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USACE / NAVFAC / AFCESA / NASA | **NASA-15195S (December 2005)**

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Superseding
NASA-15195 (May 2005)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 15195S

NATURAL GAS SYSTEMS

12/05

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SECTION 15195S

NATURAL GAS SYSTEMS
12/05

****
NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers natural gas systems at 100 pounds per square inch, gage (psig) 690 kilopascal or less, utilizing existing site supply and including aboveground and underground piping systems and components.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.
****

PART 1 GENERAL

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile

references in the publish print process.
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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992; R 2003) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.8	(1991; 8th Ed) Welding Handbook; Volume Two - Welding Processes

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11	(2002) Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.3	(1998) Malleable Iron Threaded Fittings Classes 150 and 300
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.5	(2003) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(2003) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2004) Power Piping
ASME B31.8	(2004) Gas Transmission and Distribution Piping Systems
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2003) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 181/A 181M	(2001) Standard Specification for Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron

ASTM A 234/A 234M	(2003) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures
ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(2001) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM A 53/A 53M	(2004a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 666	(2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A 694/A 694M	(2003) Standard Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service
ASTM B 280	(2003) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2003) Standard Specification for Seamless Copper Water Tube (Metric)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

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

MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-83	(2001) Steel Pipe Unions Socket Welding and Threaded
MSS SP-86	(2002) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2002) National Fuel Gas Code
NFPA 70	(2005) National Electrical Code 2005 Edition

UNDERWRITERS LABORATORIES (UL)

UL 125	(2001) UL Standard for Safety Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief)
UL 842	(1999) UL Standard for Safety Valves for Flammable Fluids
UL 860	(2001) UL Standard for Safety Pipe Unions for Flammable and Combustible Fluids and Fire-Protection Service

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-F-1183	(1987j) Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for
MS MIL-L-25567	(1993d) Leak Detection Compound, Oxygen Systems (Metric)
MS MIL-V-12003	(Rev F; Am 1) Valves, Plug: Cast-Iron or Steel, Manually Operated

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-C-530	(Rev C) Coating, Pipe, Thermoplastic Resin
FS QQ-B-654	(Rev A; Notice 1) Brazing Alloys, Silver

1.2 GENERAL REQUIREMENTS

****

NOTE: If Section 15003S GENERAL MECHANICAL PROVISIONS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

****

Section 15003S GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for in accordance with paragraph entitled, "General Requirements," of this section.

Installation drawings shall be submitted for natural gas systems in accordance with the paragraphs entitled, "Underground Piping Systems Installation" and "Aboveground Piping Systems Installation," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Piping Materials
Valves
Piping Specialties

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with paragraph entitled, "Testing," of this section.

Pneumatic

Leakage
Pressure

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Piping Materials
Valves
Piping Specialties

1.4 GENERAL REQUIREMENTS

****
NOTE: If Section 15055S WELDING MECHANICAL is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.
****

[Section 15055S WELDING MECHANICAL applies to work specified in this section.]

Fabrication Drawings shall be submitted for natural gas systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING MATERIALS

2.1.1 Piping Types

Ells and tees shall be of the same type and class of material as the pipe.

****
NOTE: Type BCS-PS materials are suitable for natural gas systems 100 psig 700 kilopascal and less, all butt weld (no flange, no thread) construction.

Anode and rectifier cathodic protection should be used to protect against rapid point metal loss due to failure to detect a fault or holiday.

In sizes 1/8 inch through 1-1/2 inches DN6 through DN40, seamless carbon-steel iron pipe size (ips) pressure pipe may be specified at a cost increase of 3 to 5 times.
****

Type BCS-PS: Black carbon steel piping with polyethylene sheath shall conform to ASTM A 53/A 53M, Type [E electric resistance welded] [S seamless]. In sizes through DN250 10-inch iron pipe size (ips), pipe shall have Schedule 40 wall. In size DN300 12 inches and larger, pipe wall shall be 10 millimeter 0.375 inch thick.

Thermoplastic sheath shall conform to FS L-C-530. Sheath joints shall be made with thermally fitted shrinking sleeves applied with factory-approved shrinking devices. Taped fitting protection and repairs shall be made in accordance with manufacturer's instructions. Electrical flaw detection testing at the factory shall require 10,000 volts to be impressed across the sheath. Sheath breakdown voltage shall be not less than 13,000 volts.

Fittings shall be long-radius butt weld carbon steel conforming to ISO 7005-2, MSS SP-86, ASTM A 234/A 234M and ASME B16.1 to match pipe wall thickness. Bending of pipe is not permitted. Aboveground terminal fittings shall be 1050 kilopascal 150-pound working steam pressure (wsp) forged steel, weld neck flanges to match wall thickness, conforming to ASTM A 694/A 694M, ASME B16.5, and ASTM A 181/A 181M, Class 60.

2.1.2 Natural Gas Shutoff Valve Assemblies

Lubricated plug valves

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NOTE: Where welded end connections are required, rewrite to: require ASTM A 216, Grade WCB carbon steel bodies; revise body rating; delete cylindrical plug valves.

****

Valves shall be Type 1, Style [A] [B], taper plug type rated for not less than 1200 kilopascal 175 pounds per square inch (psi) water, oil, or gas (wog) service and shall conform to MSS SP-86 and MS MIL-V-12003.

Valves shall be cylindrical plug type, constructed to service pressure and materials requirements specified for taper plug valves. In addition, clearance between plug and body sealing surfaces shall be 0.0508 millimeter 2 mils, maximum, for valves to DN50 2-inch ips and 0.075 to 0.127 millimeter 3 to 5 mils for larger valves. Plug stem seal and bottom support shall be reinforced tetrafluoroethylene, and plug shall be bottom spring loaded.

[Plug shall be restricted port type unless full ports or proportioning ports are specified.]

[Valves shall be provided with screwed end connections for all sizes DN25 1-inch ips and smaller and with flanged connections for all larger valves.]

Valves shall have an effective sealing and lubrication system which, when actuated, forces movement of plug within seating surfaces.

Extended lubricant lines with check valves shall be provided for grease gun access at grade. Lubricant shall be identified and sufficient quantity provided to lubricate each valve at least once.

T-handle extension operators adapted to valve stem shall be provided for sizes DN150 6-inch ips and smaller.

T-handle extensions and worm and gear operator shall be provided for valves DN200 8-inch ips and larger. Operator shall not require input of more than 70 newton-meter 50 foot-pounds of torque, shall be totally enclosed, grease packed, and sealed for 6000 millimeter 20-foot head submerged service in brackish water. Worm and shaft shall be steel, gear shall be bronze. Worm shaft shall be mounted in bronze sleeve bearings. Operator shall have open

and close stops and plug position indication.

All external surfaces shall be coated with bituminous sealer conforming to AWWA C104/A21.4.

2.1.3 Valve Boxes

Valve boxes shall be of not less than 5 millimeter 3/16-inch thick cast-iron construction with locking cover with an appropriate identification legend. Cover shall require a special wrench for access. Boxes shall be adjustable extension type with screw- or slide-type adjustment. Valves DN75 3 inches and under shall be fitted with 108 millimeter 4-1/4-inch diameter shaft. Valves DN100 4 inches and larger shall be fitted with 133 millimeter 5-1/4-inch diameter shaft. Bases shall be fitted to the valve. Box full-extended length shall be greater than required by depth of cover by not less than 100 millimeter 4 inches. One valve-operating wrench shall be supplied for each size of valve wrench nut. Guide rings shall be provided where operating rods are longer than 1800 millimeter 6 feet. Internal and external surfaces shall be coated with bituminous sealer conforming to AWWA C104/A21.4.

2.2 ABOVEGROUND PIPING MATERIALS

Type BCS-NG: Black carbon steel

Pipe (DN6 through DN250 (1/8 inch through 10 inches and where indicated): Schedule 40 seamless or electric resistance welded black carbon steel, conforming to ASTM A 53/A 53M, Grade B, Type [E] [S]

Pipe (DN300 and over): 10 millimeter (12 inches and over): 0.375-inch wall seamless black carbon steel, conforming to ASTM A 53/A 53M, Grade B, Type [E] [S]

Fittings (DN25 (1 inch and under): Class 150 banded black malleable iron screwed, conforming to ASTM A 197/A 197M, ASME B16.3 and ASTM A 234/A 234M

Unions (DN25 (1 inch and under): Class 250 female, screwed, black malleable iron with brass to iron seat and ground joint, conforming to MSS SP-83 ASME B16.39 and UL 860

Couplings (DN25 (1 inch and under): Heavyweight screwed black carbon steel

Fittings (DN32 (1-1/4 inches and over): Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness, or steel socket weld, conforming to ASTM A 105/A 105M and ASME B16.11 rated at 14 Megapascal 2,000 psi wog

Flanges (DN32 (1-1/4 inches and over): Class 150 forged steel socket or welding neck to match pipe wall thickness, and conforming to ASME B16.5 and ASTM A 694/A 694M

Type CPR-NG: Copper; natural gas vent and control and instrumentation system tubing; 200 kilopascal 30 psig and less

Tubing (all sizes with DN8 1/4-inch outside diameter minimum): Hard drawn or annealed seamless copper conforming to ASTM B 280, UNS C12200 conforming to ASTM B 88M ASTM B 88.

Fittings (all sizes DN8 1/4 inch and up): Socket joint wrought copper,

conforming to ASME B16.11. All fitting cup depths and tolerances shall conform to MSS SP-86 MS MIL-F-1183.

SAE 45-degree flare type, rod or forged brass conforming to SAE [72] [88], used only in exposed-to-view accessible places

Brazing rod	[Type 3, conforming to FS QQ-B-654]
(silver solder)	[Type BCuP-5 conforming to AWS A5.8]

2.3 PIPING SPECIALTIES

2.3.1 Appliance Connectors

Connectors shall be corrugated bronze metal with brazed inverted flare-type brass fittings complete with transition for ips connection. Maximum length shall be 1800 millimeter. 6 feet. Connectors shall be AGA-approved type.

2.3.2 Natural Gas Pressure-Reducing Station

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NOTE: The following covers regulators to 2-inch DN50 ips, reducing pressures from 2 psi 14 kilopascal.

Where pounds-to-pounds kPa-to-kPa regulators are required and where double staging for inlet pressures in excess of25 psi 175 kilopascal is required, write specification to suit project application.

Drawing schedule shall include specific gravity, temperature, inlet pressure, outlet pressure if other than specified, and capacity in standard cubic feet per hour (scfh) cubic meter per minute.

When station is located outside, show concrete, locking manhole covers, etc.

****

2.3.2.1 Pressure-Reducing Station

Pressure-reducing station shall be installed complete with a three-valve bypass-valved pressure indicator upstream of station, and valved pressure indicator downstream of station. Bypass valve shall have a proportioning port opening and shall be fitted with a locking device. All system components shall be of the size, capacity, and pressure-reduction capability indicated.

2.3.2.2 Pressure Regulator and Accessories

Pressure regulator shall be service-type, complete with automatic low-pressure cutoff and automatic pressure relief. Shop drawing shall be submitted and shall include performance curves.

****

NOTE: Normal spring ranges include: 3.5 to 6.0 inches; 90 to 150 millimeter; specified range: 6.0 to 14 inches 150 to 350 millimeter.

****

Body shall be cast iron. Valve shall be capable of shutting off under supply pressures to 700 kilopascal 100 psi. Valve spring range shall be 125 to 215 millimeter 5.0 to 8.5 inches water gage (wg), and set point shall be 180 millimeter 7 inches. Outlet pressure shall vary by not more than 13 millimeter 1/2-inch wg from the set point over the capacity range of the regulator.

Pressure relief shall be diaphragm-operated, spring-loaded type with vent for relief of excess pressure. Release set point shall be 305 millimeter 12 inches wg.

Low-pressure cutoff regulator shall be adjustable to shut off gas supply entirely if pressure drops below set point. Supply shall remain shut off until manual reset of regulator takes place.

Pressure regulator diaphragm vent and pressure relief vent shall be run as separate, jointless, full size vent lines connected to the vent tapping and terminating at an approved outside location with weatherproof, bugproof, screened vent cap.

2.3.3 Pressure Gages

Pressure gages shall conform to ASME B40.100, Type I, Class 1. Pressure-gage size shall be 90 millimeter 3-1/2-inch nominal diameter. Case shall be corrosion-resistant steel conforming to any of the AISI 300 series of ASTM A 666, with a No. 4 standard commercial polish or better. All gages shall be equipped with adjustable red marking pointer and damper screw adjustment in inlet connection.

2.3.4 Line Strainers

Strainers shall be Y-type with removable basket. Strainers in sizes DN50 2-inch ips and smaller shall have screwed ends; sizes DN65 2-1/2-inch ips and larger shall have flanged ends. Body working pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainer shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Body material shall be cast bronze conforming to ASTM B 62 or cast iron conforming to Class 30 ASTM A 278M ASTM A 278. Where system material is nonferrous, strainer body material shall be nonferrous.

Minimum free hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens for natural gas service shall have mesh cloth not to exceed 0.152 millimeter 0.006 inch. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI [Type [304] [316] corrosion-resistant steel] [Monel metal].

2.4 VALVES

2.4.1 Ball Valves (BAV)

Ball valves shall be the fire-seal type, conforming to UL 842 and UL 125.

Valves shall be rated for service at not less than 1400 kilopascal at 93 degrees C 200 psi at 200 degrees F.

Valve bodies in sizes DN25 1-inch ips and smaller shall be screwed-end type constructed of [ductile iron] [carbon steel] [cast steel].

Valve bodies in sizes DN32 1-1/4-inch ips and larger shall be flanged-end type constructed of [ductile iron] [carbon steel] [cast steel].

Valve bodies shall have socket weld ends or butt weld ends where indicated to be welded, and body shall be constructed of [carbon] [cast] steel.

Balls and stems shall be Type 316 corrosion-resistant steel.

Valves shall be suitable for flow from either direction and shall seal tightly in either direction.

Valves shall have full pipe size flow areas where noted.

Valve seats and seals shall be tetrafluoroethylene; seats shall have secondary corrosion-resistant steel seating surfaces to effect shutoff should resin be burned out.

Valve body construction shall be such that:

Torque from a pipe with valve in installed condition shall not tend to disassemble the valve by stripping setscrews or loosening body end inserts or coupling nuts.

Torque from a pipe shall be resisted by a one-piece body between end connections or by bolts in shear where body is of mating flange or surface bolted construction.

2.4.2 Diaphragm Control and Instrument Valves (DCIV)

Diaphragm valves in sizes DN8 and DN10 1/4- and 3/8-inch shall have a forged-brass body with reinforced tetrafluoroethylene diaphragm, AISI 300 series corrosion-resistant steel spring, and round phenolic handle. Handle shall be fitted with color-coded discs.

2.4.3 Gage Cocks (GC)

Gage cocks shall be T-head or lever-handle ground key type with washer and screw, constructed of polished ASTM B 62 bronze, 860 kilopascal 125 psi. End connections shall suit the service, with or without union and nipple.

2.4.4 Nonpressure-Lubricated Gas Stops (LGS)

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NOTE: High break-away torque, tendency to freeze, low cost, maximum shell pressure 85 psi 600 kilopascal.

****

Gas stops through DN25 1-inch ips shall have an operating pressure rating of not less than 415 kilopascal 60 psi, gas.

Locking feature shall be provided where noted.

2.4.5 Eccentric Plug Valves (EPV-UL)

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NOTE: These valves may be used in lieu of Type LGS valves.

****

Eccentric plug valve maximum size shall be limited to DN80 3-inch ips.

Eccentric plug valves shall be constructed with semisteel body, bronze plug with Buna-N resilient elastomer seals. Body sealing face shall be plastic coated. Body end connection shall be screwed for sizes DN25 1-inch ips and smaller and flanged in sizes through DN80 3-inch ips. Plug shall be top and bottom guided by oil-impregnated bronze bushings and shall be corrosion-resistant steel spring-loaded. Valves shall be rated at 1200 kilopascal 175-psi wog and shall be UL listed for natural gas service. Valves shall be fitted with pinned lever operators.

Valves shall be provided with locking device where noted.

2.4.6 Lubricated Plug Valves (LPV)

****

NOTE: Where welded end connections are required, rewrite to: require ASTM A 216, Grade WCB carbon steel bodies; revise body rating; delete cylindrical plug valves.

****

Valves shall be Type 1, Style [A] [B], taper-plug type, rated for not less than 1200 kilopascal 175-psi wog service and shall conform to MSS SP-86 and MS MIL-V-12003.

Valves may be cylindrical plug type, constructed to service-pressure and materials requirements specified for taper plug valves; in addition, clearance between plug and body-sealing surfaces shall not exceed 0.0508 millimeter 2 mils for valves to DN50 2-inch ips and shall be 0.076 to 0.127 millimeter 3 to 5 mils for larger valves; plug stem seal and bottom support shall be reinforced tetrafluoroethylene; plug shall be bottom spring loaded.

[Plug shall be full port or restricted port type.]

[Regulator bypass valves shall be provided with proportioning ports and locking feature.]

Valves shall be provided with screwed end connections for all sizes DN25 1-inch ips and smaller and flanged end connections for all larger valves.

Valves shall have an effective sealing and lubrication system which, when actuated, forces movement of plug within seating surfaces.

Check-valve-type lubrication fittings shall be provided for grease gun lubrication. Lubricant shall be identified and sufficient quantity shall be provided to lubricate each valve at least once.

Worm and gear operator shall be provided for all valves DN200 8-inch ips and larger. Operator shall not require input of more than 70 newton-meter 50 foot-pounds of torque and shall be totally enclosed, grease packed, and sealed. Worm and shaft shall be steel, gear shall be bronze. Worm shaft shall be mounted in bronze bearings. Operator shall have open and close stops and plug position indications.

Locking feature shall be provided, where noted.

2.4.7 Gasket Material

Gasket material and type shall be in accordance with NFPA 54.

PART 3 EXECUTION

3.1 UNDERGROUND PIPING SYSTEMS INSTALLATION

3.1.1 Installation

Installation of natural gas systems shall be performed in accordance with ASME B31.8 in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of start of installation.

All excavations shall be dry and clear of extraneous materials when pipe is being laid.

Piping shall be laid beginning at the low point of a system; when in final position it shall be true to the grades and alignment indicated, with unbroken continuity of invert.

[Connection to existing main gas line shall be as noted.]

[Connections between new work and existing gas line shall be made to the satisfaction of the Contracting Officer, using proper specials and fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fitting shall be the same size as the pipe to be connected.]

Gas mains shall be graded for the complete drainage of condensate to drips placed at low points; service lines shall be graded to drain to the main line wherever practical.

[Crossings of gas mains under traffic lanes shall be made as shown.]

[Drips shall be installed where shown and at all low points whether indicated or not. Drips shall conform to the details indicated or shall be of commercial manufacture approved as to type and capacity. A DN32 1-1/4-inch or larger blowoff pipe shall be connected to each drip at its lowest point and shall extend to or near the ground surface at a convenient location outside of traffic. Discharge terminal shall be provided with a reducing fitting, plug valve, and DN15 1/2-inch nipple turned down. Discharge terminal shall be inside a length of 300 millimeter 12-inch or larger vitrified clay pipe or concrete sewer pipe, set vertically on a bed of coarse gravel 300 millimeter 1 foot thick and about 1 meter 3 feet square, and closed at the ground surface with a suitable replacement cover. When details are not shown, drips shall be made of DN150 6-inch pipe 3700 millimeter 12 feet long, laid parallel and completely below the gas main and shall be provided with DN32 1-1/4-inch or larger blowoff as specified above.]

****
NOTE: Select the following paragraph only when drawings do not detail entry.
****

[When installed underground beneath buildings, gas piping shall be encased

in a conduit that shall extend into a normally usable and accessible portion of the building. At the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the entrance of gas into the building. Conduit shall extend at least 100 millimeter 4 inches outside the building, shall be vented above grade, and shall be installed in a manner that will prevent the entrance of water. Conduit shall be of the same materials as used for the line being enclosed. Vent shall be fitted with a metal identification plate indicating its function.]

Conduit passing through walls below grade and ground floor slab shall pass through pipe sleeves larger than conduit and shall be made watertight.

In fill areas, conduit passing under or through building grade beams shall have a minimum clearance of 100 millimeter 4 inches in all directions to prevent damage.

On excavations occurring near and below building footing, the backfilling material shall consist of Class 2000A concrete poured or pressure grouted up to the level of the footing.

Where pipe penetrates earth or concrete grade, not less than 300 millimeter 12 inches of polyethylene-coated Type BCS-PS pipe shall be exposed to view.

Type BCS-PS materials shall be installed for underground and aboveground piping and in accordance with the manufacturer's instructions. Pipe shall be palletized in padded pallets at the factory and shall be handled from pallet to final position with padded gear. Surfaces shall be protected from the sun with black polyethylene sheeting. Prior to being lowered into a trench, sheeting shall be checked for continuity with 10,000 volts applied by a continuity detector with an audible alarm. In the trench, after joints and fittings have been made, previously untested surfaces shall be checked for continuity. When discontinuities in thermoplastic sheeting are found, not less than 300 millimeter 12 inches of material upstream and downstream of the fault shall be removed and replaced.

[After valves, valve operators, and valve boxes have been inspected, and not less than 48 hours prior to being lowered into a trench, external surfaces shall be coated with a compatible bituminous coating for protection against brackish ground water.]

Application shall be in accordance with the manufacturer's instructions and shall result in a dry-film thickness of not less than 0.30 millimeter 12 mils.

After pressure testing and approval, valves and valve operators shall be thoroughly cleaned, coated with bitumen, wrapped with tape, and recoated with bitumen to form an impervious membrane. Tape shall be glass-fiber reinforced with parallel strands of continuous filament within the fiber structure, bonded with an insoluble, inert, resinous binder that is compatible with bituminous material used.

Prior to backfilling, coated and wrapped pipe and valves shall be tested with an electric holiday detector operating at from 10,000 to 15,000 volts. Defects shall be repaired by clipping back the coatings to the bare metal and recoating with the materials as specified for the original work and to the satisfaction of the Contracting Officer.

Defective materials found shall be distinctly marked and promptly removed

from the site.

3.1.2 Valve Boxes

Valves and valve boxes shall be installed where indicated and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside traffic areas. Soil shall be carefully tamped around each valve box to a distance of 1200 millimeter 4 feet on all sides of the box or to the undisturbed trench face if less than 1200 millimeter 4 feet. Valve boxes located in roads or sidewalks shall be protected by a concrete slab as indicated.

3.2 ABOVEGROUND PIPING SYSTEMS INSTALLATION

3.2.1 Aboveground Piping

****
NOTE: NFPA 54 covers the installation of gas piping, both in buildings and between buildings from point of delivery (meter, regulator, etc.) To the inlet connection or equipment and gas piping for all industrial installations regardless of the gas pressure and for all other installations operating at pressures greater than 1/2 psig 3.5 kilopascal. Portions of NFPA 54 standards are extracted and included herein.
****

[Aboveground piping with operating pressures of 3.5 kilopascal 1/2 psig and less, designated "low pressure," shall be fabricated and installed in accordance with NFPA 54, AWS WHB-2.8, MSS SP-69.]

[Aboveground piping with operating pressures in excess of 3.5 kilopascal 1/2 psig, designated "high pressure," shall be fabricated and installed in accordance with ASME B31.8, AWS WHB-2.8 and MSS SP-69.]

Work shall be performed in the presence of the Contracting Officer who shall be notified 48 hours in advance of start of work.

Pipe shall be fabricated to measurements established on the job and shall be carefully worked into place without springing or forcing. Adequate provision shall be made for absorbing all expansion and contraction without stress in any part of the system.

Pipe, tubing, fittings, valves, equipment, and accessories shall be visibly clean and free of foreign material before being installed into the respective systems. Pipe shall be cleaned by hammering, shaking, or swabbing, or by a combination of methods. Lines shall be purged with dry, oil-free compressed air after erection, but purging out shall not be relied upon for removing all foreign matter. Purge velocity shall be equal to 1-1/2 times maximum normal flow velocity. During the progress of construction, open ends of pipe, fittings, and valves shall be properly protected at all times to prevent the admission of foreign matter. Plugs or caps shall be placed in the ends of installed work at all times when connecting work is not actually under way. Plugs shall be commercially manufactured products approved by the Contracting Officer. Outlets, including valve outlets, shall be securely closed gastight with a threaded plug or cap immediately after installation and shall be left closed until the gas equipment is connected thereto.

Piping shall be installed straight and true with approved offsets around obstructions and with expansion bends or fitting offsets essential to a satisfactory installation, and as may be necessary to increase headroom or to avoid interference with the building construction, electric conduit, or facilities equipment.

Natural gas piping smaller than DN15 1/2-inch ips shall not be concealed.

When installing piping that is to be concealed, the following and similar connections shall not be concealed: unions, tubing fittings, running threads, right and left couplings, and swing joints made by combinations of fittings.

Standard long sweep pipe fittings shall be used for changes in direction; no mitered joints or unapproved pipe bends will be permitted.

[Pipe bends in seamless pipe of not less than 5 pipe diameters radius may be made with hydraulic benders in the field for pipe sizes to DN100 4-inch ips upon approval of the Contracting Officer.]

[Tee connections shall be made with screwed tee fittings or butt, or, where pipe is being welded, branch connections may be made with either butt or socket welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe-bursting strength requirements.]

[Short-radius elbows may be used only where specifically authorized by the Contracting Officer.]

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NOTE: Rewrite following paragraph if wet natural gas will be used. See NFPA standards.

****

Horizontal piping shall have a grade of 25 millimeter per 31 meter 1 inch per 100 feet.

Reducers shall be concentric or eccentric. Eccentric reducers shall be used where required to permit proper drainage of pipe lines. Bushings as reducers are not permitted. Drain valves shall be provided in all piping systems at low points.

Installation of piping shall be such as to prevent stresses and strains from being placed on connected equipment.

Dielectric connection shall be provided at inlet side to building pressure regulator.

Expansion bends in steel pipe shall be made from pipe sections and long radius welding elbows in sizes DN25 1 inch and larger. Expansion U-bends shall be cold sprung and welded into the line, which shall be anchored before removing the spreader from the expansion U-bend. Amount of cold spring shall be as indicated.

3.2.2 Joints

Joints larger than DN25 1-inch ips shall be welded.

Pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with joint compound.

Joint compounds shall be applied to the male thread only, and care shall be exercised to prevent compound from reaching the interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system.

Flanged joints shall be assembled with appropriate flanges, gaskets, and bolting. Clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system. Flange faces shall be parallel and the bores concentric. Gaskets shall be centered on the flange faces without projecting into the bore. Bolting shall be lubricated with oil and graphite before assembly to ensure uniform bolt stressing. Flange bolts shall be drawn up and tightened in staggered sequence in order to prevent unequal gasket compression and deformation of the flanges. Wherever a flange with a raised face is joined to a companion flange with a flat face, the raised face shall be machined down to a smooth matching surface and a full face gasket shall be used. After the piping system has been tested and is in service at its maximum temperature, bolting shall be retightened to achieve minimum gasket seating stress recommended by the gasket manufacturer. Only hex-head nuts and bolts shall be used.

Gasket material shall be fresh stock.

Uncoated metallic gaskets shall be assembled with specified compound.

Field-welded joints shall conform to the requirements of the AWS WHB-2.8 and ASME B31.1.

Copper tubing for solder joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Inside surfaces of fittings and outside surfaces of tubes in joint area shall be cleaned with steel wool before assembly of joint. Joint flux, solder, and heat source shall be applied in accordance with the manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100 percent shear-line strength. Valves in copper piping shall have screwed ends with end adapters to suit mechanical connections, unless solder jointing is specified or indicated for a given application. Copper joints that fail pressure tests shall be remade with new materials, including pipe or tubing fittings and filler metal.

Copper tubing for mechanical joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Care shall be exercised not to work-harden copper surfaces during flaring and, in case of doubt, tube ends shall be cut off and annealed by heating and air cooling in accordance with the manufacturer's instructions.

3.2.3 Control and Instrument Piping

Tubing shall be mechanically attached to supporting surfaces. Supports

using adhesives shall not be acceptable.

Copper tubing horizontal supports for less than three tubes shall be rigid 25 by 10 millimeter 1- by 3/8-inch metal channel and proprietary metal tube race for three or more tubes.

Copper tubing runs in soil shall be jointless and shall be protected from brackish ground water and leaching concrete alkali by 0.30 millimeter 12-mil thick bituminous coating or equivalent PVC tape wrapping.

3.2.4 General Service Valve Locations

Valves shall be located to permit isolation of branch piping and each equipment item from the balance of the system and to allow safe and convenient access without moving equipment and with a minimum of piping and equipment disassembly.

Valves shall be provided in piping mains and branches and at equipment where indicated and where specified.

Three-valve bypasses shall be provided around pressure regulating valves and where indicated.

No valve shall be placed in an inaccessible space.

3.3 NATURAL GAS SYSTEMS TESTING

3.3.1 Tests

Prior to acceptance of the work, the Contractor shall test completed systems in the presence of the Contracting Officer.

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NOTE: Due to the expansive force of compressed gases at the 100-psi 700 kilopascal and higher range of pressures normally used, pneumatic testing requires special precautions and competent supervision to guard against injury and damage when a failure occurs.

For critical systems, perform a mixed gas test adapted for natural gas.

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Tests shall be Pneumatic and shall utilize dry, oil-free nitrogen. Testing shall be done in two stages, preliminary and acceptance.

Personnel not directly involved in pneumatic testing of ferrous piping in excess of 35 kilopascal 5 psi shall be evacuated from the area.

Testing of any system for any purpose shall include preliminary testing by the process of swabbing of all joints under test with standard high-film-strength soap solution conforming to MS MIL-L-25567, and the subsequent observation for bubbles at internal pressures not in excess of 35 kilopascal 5 psi.

When testing reveals that Leakage exceeds specified limits, the leaks shall be isolated and repaired, defective materials shall be replaced where necessary, and the system shall be retested until specified requirements

are met. Leaking gasket joints shall be remade with new gaskets and new flange bolting. Removed bolting and gaskets shall not be used again. Leaking tubing joints shall be remade with new fittings and new tube ends.

Only standard piping flanges, plugs, caps, and valves shall be used for sealing off piping for test purposes.

Components that could sustain damage due to test pressure shall be removed from piping systems during testing. Piping system components such as valves shall be checked for proper operation under system test pressure.

No test media shall be added to a system during a test for a period specified or determined by the Contracting Officer.

Duration of a test will be determined by the Contracting Officer and shall be for a minimum of 15 minutes with a maximum of 24 hours. Tests may be terminated by the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

Test material shall be retained in piping system after successful testing until purged by natural gas. No ambient air shall be permitted to enter piping system.

Records of piping systems tests shall be prepared and maintained. Records shall show Governmental and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates. Each acceptance test shall require the signature of the Contracting Officer.

3.3.2 Test Gages

Contractor's test gages shall have dial size 125 millimeter 4-1/2 inches or larger with accuracy of plus or minus one-half of 1 percent of full-scale range. Dial graduations and pointer width shall be compatible with readability to one-half the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting point at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, and shall show test gage number and the project number.

3.3.3 Acceptance Pressure Testing

Testing shall take place during steady ambient temperature conditions.

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NOTE: Select 75-psi 520 kilopascal test pressure when Type LGS valves are specified; otherwise select 150-psi 1050 kilopascal test.
****

[Ferrous piping systems shall be tested at 520 kilopascal 75 psig.]

[Ferrous piping systems shall be tested at 1050 kilopascal 150 psig.]

Any reduction of test pressures shall be deemed to indicate the presence of leaks which shall be corrected unless the pressure loss can otherwise be accounted for. A correction of plus or minus 2 kilopascal 0.3 psi will be

allowed for each degree change between initial and final system temperature, plus for an increase in temperature and minus for a decrease.

Test duration shall be long enough to determine if there are any leaks but not less than 1 hour for each 14 cubic meter 500 cubic feet of pipe volume or fraction thereof, except that when testing a system having a volume of less than 0.3 cubic meter 10 cubic feet, the test duration may be reduced to 15 minutes. For piping systems having a volume of more than 680 cubic meter 24,000 cubic feet, the duration of the test shall be 24 hours.

Control and instrumentation tubing systems shall be tested at 200 kilopascal 30 psi and the test pressure shall be maintained for a period of not less than 24 hours with no pressure drop.

3.3.4 Purging of Piping

During construction, where necessary, purge valves shall be provided and located to ensure complete system purging with discharge exterior to the building.

3.3.5 Lighting of Pilot Lights

Equipment using natural gas under this Contract shall be lighted in the presence of the Contracting Officer.

3.4 ELECTRICAL WORK

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NOTE: Include applicable requirements in Division 16 "Electrical" work.

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3.4.1 Electrical Service

[Available power is [480-volt, 3-phase, 60-hertz] [120/240 volts, single-phase, 60-hertz] [_____]. Contractor equipment with voltage requirements other than that specified shall have transformer equipment. Contractor shall refer to the electrical drawings and Division 16, "Electrical," of these specifications for specific information on the arrangement of electrical circuits and their effect on the equipment and work required.]

3.4.2 Electrical Bonding and Grounding

Each aboveground portion of gas piping system upstream of the equipment shutoff valve shall be electrically continuous and bonded to any grounding electrode, in accordance with NFPA 70.

3.4.3 Electrical Circuits

Electrical circuits shall not utilize gas piping or components, except that low voltage (50 volts or less) control circuits, ignition circuits, and electronic flame detection device circuits may use piping or components for a part of an electrical circuit.

An electrically operated normally open safety control shall be provided to shut off the flow of gas if the power fails.

-- End of Section --