the DACR. The terminal shall display additional information about the building from which an alarm is received, detailed description of the current alarm, and alarm histories. The terminal shall provide operator interface with the Central Fire Alarm System. The terminal shall include a central processing unit with minimum 32 bit processor, 2 megabytes of Random Access memory, 14 inch color monitor, 101 key keyboard, 3-1/2 inch floppy disk drive and hard disk drive with sufficient capacity to store 6 months of transaction information.

2.3 MONITORING CENTER PRINTER

The monitoring center printer shall be compatible with the monitoring center terminal and shall be used to record all transaction information and history reports. Printer shall be dot matrix type with minimum 9 pin printhead, shall use 8-1/2 inch wide pin feed paper and shall print a minimum of 80 characters per line. Print speed shall be minimum 120 characters per second.

2.4 MONITORING CENTER POWER SUPPLIES

Each component of monitoring center equipment shall be provided with a self-contained power supply. An uninterruptible power supply (UPS) shall be provided for equipment which does not have a self-contained battery backup, such as the terminal and printer. The UPS shall provide all power

requirements for the connected equipment for a period of 15 minutes.

2.5 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

The DACT shall be compatible with the DACR, and shall comply with all requirements of NFPA 72. Each DACT shall be the manufacturer's current commercial product completely assembled, wired, tested at the factory, and delivered ready for installation and operation.

2.5.1 Functional Requirements

2.5.1.1 Interfacing Indicators and Controls

The DACT shall incorporate the provisions for auxiliary interconnection to existing building fire alarm systems. Connections shall be via screw terminals.

2.5.1.2 Signal Transmission

The DACT shall initiate transmission using a loop-start format. The DACT shall connect to 2 telephone lines, shown on the Contract Drawings. To initiate a transmission, the DACT shall seize the primary telephone line, disconnecting any telephones, obtain a dial tone and dial the DACR. The DACT shall make a minimum of five attempts to connect to the DACR. If a connection is not made, the DACT shall attempt to connect to the DACR via the second telephone line. A failure of one telephone line shall report a trouble condition at the building fire alarm panel and at the monitoring center via the secondary telephone line. When the DACT makes a connection to the DACR, the required alarm or test information shall be transmitted. Confirmation of the signal shall be accomplished by repetition of the signal, parity checks or equivalent checksum-type transmission. Each DACT shall transmit a test signal a minimum of once every 24 hours. The DACT shall provide a minimum of 4 alarm input connections from the building fire alarm control panel.

2.5.2 Enclosure

A locking enclosure shall be provided for each DACT. The enclosure shall be of the NEMA type indicated on the Contract Drawings, or NEMA 1 where not indicated. The enclosure shall provide sufficient space for mounting the DACT, interfaces, power supply and backup batteries, wiring and terminal strips, including adequate space for maintenance access.

2.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER POWER SUPPLY

Digital alarm communicator transmitters shall be powered by a combination of locally available 120 Vac, and sealed lead-calcium type batteries requiring no additional water. In the event of loss of 120 Vac power, the transmitter shall automatically switch to battery operation. The switchover shall be accomplished with no interruption of protective service, without adversely affecting the battery-powered capabilities, and shall cause the transmission of a trouble message in no less than 30 seconds. Upon restoration of ac power, transfer back to normal ac power supply shall be automatic and the battery shall be recharged. The battery charger shall be capable of restoring the batteries from full discharge to full charge within 12 hours. The converter/battery charger shall be installed within the transmitter enclosure. Power supply transient voltage surge suppression shall be provided.

2.6.1 Battery Power

The battery package shall be capable of supplying all the power requirements for a given DACT and DACT interface device.

2.6.2 Battery Duration

Digital alarm communicator transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 48 hours and shall be capable of transmitting alarms during that period.

2.6.3 Battery Supervision

Each DACT shall constantly monitor and supervise its own battery-powered supply. A low-battery condition shall be reported when battery voltage falls below 75 percent of the rated voltage.

2.7 PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242, and UL 797.

2.7.2 Wiring

Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit.

2.7.3 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. One spare set of fuses of each type and size required and five spare lamps of each type shall be furnished for each transmitter location and for the receiver location. Spare fuses and lamps shall be mounted in the equipment cabinets at each location.

2.7.4 DACT Programmer

A programming device shall be provided for programming the required information in each DACT, if programming capability is not an integral part of the DACT. Required programming equipment, including the programmer, interconnect cables and adaptors, and power supply shall be provided. Six spare program chips shall be provided if removable program chips are used.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and in accordance with the manufacturer's recommendations. Necessary interconnections, services, and adjustments required for a complete and operational system shall be provided. Electrical work shall be in accordance with NFPA 70 and Section 16415 ELECTRICAL WORK, INTERIOR.

3.1.1 Power Supply for the System

A single dedicated 120 volt, single phase branch-circuit connection for supplying power to the monitoring center equipment shall be provided as shown on the Contract Drawings. The backup power supply shall be automatically energized upon failure of the normal power supply. The primary power shall be supplied from a panelboard circuit breaker or disconnect switch which shall be red in color and locked in the energized position. Panel shall be marked "FIRE ALARM CIRCUIT CONTROL" with a rigid plastic nameplate. Transmitter 120 Vac power shall be extended from fire alarm panel.

3.1.2 Wiring

Wiring for systems shall be installed in intermediate metallic conduit. The conductors for central station alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Conduit shall be 1/2 inch minimum in accordance with NFPA 70.

No more than one conductor shall be installed under any screw terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within control equipment shall be readily accessible without removing component parts.

3.2 OVERVOLTAGE AND SURGE PROTECTION

Equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. Cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 TESTING

The Contractor shall notify the Contracting Officer 30 days before the performance and acceptance tests are to be conducted. The tests shall be performed in the presence of the Contracting Officer under the supervision of the central fire alarm system manufacturer's qualified representative. The Contractor shall furnish all instruments and personnel required for the tests.

3.3.1 Performance Testing

Upon completion of the installation, the system shall be subjected to a complete functional and operational performance test by the Contractor. Test shall determine that the system is free from grounded, shorted, or open circuits. When all corrections have been made, the system shall be retested to assure that it is functional. Copies of performance test reports shall be submitted in accordance with paragraph: SUBMITTALS.

3.3.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The tests shall include the following:

- a. Tests to indicate there are no grounded, shorted, or open circuits.
- b. Tests of each input to each digital alarm communicator transmitter, including transmission of trouble and alarm signals across both the first and second telephone lines at each location and proper reception at the monitoring center.
- c. Tests of DACR, terminal and printer for all required functions.
- d. Tests of normal and emergency power supplies, including batteries. Tests shall include verification of complete system operation at extreme end of the required emergency power duration, and verification of recharging time.

3.4 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the monitoring center is installed or as designated by the Contracting Officer. The training period shall consist of 3 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. Training shall be provided for the personnel. The instructions shall cover all of the items contained in the operating and maintenance instructions.

-- End of Section --