

MATERIAL STANDARD
FOR
PIPES, VALVES AND FITTINGS

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0. INTRODUCTION

Valves, pipe and fittings in general have a variety use in industry. They are manufactured in different types, materials, sizes and technical characteristics for specific purposes. They may be used for control of fluids (water, oil, gases and steam) in pipe line systems including hydraulic-power transmission, fire protection, water supply, steam supply and general system piping.

The pipes, valves and fittings which are used in above mentioned fields vary in sizes (pipe up to 2400 DN), in pressure ratings up to 450 bars and in temperature ratings from -45°C (-49°F) to very high degrees corresponding to related pressure.

However the valves, pipes and fittings used in the HVAC&R field are considered in this Standard.

1. SCOPE

This Standard is intended to cover minimum requirements for materials, fabrication, dimensions, tolerances, marking and testing of valves, pipes, fittings, strainers and flanges which are used in the HVAC&R industries. This Standard includes ferrous, nonferrous and PVC pipes, ferrous and nonferrous valves, flanges, fittings and strainers in sizes of DN 6 (¼") through DN 600 (24") and in rating Classes 12, 150, 250 and 300 PSI SWP. The media involved in this Standard shall be limited to water, steam, fuel oil and natural gas and to maximum temperature up to 220°C (450°F), suitable for the HVAC&R application.

This Standard does not cover specifications for refrigerant valves, special services valves and welded bonnet valves. Also stainless steel pipes, cast iron pipes and fittings are not included in this Standard.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendors.

ANSI/ASME (AMERICAN NATIONAL STANDARDS INSTITUTE/AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

ANSI/ASME B31.9	"For Building Services Piping"
ANSI/ASME B31.1	"For Power Piping"

MSS (MANUFACTURER'S STANDARDIZATION SOCIETY)

a) SP-25-1988	"Standard Marking System for Valves, Fittings, Flanges and Unions"
b) SP-61-1977	"Pressure Testing of Steel Valves"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO-5252-1977	"Steel Tubes Tolerance System"
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AIA (THE AMERICAN INSTITUTE OF ARCHITECTS)

Copyright 1988, Section 15100	"Valves"
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ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

a) A53-88a	"Standard Specification for Pipe, Steel Black and Hot Dipped, Zinc Coated, Welded and Seamless"
b) B88M-88a	"Standard Specification for Seamless Copper Water Tube"

3. DEFINITIONS AND TERMINOLOGY

3.1 Alloy Steel:

A steel which owes its distinctive properties to elements other than carbon, giving it greater resistance to corrosion and more strength than carbon steel .

3.2 Braze Weld or Brazing:

A process of joining metals using a nonferrous filler metal or alloy, the melting point of which is higher than 427°C (800°F) but lower than that of the metals be joined.

3.3 Carbon Steel:

A steel which owes its distinctive properties chiefly to the various percentages of carbon (as distinguished from the other elements) which it contains.

3.4 Ductility:

The property of elongation, above the elastic limit, but under the tensile strength.

3.5 Socket Fitting:

A fitting used to join pipe in which the pipe is inserted into the fitting. A filler weld is then made around the edge of the fitting and the outside wall of the pipe at the junction of the pipe and fitting.

3.6 Soldering:

A method of joining metals using fusible alloys, usually tin and lead, having melting points under 371°C (700°F).

3.7 Welding:

A process of joining metals by heating until they are fused together, or by heating and applying pressure until there is a plastic joining action. Filler metal may or may not be used.

4. UNITS

This Standard is based on International System of Units (SI) except where otherwise is specified.

5. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or order, the following priority shall apply:

- 1) First Priority : The Purchase Order
- 2) Second Priority : The data/requisition sheets and drawings referred to
- 3) Third Priority : This Standard specification

All conflicting requirements shall be referred to the Company in writing. The Company will issue confirmation documents if needed for clarification.

PART I VALVES

6. VALVES

6.1 General Features

6.1.1 The type of valves traditionally used for chilled water, condenser water, domestic hot and cold water, heating hot water and low-pressure steam services related to HVAC&R are covered in this Standard.

6.1.2 Rising stem valves 2½ -inch and larger shall have outside screw and yoke (OS&Y). The non-rising stem valves may be used where headroom prevents full extension of rising stems. For valve 2"and smaller, screwed union ring bonnet shall be used.

6.1.3 Unless otherwise indicated, the valve size shall be same size as upstream pipe.

6.1.4 The following special operator features shall be provided:

- a) Handwheels, fastened to valve stem, for valves other than quarter turns.
- b) Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Square heads shall be provided for plug valves with one wrench for every five plug valves.
- c) Where necessary chain-wheel operators with babbit adjustable sprocket rim shall be provided for valves installed 183 cm (72-inch) or higher above finished floor elevation. Chains shall be extended to an elevation of 122 cm (48-inch) above finished floor elevation.
- d) Gear drive operators, on quarter-turn valves 8-inch and larger.

6.1.5 Where insulation is indicated or specified, stems shall be extended and arranged to receive insulation.

6.1.6 By-pass and drain connections shall comply to MSS SP-45.

6.1.7 The end connections shall comply to following standard or as indicated by similar authoritative international bodies:

- a) Threaded ends to comply with ANSI B.2.1.
- b) Flanged ends to comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel.
- c) Solder joint ends to comply with ANSI B16.18. (for gate, globe and check valves, the solder melting point shall be below 449°C (840°F) and for ball valves below 215.6°C (420°F) temperature).

6.1.8 Unless otherwise mentioned, the valves shall be selected with the following ends or types of pipe/tube connections:

- a) If with copper tube sizes 2-inch and smaller shall be solder ends. However for heating hot water and low-pressure steam services, threaded ends can be used.
- b) If with steel pipe sizes 2-inch and smaller, threaded or grooved ends can be used.
- c) If with steel pipe sizes 2½ -inch and larger, grooved end or flanged ends can be used.

6.1.9 Manufacturers shall be required to provide minimum requirements of specification on individual parts for each valve with explosive views illustrated in supporting catalogs.

6.2 Gate Valves

6.2.1 General

Unless otherwise mentioned, the size, pressure, temperature rating, material and connecting ends shall be as specified below:

SIZE	STEAM WORKING PRESSURE kPa	TEMPERATURE RANGE °C	ENDS	BODY MATERIAL	INSIDE TRIM
¼"-2"	861.75-2068.2 (125-300 psi)	-20 to 200 (-4°F) to (392°F)	Screwed	Bronze or Brass	Bronze or Brass
2 ½" and Larger	861.75-1723.5 (125-250 psi)	-20 to 220 (-4°F) to (428°F)	Flanged	Cast Iron or Bronze	Aluminum or IBBM

IBBM: Iron Body Bronze Mounted

6.2.2 Material specification

6.2.2.1 Gate valves shall be solid wedge, rising or non-rising stem, union yoke for bronze valves and open screw and yoke for cast iron or IBBM valves. The thread connection for screwed type shall be to NPT and for flange type shall be to ANSI standard as specified in data sheet.

6.2.2.2 Gate valves 2 inch and smaller shall comply to MSS SP-80, Class 125 and 150 body and bonnet to ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing and malleable iron handwheel. (For hot water or steam applications, solder end valves shall not be used).

6.2.2.3 Gate valves 2½-inch and larger shall comply to MSS SP-70, Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

Notes:

- 1) Solder and brazed end valves shall not be used for hot water heating and steam piping application.
- 2) The services of MSS SP-80 valves shall be applicable for condenser water, chilled water and domestic hot and cold water.
- 3) The services of MSS SP-70 valves shall be applicable for condenser water, chilled water, domestic hot and cold water, heating hot water and low-pressure steam applications.

6.3 Globe Valves

6.3.1 General

Unless otherwise mentioned, the size, pressure and temperature rating, material and connecting ends shall be as specified below. Bronze needle globe valves are also covered in this group, but in sizes upto 2".

TYPE	SIZE	STEAM WORKING PRESSURE kPa	TEMPERATURE RANGE °C	ENDS	INSIDE TRIM
Globe & Angle	¼"-2"	861.75-2068.2 (125-300 psi)	-20 Thru 200 (-4°F) to (392°F)	Screwed	Bronze
Needle Globe	1/8"-2"	1378.8 (200 psi)	-20 Thru 220 (-4°F) to (428°F)	Screwed	IBBM
Globe	2½" -& Larger	861.75-1723.5 (125-250 psi)	-20 Thru 220 (-4°F) to (428°F)	Flanged	IBBM

6.3.2 Material specification

6.3.2.1 Globe and angle valves shall be full-port, unless the valve is specially designed for throttling service. All iron body globe and angle valves (2½" and larger) shall be outside screw and yoke (OS&Y). All globe and angle valves shall be designed with replaceable composition disc. The thread connection for screwed type shall be according to NPT and for flange type shall be to ANSI or equivalent standard as specified in data sheet.

6.3.2.2 Globe valve 2-inch and smaller shall comply to MSS SP-80, Class 125 and 150, body and screwed bonnet of ASTM B62 cast bronze; with threaded or solder ends, replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel.

6.3.2.3 Globe valves 2½ -inch and larger shall comply to MSS SP-85, Class 125 iron body and bolted bonnet conforming to ASTM A126, Class B, with outside screw and yoke, bronze mounted, flanged ends and "Teflon" impregnated packing, and two-piece backing gland assembly.

Notes:

- 1) The plug disc can be used on a long tapered disc and matching seat. The narrow seat or conventional disc shall not be used.
- 2) The Class 125 of MSS SP-80 valves shall be applicable for condenser water, chilled water and domestic hot and cold water, and the Class 150 shall be applicable for heating hot water and low-pressure steam applications.
- 3) The services of MSS SP-85 valves shall be applicable for condenser water, chilled water, domestic hot and cold water, heating hot water and low-pressure steam applications.

6.4 Check Valves

6.4.1 General

Unless otherwise mentioned, the size, pressure and temperature rating, material and connecting ends shall be as specified below:

TYPE	SIZE	STEAM WORKING PRESSURE kPa	ENDS	BODY MATERIAL
Swing Check	¼" -2"	861.75-2068.2 (125-300 psi)	Screwed	Cast Bronze
Swing Check	2½"- and Larger	861.75-1723.5 (125-250 psi)	Flanged	Cast Iron
Wafer Check	2½" and Larger	861.75 (125 psi)	Flanged	Cast Iron
Lift Check	¼"-2"	861.75 (125 psi)	Screwed	Cast Bronze

6.4.2 Material specification

6.4.2.1 The thread connection for screwed type shall be to NPT and for flange type shall be to ANSI or equivalent standard, as specified in the data sheet. The direction of flow shall be clearly indicated with a casted arrow.

6.4.2.2 Swing check valves 2 inch and smaller shall be MSS SP-80; Class 125 and 150, cast bronze body and screwed cap conforming to ASTM B62, with horizontal swing, Y-pattern and bronze disc; having threaded ends. Valves shall be capable of being reground while the valves remain in the line. (The Class 150 shall be used where system requires).

6.4.2.3 Swing check valves 2½ -inch and larger shall be MSS SP-71, Class 125 (Class 175 FM approved shall be used for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A126, Class B, horizontal swing, bronze disc or cast iron disc with bronze disc ring and flanged ends. (These valves shall be capable of being refitted while the valve remains in the line).

6.4.2.4 Wafer or globe style silent check valves 2½ -inch and larger shall be Class 250, semi-steel or cast iron body and flanged ends; with replaceable bronze seat, and center guided non-slam (silent type) design lapped and balance twin bronze flappers and bronze or stainless steel trim with torsion spring. Valves shall be designed to open and close at approximately one foot differential pressure. It shall be capable to activate at 1.72 to 3.45 kPa (¼ to ½ psi).

6.4.2.5 Lift check valves, 2-inch and smaller shall be Class 125; cast-bronze body and cap conforming to ASTM B62; horizontal or angle pattern, lift-type valve with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded end. The valves shall be capable of being refitted and ground while the valve remains in the line.

Notes:

1) The services of MSS SP-80 valves shall be applicable for condenser water, chilled water and domestic hot and cold water. The Class 150 shall be suitable for heating hot water and low-pressure steam.

2) The services of MSS SP-71 shall be applicable for condenser water, chilled water, domestic hot and cold water, heating hot water and low-pressure steam.

3) The services of wafer and lift check valves shall be similar to item (2) above.

6.5 Plug (Cock) Valves

6.5.1 General

Unless otherwise mentioned, the size, pressure, temperature rating, material and connecting ends shall be as specified below:

TYPE	SIZE	STEAM WORKING PRESSURE kPa	TEMPERATURE RANGE°C (°F)	ENDS
Plug (cock) Valve	½"-2"	1034.1 (150 psi)	Max 200 (392°F)	Screwed
Plug (cock) Valve	2½" and Larger	1034.1-2068.2 (150-300 psi)	Max 200 (392°F)	Flanged

6.5.2 Material specification

6.5.2.1 Plug valves up to 50 DN (2") shall be screwed according to *NPT standard. Plug valves 2½" and larger shall be flanged to ANSI or equivalent standard as specified in the data sheet.

6.5.2.2 Plug valves 2-inch and smaller, rated at 1034 kPa (150 psi) *WOG; bronze body, with straightaway pattern, non-lubricated type square head and threaded ends.

6.5.2.3 Plug valves 2½ -inch and larger shall be MSS SP-70, rated at 1206 kPa (175 psi) *WOG; lubricated plug type with semi-steel body, single gland, wrench operated and flanged ends.

* WOG: Water, Oil and Gas (non-shock working pressure).

* NPT: Nominal Pipe Thread (tapered).

6.6 Butterfly Valves

6.6.1 General

Unless otherwise mentioned, the size, pressure, temperature rating and material, shall be as specified below;

TYPE	SIZE	STEAM WORKING PRESSURE kPa	TEMPERATURE RANGE°C (°F)	TYPE	BODY MATERIAL
Butterfly	2½"-Inch and Larger	1034.2 (150 psi)	-5 to 110°C (7 to 230° F) or	Lug Type or Wafer Type	Cast Iron Carbon Steel

6.6.2 Material specification

6.6.2.1 Butterfly valves flanged in lug type or wafer type shall be suitable to match ANSI or equivalent flange standard as specified in the data sheet.

6.6.2.2 Butterfly valves lug type or wafer type 2½ -inch and larger shall be MSS SP-67; rated at 1379 kPa (200 psi); cast iron body conforming to ASTM A126, Class B. The valves shall be provided with field replaceable *EPDM sleeve, nickel plated ductile iron disc (except for aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Lever operators shall be provided with locks for sizes 2 through 6 inches and gear operators with position indicator for size 6 through 24 inches. The valves shall be drilled and tapped on dead-end services or requiring additional body strength.

***EPDM: Ethylene Propylene Diene Monomer**

6.6.2.3 The actuators for the butterfly valves can be electric, pneumatic/hydraulic and manual geared operated. It shall be based on ambient actuator operating temperatures from -28.9°C (-20°F) to 65.6°C (150°F).

Note:

The butterfly valves shall be applicable for condenser water, chilled water, domestic hot and cold water, heating hot water and low-pressure steam.

6.7 Ball Valves

6.7.1 Ball valves 1-inch and smaller shall be threaded ends rated for 1034 kPa (150 psi) saturated steam pressure, 2758 kPa (400 psi) WOG pressure; two piece construction; with bronze body conforming to ASTM B62, standard or regular port, chrome-plated brass ball, replaceable "Teflon" or *"TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle.

*** TFE: Tetra Fluoro Ethylene. "Teflon": is a registered trade mark of Dupont.**

6.7.2 Ball valves 1¼ -inch to 2½" shall be threaded ends rated for 1034 kPa (150 psi) saturated steam pressure, 2758 kPa (400 psi) WOG pressure; three piece construction; with bronze body conforming to ASTM B62, conventional port, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle.

Note:

The ball valves shall be applicable for condenser water, chilled water, domestic hot and cold water, heating hot water and low-pressure steam. The threaded ends shall be to NPT standard.

PART II

PIPES & FITTINGS & FLANGES

7. PIPING SPECIALTIES

7.1 Strainers

7.1.1 General

7.1.1.1 These pipeline specialty shall be provided for full line size of connecting piping, with ends matching piping system materials. The strainers shall be capable to deliver maximum strainer capacity with minimum pressure loss.

7.1.1.2 The Y-type strainers shall be available in the following two pressure Classes:

- a) With 862 kPa (125 psi) working pressure rating for low pressure applications.
- b) With 1724 kPa (250 psi) working pressure rating for high pressure application.

7.1.1.3 The temperature limitation for low pressure application on steam shall be 176.7°C (350°F) and on non-shock (WOG) conditions shall be 65.6°C (150°F); and for high pressure application on steam shall be 232°C (450°F) and on non-shock (WOG) conditions shall be 65.6°C (150°F).

7.1.1.4 Screens should be either monel or type 304 stainless for water system with 1.2 mm (3/64") perforations at 36 per square cm (233 per square inch). (For perforation on steam system, and other screen material, perforation sizes and pattern, approved manufacturer's recommendation shall be acceptable). The screen area shall preferably be no less than four times the pipe area.

7.1.1.5 Screwed drain (blow-off) plugs shall be furnished with both Y-type and basket type strainers. For cleaning of screen elements top bolted cover shall be provided for basket strainer and bottom flanged connections for the Y-type strainer.

7.1.2 Material specification

7.1.2.1 Strainers 2" and smaller shall be threaded ends, cast iron body, screwed screen retainer with centered blow-down fitted with pipe plug.

7.1.2.2 Strainers 2½" and larger shall be threaded or flanged ends, cast iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

7.1.2.3 Strainers 2½" and larger with butt welded ends for low pressure application, schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

7.1.2.4 Strainers 2½" and larger with butt welded ends for high pressure application, schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

7.1.2.5 Strainers 2½" and larger with grooved ends, tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EPDM gasket. These strainers shall be in schedule 40, 862 kPa (125 psi) ratings for low pressure applications.

7.2 Escutcheons

These shall preferably be chrome-plated, stamped steel, hinged, split-ring type with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation, where pipe is insulated. Outside diameter shall be capable to completely cover the opening in floors, walls or ceiling.

7.3 Unions

7.3.1 Unions shall be malleable iron female threaded ends, Class 150 for low pressure service and Class 250 for high pressure service; hexagonal stock with ball and socket joints, metal-to-metal bronze or galvanized seating surfaces.

7.3.2 Dielectric unions shall be provided with appropriate end connections for the pipe materials in which installed (screwed, soldered or flanged), which may effectively isolate dissimilar metals. These shall be capable to stop corrosion and prevent galvanic action in the liquid system. (These are installed in dry piping system such as, gas, compressed air, vacuum).

7.4 Dielectric Waterway Fittings

Where supplied, these shall be in sizes "1/4 to 4" electroplated steel or brass nipple, with an inert and non-corrosive thermoplastic lining. These may be threaded-to-threaded, threaded to-non-grooved or grooved fittings.

7.5 Grooved Couplings

Where required on curved piping, the grooved coupling (shall be similar to Victaulic style 77, Grinnel or equal), and machine cut to tolerance, per manufacturer's recommended maximum deflection required per coupling.

8. PIPES, FITTINGS AND FLANGES

8.1 General

8.1.1 The pipes and fittings covered in this Standard shall be suitable for HVAC&R application, unless hereinafter mentioned, capable to withstand minimum temperature of -40°C (40°F) for refrigeration, 4.4°C (40°F) for air conditioning and a maximum temperature of 148.9°C (300°F).

8.1.2 The pipe and fittings shall be visually inspected for conformity to the specification mentioned in this Standard and tested under applicable ASTM, ANSI, ASME and MSS codes and standard. Tests carried out by authoritative international bodies such as DIN, BSI, NF and JIS shall be acceptable.

8.1.3 All raw materials shall meet ASTM requirement and be covered by dimensional, visual and collating, radiographic and ultrasonic inspections.

8.1.4 Production approaches for material analysis and wall thickness of pipes shall be in accordance with relevant ASTM or equivalent standards and those for dimensions, shape and dimensional tolerance shall be in accordance with relevant ANSI or equivalent standards.

8.1.5 Where epoxy lining is required, the interior of the pipes and fittings shall be sand blasted and lined with 10-12 mil thickness of approved epoxy lining as recommended by the manufacturer.

8.2 Piping

8.2.1 Unless otherwise mentioned all black and galvanized pipes upto 10" shall be ASTM A-120 schedule 40 standard weight, and those 12" and larger shall be ASTM A-53 Grade B, 0.375 inches wall thickness.

8.2.2 Where other types of pipes are required, the following standard shall comply:

- a)** For Polyvinyl chloride (PVC) pipes, ASTM D1785, schedule 80, type 1, PVC 1120.
- b)** For stainless steel pipes, ASTM A312 type 316L schedule 10s, plain end or ANSI B36.19.
- c)** For copper pipes, type K or L, ASTM B-88 soft or hard drawn.
- d)** Fiberglass reinforced plastic (FRP) pipes, ASTM 2310 and ASTM 2396.
- e)** For wrought or seamless wrought steel pipe, ANSI B36.10.
- f)** Ductile (modular) cast iron having, dimensions conforming to ANSI/ASME B16.3, ANSI/ASME B16.4 or to ANSI/ASME B16.5 can be used in accordance with manufacturer's pressure-temperature ratings.

8.2.3 The pipes shall be tested in accordance with procedures mentioned in ASTM A53-88a standard.

8.2.4 Materials for fittings shall match the pipe system category for pressure, temperature and corrosion.

8.2.5 According to size and application of service, the type of piping materials shall preferably be in accordance to the schedule tabulated below.

SERVICE APPLICATION OF PIPE MATERIALS					
No.	SERVICE	SIZE Dia.	MATERIAL	TYPE	WEIGHT
1	CHILLED WATER	½-10 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
2	CHILLED WATER	10-24 INCH	STEEL-ASTM A-53 GRADE B	BLACK CARBON	9.5 mm (0.375") WALL THICKNESS
3	CONDENSER WATER	½-10 INCH	STEEL-ASTM A-120	GALVANIZED OR BLACK CARBON	SCHEDULE 40
4	CONDENSER WATER	10-24 INCH	STEEL-ASTM A-53 GRADE B	BLACK CARBON	9.5 mm (0.375") WALL THICKNESS
5	HOT WATER	½-10 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
6	HOT WATER	10-24 INCH	STEEL-ASTM A-53 GRADE B	BLACK CARBON	9.5 mm (0.375") WALL THICKNESS
7	STEAM (SATURATED)	½-2 INCH	STEEL-ASTM A-120	BLACK CARBON	SEAMLESS SCHEDULE 40
8	STEAM (SATURATED)	2½" AND LARGER	STEEL-ASTM A-53-GRADE B	BLACK CARBON	STD. WEIGHT OR SCHEDULE 40
9	COMPRESSED AIR	½-4 INCH	STEEL-ASTM A-120	GALVANIZED	SCHEDULE 40
10	*DH&C WATER	½-2 INCH	STEEL ASTM A-120 OR BS 1387	GALVANIZED	SCHEDULE 40, MEDIUM WT.
11	DH&C WATER	2½-10 INCH	STEEL ASTM A-120	GALVANIZED	STD. WEIGHT
12	FUEL OIL	½-4 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
13	NATURAL GAS	½-6 INCH	STEEL-ASTM A-53	BLACK CARBON	SCHEDULE 40 OR API 5L
14	ETHYLENE-GLYCOL	½-16 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
15	COOLING TOWER CHEMICAL TREATMENT	½-6 INCH	PLASTIC-ASTM D1785	* RUPVC	SCHEDULE 40
16	RELIEF	1-8 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
17	BLOW-OFF	1-4 INCH	STEEL-ASTM A-120	BLACK CARBON	SCHEDULE 40
18	DRAIN	1-3 INCH	STEEL-ASTM A-120	GALVANIZED	SCHEDULE 40
19	VENT	1-3 INCH	STEEL-ASTM A-120	GALVANIZED OR BLACK CARBON	SCHEDULE 40

* DH & C = Domestic Hot and Cold.

* RUPVC = Rigid Unplasticised polyvinyl chloride.

Note: Ethylene Glycol shall be used as a solution mixed with water.

8.3 Fittings

8.3.1 Unless otherwise mentioned all black and galvanized fittings upto 2" shall be malleable iron or cast iron screwed connections ANSI B16.4 and those 2½-inch and larger shall be buttweld connections ANSI B16.9.

8.3.2 The branch connections for butt welded joints shall be as follows:

- a) A tee shall be provided where the branch line is same size or one size smaller than main.
- b) A weldolet (welding outlet) shall be provided where the branch line is two or more sizes smaller than main.

8.3.3 All threaded joints shall be tapered to American NPT standard supplied with suitable pipe tape or dope (sealant) in accordance with ANSI B2.1.

8.3.4 Elbows upto 2-inch size shall be short radius and 2½" inch and larger shall be long radius type.

8.3.5 The manufacturing method, quality, dimensions shapes and dimension tolerance of butt welded fittings shall be applicable to following standards.

a) ANSI Standards:

- B16.9 wrought steel butt welded fittings.
- B16.25 butt welded ends.

b) ASTM Standards:

- A234 piping fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures.
- A403 wrought austentic stainless steel pipe fittings.

8.3.6 According to size and application of service, the type of fitting materials shall preferably be in accordance to the schedule tabulated below:

SERVICE APPLICATION OF PIPE FITTING MATERIALS					
No.	SERVICE	SIZE	MATERIAL	CONNECTING ENDS	WEIGHT
1	CHILLED WATER	½" -2"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)
2	CHILLED WATER	2½" AND LARGER	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD WEIGHT
3	CONDENSER WATER	½" -8"	GALVANIZED STEEL OR BLACK	BUTTWELD OR SCREWED	STANDARD
4	CONDENSER WATER	10" AND LARGER	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
5	HOT WATER	½" -2"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)
6	HOT WATER	2½" AND LARGER	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
7	STEAM (SATURATED)	½" -2"	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
8	STEAM (SATURATED)	2½" AND LARGER	WROUGHT STEEL	BUTTWELD	STANDARD
9	COMPRESSED AIR	½" -4"	GALVANIZED OR WROUGHT STEEL ANSI B16.9	BUTTWELD OR SCREWED FLANGES	STANDARD
10	FUEL OIL	½" -2"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)
11	FUEL OIL	2½" -4"	WROUGHT <u>STEEL</u> ANSI B16.9	BUTTWELD	STANDARD
12	DH&C WATER	½" -2"	MALLEABLE IRON ANSI B16.3	SCREWED	1034 kPa (150 lbs)
13	DH&C WATER	2½" -10"	CAST IRON B16.1	FLANGED ENDS	862 kPa (125 lbs)
14	NATURAL GAS	½" -6"	ANSI B16.3 CARBON STEEL	WELDED	ASTM A234
15	ETHYLENE GLYCOL	½" -16"	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
16	COOLING TOWER CHEMICAL TREATMENT	½" -6"	POLYVINYL CHLORIDE (PVC)	SOCKET WELD	SCHEDULE 80
17	RELIEF	½" -2"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)
18	RELIEF	2½" -8"	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
19	BLOW-OFF	½" -2"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)
20	BLOW-OFF	2½" -4"	WROUGHT STEEL ANSI B16.9	BUTTWELD	STANDARD
21	VENT	1" -4"	CAST IRON ANSI B16.4	SCREWED OR BUTTWELD	862 kPa (125 lbs)
22	DRAIN	1" -4"	CAST IRON ANSI B16.4	SCREWED	862 kPa (125 lbs)

Note:

The fitting material for DH&C water 2½ "to 10" shall be with screwed flanges.

8.4 Flanges

8.4.1 Unless otherwise mentioned flanged end fittings and connections on equipment, valves pumps and pipe lines size 2½"-inch and larger shall be furnished with companion mating flanges (flat faced for valves), stud bolts, nuts and gaskets for the following type of flanges:

- a) Flanges on galvanized steel pipe shall be cast iron screwed to ANSI B16.1 or ANSI B16.5, 1034 kPa (150 psi). The threads shall be tapered to ANSI B2.1.
- b) Flanges on black carbon steel pipes shall be black steel, butt welded to ANSI B16.5 and ASTM A-181, schedule 40.
- c) Both raised faced (1/16") and flat faced flanges (flat faced preferred) shall be made available upto normal pressure of 2068 kPa (300 psi).

8.4.2 All flanges shall be supplied faced, drilled with dimensional tolerance per requirements of ANSI B16.5 or approved equal. These shall be tested complying to procedures covered in MSS-SP-44-1991 standard recommended practice.

8.4.3 Types of flanges covered by this Standard shall be either welding neck, slip-on, lap joint, socket weld and screwed flanges with sizes limited to 24-inch size as specified in the order sheet. Where required the blind flanges shall be flat faced supplied bored or tapped to required nominal pipe sizes.

8.4.4 The stud bolts and nuts shall be hexagonal fixed head, black ASTM A-307 Grade A or steel ASTM A-42 standard black carbon type. For galvanized pipes, similar stud bolts and nuts shall be galvanized.

8.4.5 The gaskets shall be of 1/6" minimum thickness of asbestos long fiber composition, cross laminated with provisions of tensile strength. The gaskets shall cover the entire flat face or raised face of the flanges.

8.4.6 Gasket material shall be full-faced for cast iron flanges and raised-face for steel flanges. The gasket material shall be selected to suit the service of the piping system in which installed conforming to respective ANSI Standard (A21.11, B16.20 or B16.21). The material shall not be affected by the chemical and thermal conditions of the fluid being carried.

**PART III
GENERAL ADMINISTRATIVE
AND
PROCEDURAL REQUIREMENTS**

9. GENERAL REQUIREMENTS

9.1 Labeling

9.1.1 On all pipes and fittings the following information shall be permanently affixed to or stamped into the metal:

- a)** Manufacturer's name or trade mark
- b)** Size and wall thickness
- c)** Schedule number or weight
- d)** Material type number
- e)** Laboratory control number (optional)

9.1.2 All ANSI flanges shall be marked with the following data:

- a)** Manufacturer's name or trade mark
- b)** Nominal size
- c)** Primary service pressure
- d)** Material designation
- e)** Heat code
- f)** Schedule number

9.1.3 All products shall be properly identified with names, types, sizes, grades, compliance labels and other information needed for identification.

9.2 Inspection/Quality Control and Quality Records

9.2.1 Inspection/quality control and test

9.2.1.1 The Purchaser's inspector, or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the pipes, valves and fittings to carry out necessary inspection at any stage of work.

9.2.1.2 Approval by the Purchaser's inspector or assigned representative shall not relieve the Vendor of this commitments under the terms of this specification or any associated order.

9.2.1.3 The supplier shall make available technical data, test facilities and samples that the Purchaser's representative may require for verification in conjunction with pertinent products.

9.2.1.4 Factory and mill test certificates and test reports shall refer to the serial number of the pipes, valves and fittings tested and bear the Purchaser's name, order number and manufacturer's name and trade mark.

9.2.2 Certification

A certification that the finished pipes, valves and fittings conform to the requirements of this Standard and that the material from which they are made conform to the chemical and physical requirements of the respective specifications shall be the basis of acceptance.

9.2.3 Quality control records

The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements. Preference shall be given to those ISO-certified suppliers that apply ISO-9000 version of quality management and quality assurance.

9.3 Export Packing and Shipment

9.3.1 The method of cleaning, preserving and the details of packing including moisture elimination, cushioning, blocking and crating shall be such to protect the valves, pipes and fittings against all damages which may occur during handling, sea shipment to the port and rough road haulage to site and during extended tropical open air storage.

9.3.2 Pipes and valve openings shall be suitably plugged by metal, wood or plastic to prevent dirt and other foreign materials from entering it. The end caps shall be maintained throughout the shipping, storage and handling duration.

9.3.3 Flanges, fittings and pipe specialties shall be protected from moisture and dirt by inside storage and enclosure or by packaging with durable, waterproofing wrapping.

9.3.4 Valves shall be prepared for shipment as follows:

- a) All valves shall remain dry and internally protected against rust and corrosion.
- b) Valve ends shall be protected against damage to threads, flange faces and weld-end preps.
- c) Valves shall be set at best position for handling. The globe and gate valves shall be set closed to prevent rattling; the ball and plug valves shall be set open to minimize exposure of functional surfaces; the butterfly valves shall be set closed or slightly open; and swing check valves shall be blocked in either closed or open position.

9.3.5 The following precautions shall be used for storage at the factory or site:

- a) Valve end protectors shall not be removed unless necessary for inspection.
- b) Valves shall be weather protected and stored indoors. Valve temperature must be maintained higher than the ambient dew point temperature. In the event outdoor storage is necessary, valves shall be supported off the ground or pavement in watertight enclosures.
- c) Valves shall be rigged to avoid damage on exposed parts. Do not use handwheels and stem for lifting purposes.

9.4 Submittals

9.4.1 The valve manufacturer shall provide clear product data, including body and parts material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances and installation instructions.

9.4.2 Product data shall also be submitted for the following piping specialties:

- Escutcheons - Dielectric unions and fittings - Strainers

9.4.3 Welder's certificates for fabrication of pipe and fittings shall be submitted for quality control specifying in quality assurance as follows:

- Welder's qualification shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing qualifications.
- Welding procedures and testing shall comply with ANSI standard B31.1.0.
- Soldering and brazing procedures shall conform to ANSI B9.1 standard safety code for mechanical refrigeration.

9.5 Guarantee

9.5.1 Clearance of defect

The pipes, valves, fittings and fitting specialties shall be free of cavity and must carry the manufacturer's performance guarantee on all products supplied.

9.5.2 Replacement of defective parts

All defective products shall be replaced by the supplier in shortest possible time, free of charge including transportation cost to site. The above mentioned period shall not be later than 18 months from the date of dispatch from manufacturer's works.

9.6 Coordination Responsibility with Others

9.6.1 In case the equipment ordered should be mounted on, aligned, connected, adjusted, or tested with the equipment of other manufacturer(s), the supplier shall coordinate with the participating manufacturer(s) and obtain all dimensional and technical informations allowing for any interconnecting equipment and tests that may be required.

9.6.2 The supplier shall be responsible for correct and timely communication with the participating manufacturer(s) and for any delay and/or cost claims arising from such communications.

9.6.3 Copies of all correspondence including those with sub-vendors shall be furnished to the purchaser.

9.7 Languages

All correspondence, submittals, layouts, documents, certificates including testing procedures and edited specifications shall be submitted in ENGLISH and / or Persian language.