DOCUMENT COVER SHEET

CONTRACT NO. : 제 C0022220032-1호

I T E M :

DOC. TITLE : PIPING MATERIAL CLASSES

DOCUMENT REVIEW STATUS

	FILE NO. :
KOREA DISTRICT HEATING ENGINEERING CO., LTD.	
DOCUMENT STATUS. 1. ☐ WORK MAY PROCEED. CONTRACTOR MAY PROCEED WITH FABRICATION OR CONSTRUCTION IN ACCORDANCE WITH SPECIFICATION. 2. ☐ REVISE AND RESUBMIT. CONTRACTOR MAY PROCEED IN ACCORDANCE WITH SPECIFICATION BASED ON MAKING REVISIONS AS NOTED AND RESUBMIT. 3. ☐ REVISE AND RESUBMIT (WORK MAY NOT PROCEED). REVISE AS NOTED AND RESUBMIT. HOLD FABRICATION / CONSTRUCTION. 4. ☐ FOR INFORMATION ONLY. 5. ☐ RESUBMIT. NOT ACCEPTABLE FOR MICROFILM OR REPRODUCTIONS. OTHERWISE CONSIDERED STATUS 1 AND WORK MAY PROCEED.	
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1. **GENERAL NOTES**

가. PIPING AND VALVE CLASS

Piping and valve classes are indicated by a three letters as follows ;

- The first letter : Primary valve and flange ratings
- The second letter : The type of material
- The third letter : SEQUENTIAL NUMBER (0,1,2....)
- The fourth letter : Code and standards

All ratings shall comply with ASME B16.5(flange), ASME B16.34(valve) unless otherwise noted.

1) THE FIRST LETTER - PRESSURE TEMPERATURE RATING

A	Special Rating as Designated on Class Sheet	
B	2500#	ASME B16.5
C	1500#	ASME B16.5
D	900#	ASME B16.5
E	600#	ASME B16.5
F	400#	ASME B16.5
G	300#	ASME B16.5
H	150#	ASME B16.5
J	125#	ASME B16.1
K	175#	Underwriter's Laboratory
L	250#	ASME B16.1
M	200#	(Manufacturer's Rating)
N	150#	ASME B16.24
P	100#	(Manufacturer's Rating)
R	75#	(Manufacturer's Rating)
S	50#	WOG
T	25#	AWWA (or Manufacturer's Rating)
V		Vendor Supplied Piping
W		Vendor Supplied Piping
X		General Use as Designated on Class Sheet
Y		General Use as Designated on Class Sheet
Z		General Use as Designated on Class Sheet

2) THE SECOND LETTER - MATERIAL

A	Low and Intermediate Alloy Steel (Cr-Mo)
B	Carbon Steel
C	Austenitic Stainless Steel
D	Copper, Brass or Bronze
E	Aluminum Bronze
F	Fiberglass - Glass-Fiber-Reinforced Thermosetting-Resin.GRP
G	Carbon Steel - Cement Mortar Lined
H	Cast Iron
I	Carbon Steel - Rubber Lined
J	Concrete
K	Vitrified Clay
L	Carbon Steel - Impact Tested
M	Cast Iron (High Silicon)
N	Carbon Steel - Galvanized
O	As Specified on Class Sheet
P	Cast Iron - Cement Lined
Q	As Specified on Class Sheet
R	Ductile Iron
S	Copper Nickel
T	Polyvinyl Chloride (PVC)
U	Polyethylene (PE) Pipe
V	Carbon Steel - Polypropylene Lined
W	Ductile Iron - Cement Lined
X	As Specified on Class Sheet
Y	As Specified on Class Sheet
Z	As Specified on Class Sheet

3) THE THIRD LETTER = SEQUENTIAL NUMBER (0,1,2....)

4) THE FOURTH LETTER - APPLICABLE CODES/STANDARDS

D	ASME B31.1 (Power Piping, Non-Boiler External Piping)
E	ASME B31.8 (Gas Transmission & Distribution Piping)
F	National Fire Safety Code / National Fire Protection Association
G	National Plumbing Code or Applicable Plumbing Code
H	ASME B&PV, Sec.I ((Power Boilers) / ASME B31.1 (Boiler External Piping)
J	American Water Works Association
K	Korean Industrial Standards
X	Vendor Supplied Piping (e.g. Turbine Piping, Manufacturers Standards, etc.)
Y	ASME B31.1(Power Piping, Alternate Materials)

Z Others

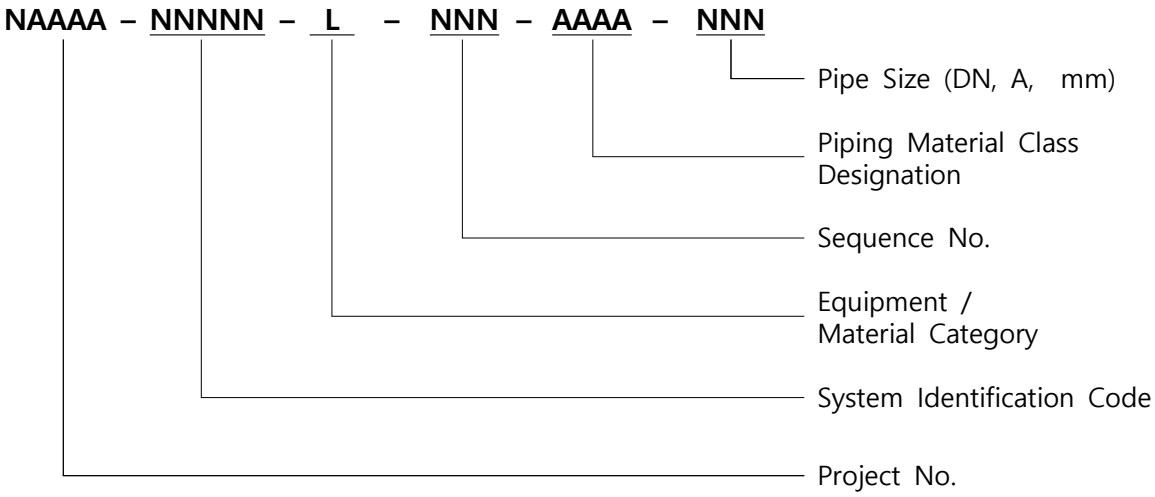
나. NUMBERING SYSTEM

1) PIPING LINE NUMBER

Piping line numbers shall be formed by six groups.

Each element is explained with an example as follows.

The sequence number consists of three digits and are renewed for each system.

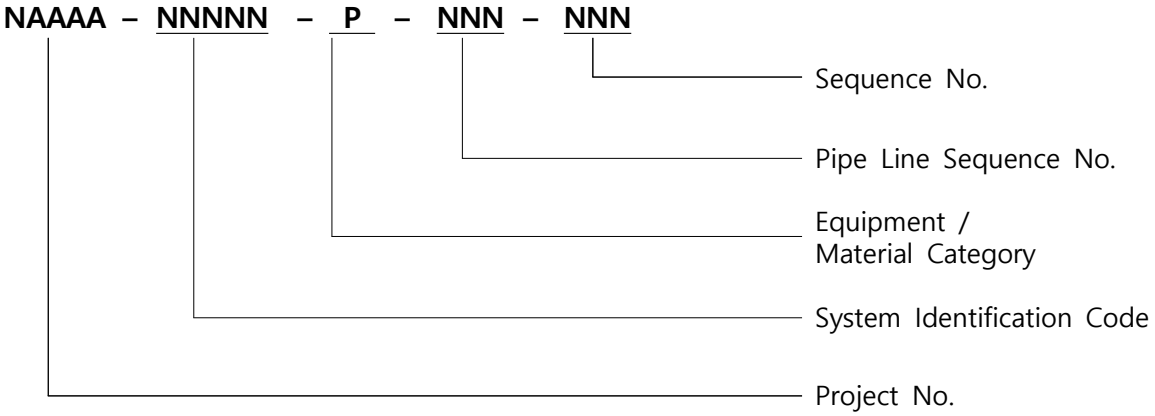


2) PIPING SPOOL

Piping spools shall be formed by five groups.

Each element is explained with an example as follows.

The spool sequence numbers consists of three digits and are renewed for each line.

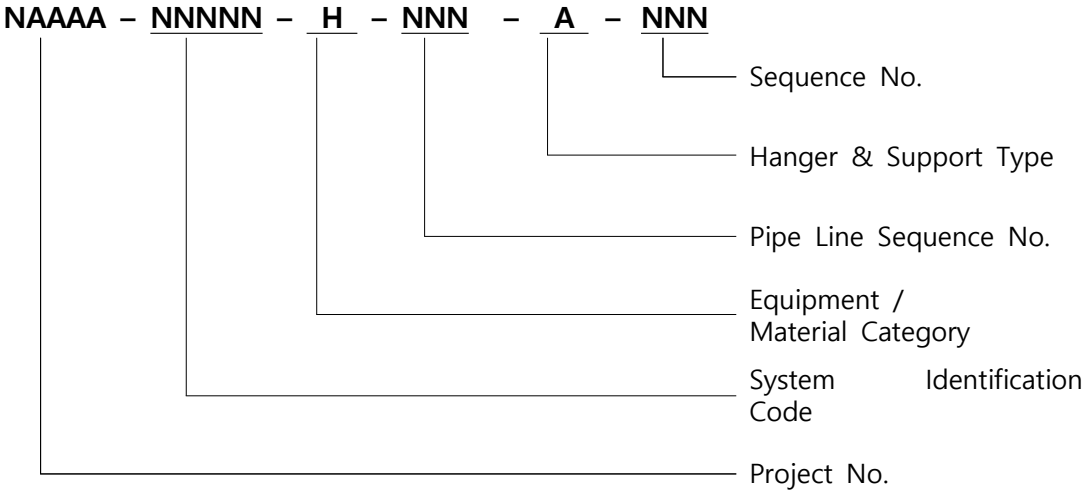


3) PIPE HANGER & SUPPORT

Pipe hangers shall be formed by six groups.

Each element is explained with an example as follows.

The hanger sequence numbers consists of three digits and are renewed for each line.



Type of Hanger is as follows ;

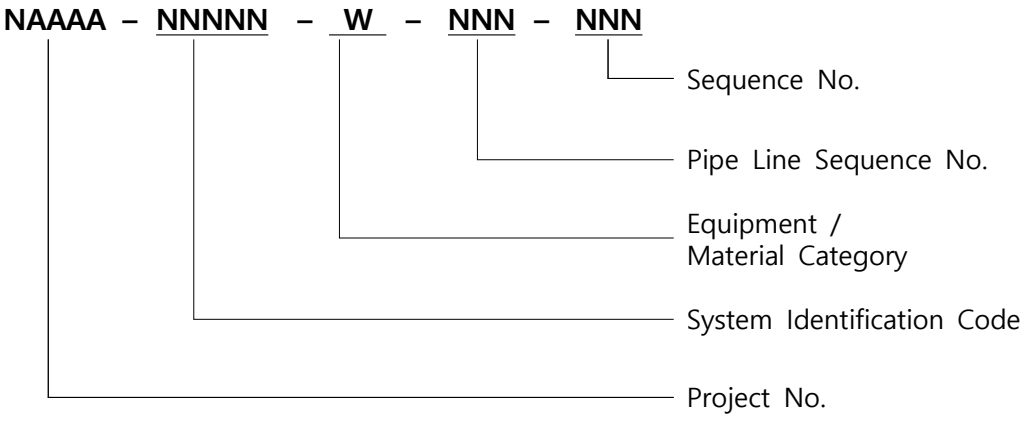
A : Anchor,	C : Constant Spring,	R : Rigid Hanger,
G : Guide,	U : Under Rigid Support,	T : Sway Strut,
X : Snubber or Sway Brace,	S : Limit Stop (Stop Gap)	N : Line Stop,
Q : One Way Restraint,	R : Rod or Rigid hanger,	W : Three Way Restraint
V : Variable Spring		

4) WELDING POINT

Welding point shall be formed by five groups.

Each element is explained with an example as follows.

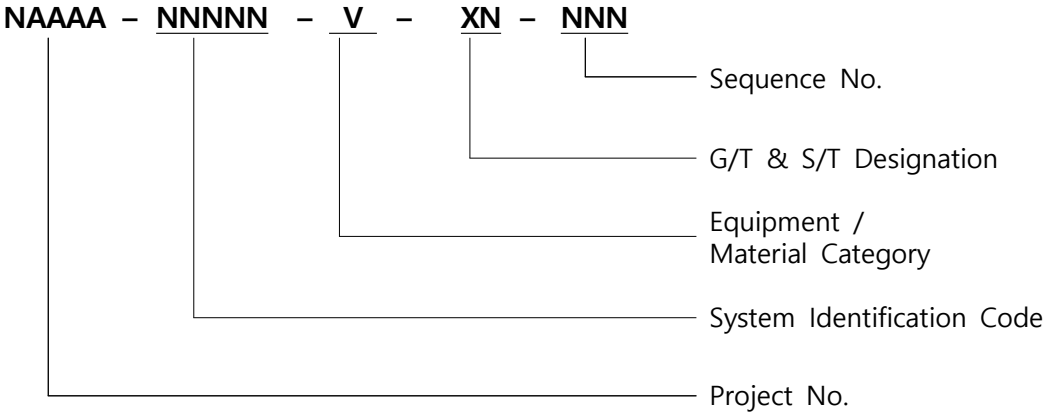
The weld sequence numbers consists of three digits and are renewed for each line.



5) VALVE NUMBER

Valve numbers shall be formed by five groups.

Each element is explained with an example as follows. The valve sequence numbers are renewed for each line.



다. GENERAL REQUIREMENTS

1) Materials specified in the Piping Classification shall comply with the conditions of the applicable Codes, Standards and the applicable technical specifications. Any deviation of materials and specifications shall be approved by KOWEPO.

2) Critical piping systems are designated as follows ;

가) Main steam
나) Reheat steam (Hot, Cold)
다) Low pressure steam
라) Bypass steam
마) Boiler feed water
바) Turbine extraction steam piping and heater drain & vent
사) Condensate
아) Auxiliary steam
자) Steam turbine steam seals
차) System that design temperature is 400 °C or higher
카) System that ASME flange rating is Class 900 or higher
타) The system which is considered as critical because of temperature and pressure condition
파) District heating supply/return & associated lines with 7 kg/cm².g and over of design pressure (Inc. Safety Valve) (If Required)
하) LNG (Fuel gas) lines

3) The LINE DESIGNATION LIST is a summary of all lines shown on the P&IDs and is included as belows.

가) Piping Material Class designation
나) Material, size, thickness of piping
다) Type and thickness of insulation
라) Description (From and To)
마) Design and operating temperatures
바) Design and operating pressures

4) The MASTER VALVE LIST is a summary of all valves and is included as belows.
가) Material, type and identification Number of Valves
나) Type of Valve ends

라. REQUIREMENTS FOR FITTINGS

1) All fittings and flanges, unless otherwise noted, shall be belows :
A : Tees – straight, B : Elbows – long radius, C : Reducers and swages-concentric

2) All pipe bends shall be 1.5~5 diameter radius, unless otherwise noted.

3) Elbow shall be long radius elbow if possible.

4) The threaded fittings shall be backwelded according to code limitations under the following conditions when socket weld connections can not be provided with equipment :
가) Connection subject to 21 barg and up
나) Vacuum, nitrogen, and hydrogen lines
다) Connection to pressure vessels
라) Instrument connections for piping or vessels to first valve

5) Butt weld end preparations and the transitions of butt weld end for field welds shall comply with ASME 16.25.

6) Unless otherwise noted, the wall thickness of butt-welding fittings, flanges and valves shall be equal to the thickness of connecting pipe. When fittings, flanges and valves are specified to a thickness other than that of the pipe (i.e. Sch.40 fittings for lighter than Sch.40 pipe) and this results in a misalignment greater than 2 mm between the inside surfaces of the components to be joined, the heavier wall component shall be taper bored to reduce the difference to 2 mm maximum. This however, shall not result in a piping component with less than the nominal pipe thickness minus the mill tolerance.

7) Pipe threads and thread compound

가) Thread compound when required shall be harmonious with the service and design conditions of the Piping material class.
나) Thread compound shall not be used on joints as "seal welded".
다) When making-up threaded connections in stainless steel piping, thread compound shall be cautiously applied to all the male threads for minimizing galling. It is prohibited that thread compound overhang the end of the pipe.

마. REQUIREMENTS FOR FLANGES, GASKETS & BOLTS / NUTS

1) All flanges DN 600 and smaller shall have the dimensions in accordance with ASME B16.5 for steel flanges, ASME B16.1 for cast iron flange and ASME B16.24 for bronze flanges, unless otherwise noted in the Piping Material Class.

2) Steel flanges larger than DN 600 shall be specified on the applicable drawings when required.

3) Orifice plates (FE on P&ID) shall have orifice flanges. The other orifice plates (FO on P&ID) shall have standard flanges in accordance with the applicable Piping Material Class.

4) All orifice flanges for flow measurement shall be welding neck, raised face, Class 300 minimum and provided with two jackscrews and tapped in accordance with Para.바.2).

5) Flanges DN 65 and larger adjacent to fittings shall be welding neck (not slip-on) unless otherwise noted on piping drawings.

6) Bolt holes are in multiples offour. Bolt holes shall be equally spaced and pairs of bolt holes shall straddle fitting center lines.

7) Bolting materials shall be noticed in each Piping material class in detail. Bolts and Nuts shall be hot dip galvanized per ASTM A153 Class C below 200 ℃, and chromium chromate coated over 200 ℃ per ASTM B166 unless otherwise indicated in the Piping Material Classes except stainless material.

8) Bolts and nuts shall be in accordance with the followings unless otherwise indicated in the Piping material class.

가) Stud Bolts/Nuts
- Bolts : Continuously threaded in accordance with ASME B1.1, Class 2 A fit.
(1) Sizes 1" & smaller in diameter - coarse thread series.

(2) Sizes 1⅛" & larger in diameter – 8 pitch thread series.
(3) Length shall be in accordance with ASTM B16.5.

- Nuts : Hexagon semi-finished, American Standard heavy series in accordance with ASME B18.2.2, threaded in accordance with ASME B1.1 Class 2B fit.
(1) Sizes 1" & smaller in diameter - coarse thread series.
(2) Sizes 1⅛" & larger in diameter – 8 pitch thread series.

나) Machine Bolts/Nuts
- Bolts : Heavy Hexagonal Head Machine Bolts in accordance with ASME B18.2.1 threaded in accordance with ASME B1.1 coarse thread series Class 2A fit.
- Nuts : Hexagon Standard heavy series in accordance with ASME B18.2.2, threaded in accordance with ASME B1.1, coarse thread series, Class 2B fit.

9) Flexible type gaskets shall be as follows unless otherwise indicated.
가) 4.45 mm nominal original thickness
나) Type 304 stainless steel with Non-asbestos filler

10) If flexible type gaskets are used with stainless steel flanges, the gasket filler material shall contain a maximum of 200 ppm leachable chlorides.

바. REQUIREMENTS FOR BRANCH CONNECTION

1) Branch connections shall be in accordance with the branch connection table.

2) Orifice Flange Taps
Socket weld or threaded construction shall be in accordance with ASME B16.11. The pipe tap shall be provided for as belows;
가) DN 15 : class 600 and lower flanges
나) DN 20 : class 900 and higher flanges

3) Sample or Analyzer Connection
Material and weight/schedule shall be in accordance with the Piping Material Class.

4) Pressure Tap
Socket weld or threaded construction shall be in accordance with the Piping Material Classification. Fittings shall be 3000# minimum; weight / schedule, construction and material shall be in accordance with the applicable Piping Material Class.

5) Thermowell Connection
Thermowell connection shall be in accordance with the thermowell installation.

Weight or schedule shall be in accordance with the applicable piping material class.

6) For instrumentation installation details, see Chapter 5. 라. thru 타.

사. OTHER REQUIREMENTS

1) Vent and Drain
   가) High point vents and low point drains are required for all piping, except for air, nitrogen, carbon dioxide, vacuum or natural gas lines. For vent and drain connection details, see Chapter 5. 다.
   나) Globe Valves shall be used for vents and drains unless otherwise indicated on P&ID.
   다) Downstream of heater drain control valves where flashing conditions use tees and caps, or welding neck and blind flange instead of 90° elbows.
   라) The piping material class for vent and drain piping up to and including the root valves shall be the same as that of the piping system to which the vent or drain is attached.

2) The corrosion allowance in the calculation of piping thickness shall be 1.6 mm for carbon steel and 0.3 mm for low alloy up to 9Cr (A335-P91, P92). Stainless steel shall not consider corrosion tolerance.

3) Insulating flange kits use prevent galvanic corrosion of different metals or in connection with underground piping shall be supplied where shown on the design drawings.

4) Coating and wrapping for all underground carbon and stainless steel piping in all sizes shall comply with chapter4.라 or equivalent accepted by customer.

5) To cathodic protect, plant piping shall be electrically isolated from the station copper ground grid and other foreign metallic structures by way of insulating flange kit or insulating coupling.

6) All galvanizing of piping shall be done by the hot dip process.

7) Pipelines requiring insulation will be shop primer coated in accordance with the painting specification.

8) Pipelines not requiring insulation will be final painted in accordance with the painting specification.

9) When the control valve fails open, a DN 25 bleed valve shall be installed between upstream block valve and control valve. When the control valve fails close, two bleed valve shall be installed in case of one each side of the control valve.

10) Weld-end type ball valve on the gas line shall be designed to be easily serviced or replaced in-line.

11) For the Pre-Insulated Piping, see chapter5. 파."'PIPING MATERIAL SPECIFICATION FOR PRE INSULATED PIPING".

12) Otherwise specified in P&ID, In case of using HDPE, the specification of HDPE should applied in accordance with following table.

Specified size on the P&ID	25	50	65	80	100	150	200	250	300
↓	↓								
HDPE Size	32	63	75	90	110	160	225	280	355

13) Any substitution of materials or deviation from specifications shall be approved by KOWEPO.
14) If required bending, radius of bends is 1.5~5 pipe diameters in accordance with ASME B31.1 table 102.4.5. The minimum thickness is for straight pipe not considering bending allowance thickness.
15) Detailed piping material classes for Vendor package (First letter of classes is V or W) may be changed in accordance with the Vendor's standards.

2. **SERVICE SYSTEM INDEX**

PIPING MATERIAL CLASS	CLASS RATING	APPLICABLE CODE	SERVICE SYSTEM
EB1E	600	B31.8	Fuel Gas Supply (From LNG G/S to Fuel gas Emergency Shut off) Fuel Gas Supply (From LNG G/S to Aux. Boiler)
EB2E	600	B31.8	Fuel Gas Supply (From LNG G/S to Fuel gas Emergency Shut off) (U/G) Fuel Gas Supply (From LNG G/S to Aux. Boiler) (U/G)
GB1D	300	B31.1	Aux. Steam from Aux. BLR, COP Discharge to Condensate Storage Tank
GB2D	300	B31.1	COP Discharge to Condensate Storage Tank (U/G)
HB1D	150	B31.1	Misc. Vent & Drains, Aux. Steam, N2 Transfer, Plant Heating Steam Condenser Overboard Pump to C/T Basin HRSG Blowdown Transfer to C/T Basin
HB2D	150	B31.1	Misc. Vent & Drains, N2 Transfer (U/G) Condenser Overboard Pump to C/T Basin (U/G)
HB1Y	150	B31.1	Closed Cooling / Raw (Filtered Water) / Service Water Non Chemical Waste Water, Sanitary Water Waste Water Sump Pump Discharge (Oily, except JX1D) HVAC Condensate, Basin Over Flow Drain
HB2Y	150	B31.1	Closed Cooling Water / Basin Over Flow Drain (U/G)
HC1D	150	B31.1	Chemical Dosing : Inhibitor (Cooling Tower Basin)
HC3D	150	B31.1	C/T BD Transfer Pump Suction, Discharge
HC1Y	150	B31.1	Demineralized / Portable water / Condensate Transfer Instrument / Service Air / Hot Water Chiller Cooling Water / Chilled Water / Warm Water (for sanitary) Sanitary Sewer / Roof Drain HRSG Blow Down Sump Pump Waste Water C/T Reuse Make-up Water

PIPING MATERIAL CLASS	CLASS RATING	APPLI-CABLE CODE	SERVICE SYSTEM
HC2Y	150	B31.1	Demineralized / Portable water / Condensate Transfer(U/G) Instrument / Service Air (U/G) Chiller Cooling Water / Chilled Water / Warm Water (for sanitary) (U/G) Sanitary Sewer / Roof Drain (U/G) HRSG Blow Down Sump Pump Waste Water (U/G) C/T Reuse Make-up water (U/G)
HX2Y	150	KS	Waste Water / Raw Water / Service Water (U/G) Portable Water (U/G)
HX3Y	150	KS	Sanitary Sewer (U/G)
JX1D	125	B31.1 / AWWA	Cooling Water (A/G), Chemical Waste Water (A/G)
JX2D	125	B31.1 / AWWA	Cooling Water (U/G), Chemical Waste Water (U/G)
XB1K	Special	KS	Steam Heating
XH1G	Special	NP	Floor & Equipment Drain, Sanitary Sewer, Roof Drain
XN1K	Special	KS	Floor & Equipment Drain, Sanitary Vent
XR1K	Special	KS	Raw Water TP Area
XT1K	10K	KS	Chemical Dosing : NaOCl (Cooling Tower Basin) Chemical Dosing : H2SO4 (Cooling Tower Basin)

3. **PIPING CLASSES**

CODE	ASME B16.5 CLASS 600	CLASS
GAS TRANSMISSION &DISTRIBUTION PIPING ASME B31.8	CARBON STEEL	EB1E

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Fuel Gas Supply (From LNG G/S to Fuel gas Emergency Shut off)	71.0	60.0
Fuel Gas Supply (From LNG G/S to Aux. Boiler)	76.0	65.5

PIPE	API 5L, Gr.X65	DN 300 thru 500	ERW, BE, 14.3 mm
	API 5L, Gr.X42	DN 125 thru 250	ERW, BE, XS
		DN 65 thru 100	Seamless, BE, Sch.80
		DN 50 & Smaller	Seamless, PE, Sch.80
FITTING	API 5L, Gr.X65	DN 300 thru 500	Refer to Note. 2
	API 5L, Gr.X42 or ASTM A-234, Gr.WPB	DN 125 thru 250	Refer to Note. 2
		DN 65 thru 100	Refer to Note. 2
	ASTM A-105	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A694 Gr.F65	DN 350 & Larger	Class 600, RTJWN
	ASTM A-105	DN 65 thru 300	Class 600, RTJWN
		DN 50 & Smaller	Class 600, RTJSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	ASME B16.20 Ring Joint Type Gasket, Class 600		
PLATE	None		

CODE	ASME B16.5 CLASS 600	CLASS
GAS TRANSMISSION &DISTRIBUTION PIPING ASME B31.8	CARBON STEEL	EB1E

VALVE (Note 1, 2)

Size	Body Material	Class/Ends	Ball	Globe	
DN 250 thru 600	A350 LF2 or Equiv.	600/BW	186	-	
DN 125 thru 200	A350 LF2 or Equiv.	600/BW	187	-	
DN 65 thru 100	A350 LF2 or Equiv. / A216 Gr.WCB or A105 (for Globe Valve)	600/BW	188	162	
DN 50 & Smaller	A350 LF2 or Equiv. / A216 Gr.WCB or A105 (for Globe Valve)	600/SW/Flgd.	183	165	

JOINT

Welded except at Flanged Connections

NOTE

1. Valves shall be stamped by Korea Gas Safety Corporation.
2. Wall Thickness of Fitting

구분	1.5D ELBOW			TEE			REDUCER			CAP		
재질 / 외경 (호칭경)	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB
508.0(20")	14.3	-	-	23.8	-	-	17.5	-	-	15.9	-	-
457.0(18")	12.7	-	-	20.6	-	-	15.9	-	-	14.3	-	-
406.4(16")	11.9	-	-	19.1	-	-	14.3	-	-	11.9	-	-
355.6(14")	10.3	-	-	15.9	-	-	12.7	-	-	10.3	-	-
323.9(12")	9.5	14.3	17.5	14.3	22.2	27.0	11.1	14.3	14.3	9.5	14.3	14.3
273.1(10")	9.3	12.7	14.3	12.7	20.6	22.2	11.1	12.7	12.7	9.5	12.7	12.7
219.1(8")	7.0	9.5	12.7	11.1	15.9	18.3	7.9	9.5	9.5	7.0	9.5	9.5
168.3(6")	7.1	7.9	8.7	7.9	12.7	14.3	7.1	7.9	7.9	7.1	7.1	7.1
114.3(4")	6.0	6.0	6.0	6.0	7.9	11.1	6.0	6.0	6.0	6.0	6.0	6.0
88.9(3")	5.5	5.5	5.5	5.5	6.4	7.6	5.5	5.5	5.5	5.5	5.5	5.5
60.3(2")	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5

CODE	ASME B16.5 CLASS 600	CLASS
GAS TRANSMISSION &DISTRIBUTION PIPING ASME B31.8	CARBON STEEL	EB2E

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Fuel Gas Supply (From LNG G/S to Fuel gas Emergency Shut off) (U/G)	64.0	60.0
Fuel Gas Supply (From LNG G/S to Aux. Boiler) (U/G)	80.0	65.5

PIPE	API 5L, Gr.X65 (EX:PE)	DN 300 thru 500	ERW, BE, 14.3 mm
	API 5L, Gr.X42 (EX:PE)	DN 125 thru 250	ERW, BE, XS
		DN 65 thru 100	Seamless, BE, Sch.80
		DN 50 & Smaller	Seamless, PE, Sch.80
FITTING	API 5L, Gr.X65 (EX:PE)	DN 300 thru 500	Refer to Note. 3
	API 5L, Gr.X42 or ASTM A-234, Gr.WPB (EX:PE)	DN 125 thru 250	Refer to Note. 3
		DN 65 thru 100	Refer to Note. 3
	ASTM A-105 (EX:PE)	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A694 Gr.F65	DN 350 & Larger	Class 600, RTJWN
	ASTM A-105	DN 65 thru 300	Class 600, RTJWN
		DN 50 & Smaller	Class 600, RTJSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	ASME B16.20 Ring Joint Type Gasket, Class 600		
PLATE	None		

CODE	ASME B16.5 CLASS 600	CLASS
GAS TRANSMISSION &DISTRIBUTION PIPING ASME B31.8	CARBON STEEL	EB2E

VALVE (Note 1, 2)

Size	Body Material	Class/Ends	Ball	Globe	
DN 250 thru 600	A350 LF2 or Equiv.	600/BW	-	-	
DN 125 thru 200	A350 LF2 or Equiv.	600/BW	-	-	
DN 65 thru 100	A350 LF2 or Equiv. / A216 Gr.WCB or A105 (for Globe Valve)	600/BW	-	-	
DN 50 & Smaller	A350 LF2 or Equiv. / A216 Gr.WCB or A105 (for Globe Valve)	600/SW/Flgd.	-	-	

JOINT

Welded except at Flanged Connections

NOTE

1. Valves shall be stamped by Korea Gas Safety Corporation.
2. Wall Thickness of Fitting
3. All underground piping shall be coated and wrapped in accordance with chapter4. 라., External Polyethylene Coating or customer accepted equivalent.

구분	1.5D ELBOW			TEE			REDUCER			CAP		
재질 / 외경 (호칭경)	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB	API 5L GR.X65	API 5L GR.X42	ASTM A234 GR.WPB
508.0(20")	14.3	-	-	23.8	-	-	17.5	-	-	15.9	-	-
457.0(18")	12.7	-	-	20.6	-	-	15.9	-	-	14.3	-	-
406.4(16")	11.9	-	-	19.1	-	-	14.3	-	-	11.9	-	-
355.6(14")	10.3	-	-	15.9	-	-	12.7	-	-	10.3	-	-
323.9(12")	9.5	14.3	17.5	14.3	22.2	27.0	11.1	14.3	14.3	9.5	14.3	14.3
273.1(10")	9.3	12.7	14.3	12.7	20.6	22.2	11.1	12.7	12.7	9.5	12.7	12.7
219.1(8")	7.0	9.5	12.7	11.1	15.9	18.3	7.9	9.5	9.5	7.0	9.5	9.5
168.3(6")	7.1	7.9	8.7	7.9	12.7	14.3	7.1	7.9	7.9	7.1	7.1	7.1
114.3(4")	6.0	6.0	6.0	6.0	7.9	11.1	6.0	6.0	6.0	6.0	6.0	6.0
88.9(3")	5.5	5.5	5.5	5.5	6.4	7.6	5.5	5.5	5.5	5.5	5.5	5.5
60.3(2")	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5

CODE	ASME B16.5 CLASS 300	CLASS
POWER PIPING ASME B31.1	CARBON STEEL	GB1D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Aux Steam from Aux. Boiler	16.0	260.0
COP Discharge to Condensate Storage Tank	35.0	105.0

PIPE	ASTM A-106, Gr.B	DN 65 thru 250	Seamless, Sch. 40
		DN 50 & Smaller	Seamless, Sch. 80
FITTING	ASTM A-234, Gr.WPB	DN 65 thru 250	Seamless or Welded, BW, Sch.40
	ASTM A-105	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-105	DN 65 & Larger	Class 300, RFWN
		DN 50 & Smaller	Class 300, RFSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-515, Gr. 60		

	Size	Body Material	Class/Ends	Gate	Globe	Check
VALVE	DN 65 & Larger	A216WCB or A105	300 / BW	200	206	210
	DN 50 & Smaller	A105	600 / SW	154	165	176

JOINT	Welded except at Flanged Connections
NOTE	

CODE	ASME B16.5 CLASS 300	CLASS
POWER PIPING ASME B31.1	CARBON STEEL	GB2D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
COP Discharge to Condensate Storage Tank (U/G)	35.0	105.0

PIPE	ASTM A-106, Gr.B (EX:PE)	DN 65 thru 250	Seamless, Sch. 40
		DN 50 & Smaller	Seamless, Sch. 80
FITTING	ASTM A-234, Gr.WPB (EX:PE)	DN 65 thru 250	Seamless or Welded, BW, Sch.40
	ASTM A-105 (EX:PE)	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-105	DN 65 & Larger	Class 300, RFWN
		DN 50 & Smaller	Class 300, RFSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-515, Gr. 60		

VALVE	Size	Body Material	Class/Ends	Gate	Globe	Check
	DN 65 & Larger	A216WCB or A105	300 / BW	-	-	-
	DN 50 & Smaller	A105	600 / SW	-	-	-

JOINT	Welded except at Flanged Connections
NOTE	1. All underground piping shall be coated and wrapped in accordance withchapter4. 라., External Polyethylene Coating or customer accepted equivalent.

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	CARBON STEEL	HB1D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Misc. Vent & Drains,	10.0	60.0
Aux. Steam	16.0	260.0
N2 Transfer	10.0	60.0
Plant Heating Steam	2.0	120.0
HRSG Blow Down Transfer Pump Discharge	14.3	150.0
Condenser Overboard Pump to C/T Basin	5.0	105.0

PIPE	ASTM A-106, Gr.B	DN 300 thru 600	Seamless, STD WT.
		DN 65 & DN 250	Seamless, Sch. 40
		DN 50 & Smaller	Seamless, Sch. 80
FITTING	ASTM A-234, Gr.WPB	DN 300 thru 600	Seamless, BW, STD WT.
		DN 65 thru 250	Seamless, BW, Sch. 40
	ASTM A-105	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-105	DN 65 & Larger	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-515, Gr. 60		

VALVE	Size	Body Material	Class/Ends	Gate	Globe	Check	Ball
	DN 65 & Larger	A216WCB or A105	150 / BW	401	409	415	433
	DN 50 & Smaller	A105	600 / SW	154	165	176	182

JOINT	Welded except at Flanged Connections
NOTE	

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	CARBON STEEL (EX : PE)	HB2D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Misc. Vent & Drains, N2 Transfer (U/G)	10.0	60.0
Condenser Overboard Pump to C/T Basin(U/G)	5.0	105.0

PIPE	ASTM A-106, Gr.B (EX : PE)	DN 300 thru 600	Seamless, STD WT.
		DN 65 & DN 250	Seamless, Sch. 40
		DN 50 & Smaller	Seamless, Sch. 80
FITTING	ASTM A-234, Gr.WPB (EX : PE)	DN 300 thru 600	Seamless, BW, STD WT.
		DN 65 thru 250	Seamless, BW, Sch. 40
	ASTM A-105 (EX : PE)	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-105 (EX : PE)	DN 65 & Larger	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-515, Gr. 60		

	Size	Body Material	Class/Ends	Gate	Globe	Check	Ball
VALVE	DN 65 & Larger	A216WCB or A105	150 / BW	-	-	-	-
	DN 50 & Smaller	A105	600 / SW	-	-	-	-

JOINT	Welded except at Flanged Connections
NOTE	1. All underground piping shall be coated & wrapped in accordance with chapter4.라 or owner accepted equal.

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	CARBON STEEL (Alternate Material)	HB1Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Closed Cooling / Raw (Filtered Water) / Service Water	10.0	60.0
Non Chemical Waste Water	10.0	60.0
HVAC Condensate	10.0	180.0
Sanitary Water (A/G)	10.0	AMB.
Waste Water Sump Pump (OILY, except JX1D)	10.0	60.0
Basin Over Flow Drain	3.0	60.0

PIPE (Note 2)	ASTM A-134, Gr.A283C	DN 650 & Larger	Welded, STD WT..
	ASTM A-53, Gr.B	DN 300 thru 600	ERW, STD WT.
		DN 65 thru 250	ERW, Sch. 40
		DN 50 & Smaller	ERW, Sch. 80
FITTING (Note 2)	ASTM A-234, Gr.WPB or Gr.WPBW	DN 300 & Larger	Welded, BW, STD WT.
		DN 65 thru 250	Welded, BW, Sch.40
	ASTM A-105	DN 50 & Smaller	3000#, SW
FLANGE (Note 1,2)	MSS-SP44	DN 650 & Larger	Class 150, RFWN
	ASTM A-105	DN 65 thru 600	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
	KS D 3503, SS275 (Note 1)	Under Ground Maching Joint	Class 1 Flange for Water Service (KS D 3578 Drilling)
BOLTING	ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-515, Gr. 60		

VALVE	Size	Body Material	Class/Ends	Gate	Globe	Check	Butterfly	Ball
	DN 65 & Larger	A216WCB or A105	150 / BW	401 401A	409 409A	415, 442	448	433
	DN 50 & Smaller	A105	600 / SW	154 154A	165 165A	176 176A	-	182

JOINT	Welded except at Flanged Connections
NOTE	1. If U/G piping material is ductile iron, the joints shall be KS D 3503, SS275, Flanges(Class 1 flanges for water service, KS D 3578 drilling) 2. Piping materials may be substituted by equivalent KS if approved by owner.

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	CARBON STEEL (Alternate Material)	HB2Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Closed Cooling Water (U/G)	10.0	60.0
Basin Over Flow Drain (U/G)	3.0	60.0

PIPE (Note 2)	ASTM A-134, Gr.A283C (EX:PE)	DN 650 & Larger	Welded, STD WT..
	ASTM A-53, Gr.B (EX:PE)	DN 300 thru 600	ERW, STD WT.
		DN 65 thru 250	ERW, Sch. 40
		DN 50 & Smaller	ERW, Sch. 80
FITTING (Note 2)	ASTM A-234, Gr.WPB (EX:PE) or Gr.WPBW (EX:PE)	DN 300 & Larger	Welded, BW, STD WT.
		DN 65 thru 250	Welded, BW, Sch.40
	ASTM A-105 (EX:PE)	DN 50 & Smaller	3000#, SW
FLANGE (Note 1,2)	MSS-SP44	DN 650 & Larger	Class 150, RFWN
	ASTM A-105	DN 65 thru 600	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
	KS D 3503, SS275 (Note 1)	Under Ground Maching Joint	Class 1 Flange for Water Service (KS D 3578 Drilling)

BOLTING : ASTM A-193, Gr.B7 : Stud Bolts, ASTM A-194, Gr.2H : Heavy Hex Nuts, (hot dip galvanized per ASTM A153 Class C below 200 °C, chromium chromate coated over 200 °C per ASTM B166)

GASKET : Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4

PLATE : ASTM A-515, Gr. 60

VALVE

Size	Body Material	Class/Ends	Gate	Globe	Check	Butterfly	Ball
DN 65 & Larger	A216WCB or A105	150 / BW	401 401A	409 409A	415, 442	448	433
DN 50 & Smaller	A105	600 / SW	154 154A	165 165A	176 176A	-	182

JOINT : Welded except at Flanged Connections

NOTE

1. If U/G piping material is ductile iron, the joints shall be KS D 3503, SS275, Flanges(Class 1 flanges for water service, KS D 3578 drilling)
2. Piping materials may be substituted by equivalent KS if approved by owner.
3. All underground piping shall be coated & wrapped in accordance with chapter4.라 or owner accepted equal.

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	AUSTENITIC STAINLESS STEEL	HC1D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Chemical Dosing : Inhibitor (Cooling Tower basin) (A/G)	10.0	50.0

PIPE	A-312 Gr.TP316	DN 50 & Smaller	Seamless, Sch. 40S
FITTING	ASTM A-182, Gr.F316	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-182, Gr.F316	DN 50 & Smaller	Class 150, RFWN
BOLTING	ASTM A-193, Gr.B8M : Stud Bolts, ASTM A-194, Gr.8M : Heavy Hex Nuts		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-240, Gr. 316		

	Size	Body Material	Class/Ends	Gate	Globe	Check
VALVE	DN 50 & Smaller	A182 F316	600 / SW	158 158A	169 169A	178 178A

JOINT	Welded except at Flanged Connections
NOTE	

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	AUSTENITIC STAINLESS STEEL	HC3D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
C/T BD Transfer Pump Suction, Discharge (A/G)	10.0	60.0

PIPE	ASTM A312, Gr.TP316L		DN 65 thru 250			Seamless, Sch. 10S
			DN 50 & Smaller			Seamless, Sch. 40S
FITTING	ASTM A403 Gr.WP316L		DN 65 thru 250			Seamless, BW
	ASTM A182, Gr.F316L		DN 50 & Smaller			3000#, SW
FLANGE	ASTM A182, Gr. F316L		DN 250 & Smaller			Class 150, FFWN
BOLTING	ASTM A-193, Gr.B8M : Stud Bolts, ASTM A-194, Gr.8M : Heavy Hex Nuts					
GASKET	Non Asbestos Comp. Fiber Flat Ring 3.2 mm THK					
PLATE	ASTM A-240, Gr. 316L					
VALVE	Size	Body Material	Class/Ends	Gate	Globe	Check
	DN 50 & Smaller	A182 F316L	600 / SW	157 157A	168 168A	179 179A
	DN 65 ~ DN 250	A351 CF3M	150# / BW	402	410	416
JOINT	Welded except at Flanged Connections					
NOTE						

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	STAINLESS STEEL (Alternate Material)	HC1Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Demineralized / Portable water	10.0	60.0
Condensate Transter (A/G)	12.0	60.0
Instrument / Service Air (A/G)	10.0	60.0
Hot Water (A/G)	9.0	180.0
Chiller Cooling Water / Chilled Water / Warm Water (for sanitary) (A/G)	5.4	60.0
Sanitary Sewer (A/G) / Roof Drain (A/G)	ATM.	AMB.
HRSG Blow Down Sump Pump Waste Water (A/G)	10.0	90.0
C/T Reuse Make-up Water (A/G)	10.0	50.0

PIPE	A-358 Gr.TP304 CL.2	DN 250 & Larger	Welded, Sch. 10S
	A-312 Gr.TP304	DN 65 thru 200	Seamless, Sch. 10S
		DN 50 & Smaller	Seamless, Sch. 40S
FITTING	ASTM A-403, Gr.WP304W	DN 250 & Larger	Welded, BW
	ASTM A-403, Gr.WP304	DN 65 thru 200	Seamless, BW
	ASTM A-182, Gr.F304	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-182, Gr.F304	DN 65 & Larger	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
BOLTING	ASTM A-193, Gr.B8M CL.2 : Stud Bolts, ASTM A-194, Gr.8M : Heavy Hex Nuts		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-240, Gr. 304		

VALVE	Size	Body Material	Class/Ends	Gate	Globe	Check
	DN 65 thru 600	A351 CF8 or A182 F304	150 / BW or Flgd	407 407A	424 424A	426 426A
	DN 50 & Smaller	A182 F304	600 / SW	159 159A	170 170A	181 181A

JOINT	Welded except at Flanged Connections
NOTE	

CODE	ASME B16.5 CLASS 150	CLASS
POWER PIPING ASME B31.1	STAINLESS STEEL (EX : PE) (Alternate Material)	HC2Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Demineralized / Portable water	10.0	60.0
Condensate Transfer(U/G)	12.0	60.0
Instrument / Service Air (U/G)	10.0	60.0
HRSG Blow Down Sump Pump Waste Water (U/G)	10.0	90.0
Chiller Cooling Water / Chilled Water / Warm Water (for sanitary) (U/G)	5.4	60.0
Sanitary Sewer / Roof Drain (U/G)	ATM.	AMB.
C/T Reuse Make-up Water (U/G)	10.0	50.0

PIPE	A-358 Gr.TP304 CL.2 (EX:PE)	DN 250 & Larger	Welded, Sch. 10S
	A-312 Gr.TP304 (EX:PE)	DN 65 thru 200	Seamless, Sch. 10S
		DN 50 & Smaller	Seamless, Sch. 40S
FITTING	ASTM A-403, Gr.WP304W (EX:PE)	DN 250 & Larger	Welded, BW
	ASTM A-403, Gr.WP304 (EX:PE)	DN 65 thru 200	Seamless, BW
	ASTM A-182, Gr.F304 (EX:PE)	DN 50 & Smaller	3000#, SW
FLANGE	ASTM A-182, Gr.F304	DN 65 & Larger	Class 150, RFWN
		DN 50 & Smaller	Class 150, RFSW
BOLTING	ASTM A-193, Gr.B8M CL.2 : Stud Bolts, ASTM A-194, Gr.8M : Heavy Hex Nuts		
GASKET	Spiral Wound Metal with Inner, Outer and Non-Asbestos Gasket suitable for the Requirement of ASME B16.5 and B31.1 Para.108.4		
PLATE	ASTM A-240, Gr. 304		

	Size	Body Material	Class/Ends	Gate	Globe	Check
VALVE	DN 65 thru 600	A351 CF8 or A182 F304	150 / BW or Flgd	-	-	-
	DN 50 & Smaller	A182 F304	600 / SW	-	-	-

JOINT	Welded except at Flanged Connections
NOTE	1. All underground piping shall be coated & wrapped in accordance with chapter4.라 or owner accepted equal.

CODE	ASME B16.5 CLASS 150	CLASS
KS	HIGH DENSITY POLYETHYLENE (HDPE)	HX2Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Waste Water / Raw Water / Service Water (U/G)	10.0	60.0
Portable Water (U/G) (Note 9.)	10.0	60.0

PIPE (Note 1,2,3,4)	KS M3408-2 SP1 (PE100, SDR11)	DN 65(75) & Larger	Butt Fusion, Single Layer
		DN 50(63) & Smaller	Socket Fusion, Single Layer
FITTING (Note 1,2,3,4)	KS M3408-3	DN 65(75) & Larger	Butt Fusion
		DN 50(63) & Smaller	Socket Fusion
FLANGE (Note 1,2,3,5,6)	KS B 1503, SS275 & KS M3408-3 (PE100, SDR11)	DN 600 & Smaller	PE100 SDR11 Stub End with Back-Up Ring drilled to ASME B16.5 CL.150, FF
	KS B 1506, STS304 & KS M3408-3 (PE100, SDR11) (Note 11)	DN 600 & Smaller	PE100 SDR11 Stub End with Back-Up Ring drilled to ASME B16.5 CL.150, FF
BOLTING (Note 3,10)	ASTM A-193, Gr.B7 ASTM A-194, Gr.2H	Stud Bolts Heavy Hex Nuts	
GASKET	Rubber Gasket 4.0 mm thickness 150# Flat Ring Type. (Note 6)		

VALVE (Note 3)

SIZE	BODY MATERIAL	Class/Ends	Gate	Globe	Check	Plug
DN 65 thru 600	A216 WCB or A105	150/Flgd	404	412	419	-
DN 50 & Smaller	A105	600/Flgd	155	167	177	376

JOINT: Butt or Socket Fusion except at Flanged Connections

NOTE

1. High density polyethylene piping shall be manufactured in accordance with chapter4.바. ISO4427 PE100 SDR11 shall be used for pipe, fittings, and flanges of systems designated.
2. If HDPE piping is applied aboveground, carbon black compound shall be contained for the protection from ultraviolet.
3. These materials and flange type may be substituted for the equivalent materials approved by Owner.
4. If polyethylene piping is connected with the ferritic piping or valve, the polyethylene pipe size shall be selected on the basis of the inside diameter of ferritic piping or valve.
5. If polyethylene piping is connected with the ferritic piping or valve, the flange joint of this piping shall be fabricated and drilled to fit the ferritic flange.
6. A release agent shall be used when all polyethylene flange joints are bolted up. Release agent shall be approved by Owner. Gaskets are necessary between flange joints.
7. For HDPE underground piping, the pipe should be detectable HDPE pipe intergrated metal wire to detect by location detector from aboveground without installation of magnetic tape, etc.
8. If polyethylene piping is connected with the steel flange, can be assembled to supply count-flange, bolt, nut, gasket.
9. The specification of piping shall be selected in accordance with class"HC1Y"
10. Bolts and nuts shall be hot dip galvanized per ASTM A153 class C
11. If polyethylene piping is connected with the stainless piping or valve, the flange joint of this piping shall be applied.

CODE	ASME B16.5 CLASS 150	CLASS
KS	HIGH DENSITY POLYETHYLENE (HDPE)	HX3Y

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Sanitary Sewer (U/G)	10.0	66.0.

PIPE (Note 1,2,3,4)	KS M3408-2 SP1 (PE80, SDR13.6)	DN 65(75) & Larger	Butt Fusion, Single Layer
		DN 50(63) & Smaller	Socket Fusion, Single Layer
FITTING (Note 1,2,3,4)	KS M3408-3	DN 65(75) & Larger	Butt Fusion
		DN 50(63) & Smaller	Socket Fusion
FLANGE (Note 1,2,3,5,6)	KS M3408-3 (PE80, SDR13.6)	DN 600 & Smaller	PE80 SDR13.6 Stub End with Back-Up Ring drilled to ASME B16.5 CL.150, FF

BOLTING (Note 3,10)	ASTM A-307, Gr.B ASTM A-307, Gr.B		Hex Head Machine Bolts Heavy Hex Nuts
	ASTM A-307, Gr.B ASTM A-307, Gr.B	DN 50(63) & Smaller DN 50(63) & Smaller	Stud Bolts (Plug Valve only) KS B1012 Hex Nuts (Plug Valve only)

GASKET : PTFE (Garlock 3545 or Equal.) Gasket : 3.2 mm thickness Full Face with Bolt Holes

VALVE (Note 3)

SIZE	BODY MATERIAL	Class/Ends	Check	Diaphragm	Plug	Ball
DN 125 thru 600	A126B	125/Flgd	473	468	-	-
DN 65 thru 100	A126B	125/Flgd	474	468	477	-
DN 50 & Smaller	A126B	125/Flgd	475	468	476	-
All Size	B62	150/Flgd	-	-	-	368

JOINT : Butt or Socket Fusion except at Flanged Connections

NOTE

1. High density polyethylene piping shall be manufactured in accordance with chapter4.바. ISO4427 PE100 SDR11 shall be used for pipe, fittings, and flanges of systems designated.
2. If HDPE piping is applied aboveground, carbon black compound shall be contained for the protection from ultraviolet.
3. These materials and flange type may be substituted for the equivalent materials approved by owner.
4. If polyethylene piping is connected with the ferritic piping or valve, the polyethylene pipe size shall be selected on the basis of the inside diameter of ferritic piping or valve.
5. If polyethylene piping is connected with the ferritic piping or valve, the flange joint of this piping shall be fabricated and drilled to fit the ferritic flange.
6. A release agent shall be used when all polyethylene flange joints are bolted up. Release agent shall be approved by Owner. Gaskets are necessary between flange joints.
7. For HDPE underground piping, the pipe should be detectable HDPE pipe intergrated metal wire to detect by location detector from aboveground without installation of magnetic tape, etc.
8. If polyethylene piping is connected with the steel flange, can be assembled to supply count-flange, bolt, nut, gasket.
9. The specification of piping shall be selected in accordance with class"HC1Y"
10. Bolts and nuts shall be hot dip galvanized per ASTM A153 class C.
11. If polyyethylene piping is connected with the steel flange, can be assembled to supply counter flange, bolt, nut, gasket.

CODE	ASME B16.1 CLASS 125	CLASS
POWER PIPING ASME B31.1	GLASS FLAKE, RUBBER LINED CARBON STEEL AND STAINLESS STEEL	JX1D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Cooling Water (A/G)	6.0 / F.V	60.0
Chemical Waste Water (A/G)	10.0	60.0

PIPE	ASTM A134, A283, Gr.C		DN 2100	Welded, 21mm Wall
	ASTM A134, A283, Gr.C		DN 1500 thru 1800	Welded, 15.88mm Wall
			DN 1100 thru 1400	Welded, 13mm Wall
			DN 650 thru 1000	Welded, STD WT.
	ASTM A53, Gr.B		DN 300 thru 600	ERW, STD WT.
	ASTM A53, Gr.B		DN 65 thru 250	ERW, SCH. 40
	ASTM A321, Gr.TP317L		DN 50 and smaller	Seamless, SCH.40S
FITTING	ASTM A234, Gr.WPBW		DN 300 & Larger	Welded, BW
	ASTM A234, Gr.WPB		DN 65 thru 250	Seamless, BW
	ASTM A182, Gr.F317L or ASTM A105 (Note 4)		DN 50 & Smaller	3000#, SW
FLANGE	ASTM A181, Class 60 or ASTM A105		DN 650 and larger	AWWA C207 150#, FF SLIP-On (Class D, Ring Type)
	ASTM A105		DN 65 thru 600	Class 150, FFWN
	ASTM A182, Gr.F317L		DN 50 & Smaller	Class 150, FFSW
	ASTM A105 (Note 4)		DN 50 & Smaller	Class 150, FFWN (ASME B16.5 Drilling)
BOLTING	ASTM A307, Gr.B (Galv.)	DN 65 & Larger		Hex. Head Machine Bolts / CAP
	ASTM A563, Gr.A (Galv.)	DN 65 & Larger		Heavy Hex. Nuts / CAP
	ASTM A193, Gr.B8M	DN 50 & Smaller		Stud Bolts / CAP
	ASTM A194, Gr.8M	DN 50 & Smaller		Heavy Hex. Nuts / CAP
GASKET (Note.2,6,7)	RED RUBBER GASKET 3.2mm THK FF WITH BOLT HOLE, SHORE A 80~90		150#	DN 200 Thru DN 600
			AWWA C207 CL.D 150#	DN 650 Thru DN 1000
	RED RUBBER GASKET 5.0mm THK FF WITH BOLT HOLE, SHORE A 80~90		AWWA C207 CL.D 150#	DN 1100 Over.
	Teflon Gasket		150#	Note.6
	Non Asbestos Comp. Fiber Flat Ring 3.2 mm THK		150#	DN 25 Thru DN 150
PLATE	ASTM A283, Gr.B			

CODE	ASME B16.1 CLASS 125	CLASS
POWER PIPING ASME B31.1	GLASS FLAKE, RUBBER LINED CARBON STEEL AND STAINLESS STEEL	JX1D

VALVE (Note.4)

Size	Body Material	Class/Ends	Plug	Check (Note 5)	Diaphragm	Gate
DN 650 & Larger	A126, CL.B	125/Flgd	-	472	-	-
DN 150 thru 600	A126, CL.B	150/Flgd	469	473	468	-
DN 65 thru 100	A126, CL.B	150/Flgd	477	474	468	-
DN 20 thru 50	A126, CL.B / A105 (only Plug Valve) or A182, F317L(only Gate Valve)	150/Flgd	376	375	468	379

Size	Body Material	Class/Ends	Butterfly		
DN 1000 thru DN 1600	ASTM A126 CL.B	125#/FLGD	448B	-	-
DN 550, DN 650 thru DN 950	ASTM A216 WCB	150#/FLGD	448A	-	-
DN 200 thru DN 600 (except DN 550)	ASTM A216 WCB	150#/Lug	448	-	-
DN 50 thru DN 150	ASTM A216 WCB	150#/Wafer	447	-	-

JOINT

Shop	Welded
Field	Carbon Steel – Welded (DN650 & Larger) or Flanged (DN65 thru 600) Stainless Steel - Welded

NOTE

1. All carbon steel piping and fittings shall be internally lined as follows;
   - DN 65 thru DN 250 : Rubber (chapter4.나)
   - DN 300 & Larger :Glass Flake lined (chapter4.가) in accordance with chapter4.가.
2. A release agent shall be used when all Glass flake lined flange joints are bolted up. Release agent shall be approved by Owner. Gaskets are necessary between flange joints.
3. Pipes for DN 650 & larger shall be fabricated by straight seam welding.
4. For the connections of temperature, pressure instruments, vents & drains, DN 50 & Smaller size in lined piping, ASTM A105 shall be used instead of ASTM A182, Gr.F317L.
5. For MCW & ACW Pump discharge lines, Non-Slam Check Valve shall be used.
6. Isolation kit shall be installed for Stainless flange connection for Instrument, drain, vent Etc.(Refer to 5. 라)
7. In the case of a rubber seat type butterfly valve, there is no need to install a gasket between the valve surfaces.
8. Carbon steel piping and fitting for DN65 & Larger including thimble of condenser discharge shall be internally coated with the glass flake lined in accordance with chapter4.가
9. Polyproplylene (P.P) lined piping should be used for chemical waste water service.

CODE	ASME B16.1 CLASS 125	CLASS
POWER PIPING ASME B31.1	GLASS FLAKE, RUBBER LINED CARBON STEEL AND STAINLESS STEEL (EX : PE)	JX2D

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Cooling Water (U/G)	6.0 / F.V	60.0
Chemical Waste Water (U/G)	10.0	60.0

PIPE	ASTM A134, A283, Gr.C (EX:PE)		DN 2100	Welded, 21mm Wall
	ASTM A134, A283, Gr.C (EX:PE)		DN 1500 thru 1800	Welded, 15.88mm Wall
			DN 1100 thru 1400	Welded, 13mm Wall
			DN 650 thru 1000	Welded, STD WT.
	ASTM A53, Gr.B (EX:PE)		DN 300 thru 600	ERW, STD WT.
	ASTM A53, Gr.B (EX:PE)		DN 65 thru 250	ERW, SCH. 40
	ASTM A321, Gr.TP317L (EX:PE)		DN 50 and smaller	Seamless, SCH.40S
FITTING	ASTM A234, Gr.WPBW (EX:PE)		DN 300 & Larger	Welded, BW
	ASTM A234, Gr.WPB (EX:PE)		DN 65 thru 250	Seamless, BW
	ASTM A182, Gr.F317L or ASTM A105 (Note 4) (EX:PE)		DN 50 & Smaller	3000#, SW
FLANGE	ASTM A181, Class 60 or ASTM A105		DN 650 and larger	AWWA C207 150#, FF SLIP-On (Class D, Ring Type)
	ASTM A105		DN 65 thru 600	Class 150, FFWN
	ASTM A182, Gr.F317L		DN 50 & Smaller	Class 150, FFSW
	ASTM A105 (Note 4)		DN 50 & Smaller	Class 150, FFWN (ASME B16.5 Drilling)
BOLTING	ASTM A307, Gr.B (Galv.)	DN 65 & Larger	Hex. Head Machine Bolts / CAP	
	ASTM A563, Gr.A (Galv.)	DN 65 & Larger	Heavy Hex. Nuts / CAP	
	ASTM A193, Gr.B8M	DN 50 & Smaller	Stud Bolts / CAP	
	ASTM A194, Gr.8M	DN 50 & Smaller	Heavy Hex. Nuts / CAP	
GASKET (Note.2,6,7)	RED RUBBER GASKET 3.2mm THK FF WITH BOLT HOLE, SHORE A 80~90		150#	DN 200 Thru DN 600
			AWWA C207 CL.D 150#	DN 650 Thru DN 1000
	RED RUBBER GASKET 5.0mm THK FF WITH BOLT HOLE, SHORE A 80~90		AWWA C207 CL.D 150#	DN 1100 Over.
	Teflon Gasket		150#	Note.6
	Non Asbestos Comp. Fiber Flat Ring 3.2 mm THK		150#	DN 25 Thru DN 150
PLATE	ASTM A283, Gr.B			

CODE	ASME B16.1 CLASS 125	CLASS
POWER PIPING ASME B31.1	GLASS FLAKE, RUBBER LINED CARBON STEEL AND STAINLESS STEEL	JX2D

	Size	Body Material	Class/Ends	Plug	Check (Note 5)	Diaphragm	Gate
VALVE (Note.4)	DN 650 & Larger	ASTM A126, CL.B	125/Flgd	-	-	-	-
	DN 150 thru 600	ASTM A126, CL.B	150/Flgd	-	-	-	-
	DN 65 thru 100	ASTM A126, CL.B	150/Flgd	-	-	-	-
	DN 20 thru 50	ASTM A105 or A395 or A182, F317L	150/Flgd	-	-	-	-
	Size	Body Material	Class/Ends	Butterfly		-	-
	DN 1250 and larger	A536+Rubber or EQ.	AWWA150B /Flgd	-		-	-
	DN 650 thru DN1200	A536+Rubber or EQ.	AWWA150B /Flgd	-		-	-
	DN 200 thru DN 600	A536+Rubber or EQ.	150#/Lug	-		-	-
	DN 65 thru DN 150	A536+Rubber or EQ.	150#/Wafer	-		-	-
JOINT	Shop	Welded					
	Field	Carbon Steel – Welded (DN650 & Larger) or Flanged (DN65 thru 600) Stainless Steel - Welded					

NOTE

1. All carbon steel piping and fittings shall be internally lined as follows;
   - DN 65 thru DN 250 : Rubber (chapter4. 나)
   - DN 300 & Larger :Glass Flake lined (chapter4.가) in accordance with chpater4.가
2. A release agent shall be used when all Glass flake lined flange joints are bolted up. Release agent shall be approved by Owner. Gaskets are necessary between flange joints.
3. Pipes for DN 650 & larger shall be fabricated by straight seam welding.
4. For the connections of temperature, pressure instruments, vents & drains, DN 50 & Smaller size in lined piping, ASTM A105 shall be used instead of ASTM A182, Gr.F317L.
5. For MCW & ACW Pump discharge lines, Non-Slam Check Valve shall be used.
6. Isolation kit shall be installed for Stainless flange connection for Instrument, drain, vent Etc.(Refer to chapter 5. 라)
7. In the case of a rubber seat type butterfly valve, there is no need to install a gasket between the valve surfaces.
8. Carbon steel piping and fitting for DN65 & Larger including thimble of condenser discharge shall be internally coated with the glass flake lined in accordance with chpater4.가
9. Polyproplylene (P.P) lined piping should be sued for chemical waste water service.
10. All underground carbon steel piping shall be coated and wrapped in accordance with chapter4.라 or owner accepted equivalent.

CODE	SPECIAL CLASS	CLASS
KS	CARBON STEEL or GALVANIZED CARBON STEEL	XB1K

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Steam Heating (Carbon Steel)	8.0	180.0

PIPE	KS D3507, SPP (Galv.)	DN 65 & Larger	ERW
		DN 50 & Smaller	ERW, threaded & Coupled, SW
FITTING (Note 1, 2)	KS B1522, SPP (Galv.)	DN 65 & Larger	Welded, BW
	ASME B16.11, A105 (Galv.)	DN 50 & Smaller	3000#, SW
FLANGE	KS B1503 SS275 (Galv.)	All Sizes	Class 10kg/cm², FFSO
BOLTING	KS D3752, SM45C : Hex Head Machine Bolt, Hot dip galvanized KS D3752, SM45C : Hex Nuts, Hot dip galvanized		
GASKET	Spiral Wound Metal and Non-Asbestos Gasket, 3.2 mm Thickness		
PLATE	None		

VALVE (Note 4)	Size	Body Material	Class/Ends	Gate	Globe	Check
	DN 65 & Larger	KS B2361, SCPH2	10K/Flgd	400	408	431
	DN 50 & Smaller	ASTM A105	600#/SW	154	165	176
		KS D3710, SF440A	10K/SW	427	429	430

JOINT	See notes
NOTE	1. DN 65 and larger joints shall be welded except at flanged connections. 2. DN 50 and smaller joints shall be threaded except at flanged connections. 3. For DN 50 and smaller branch connections on DN 65 and larger headers, use ASTM A105, 3000# forged steel screwed type fittings.

CODE	SPECIAL CLASS	CLASS
NATIONAL PLUMBING CODE	CAST IRON	XH1G

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Floor & Equipment Drain	Atmospheric	Ambient
Sanitary Sewer, Roof Drain		

PIPE	ASTM A 74 or KS D 4307 Class 2	DN 400 & Smaller	Service Weight, No-Hub(A/G) (Note.3)
FITTING	ASTM A 74 or KS D 4307 Class 2	DN 400 & Smaller	Service Weight, No-Hub(A/G) (Note.3)
FLANGE (Note.1)	None		
BOLTING (Note.1)	None		
GASKET (Note.1)	None		
PLATE	None		
VALVE	None		
JOINT (Note.2)	KS D9201	DN 400 & Smaller	Stainless Steel Band Coupling with Neoprene Rubber Sleeve
BRANCH CONNECTIONS	Use 45°Wye and one-eighth bend or single combination fittings. Connections to mains shall be staggered.		
NOTE	1. If the cast iron piping is connected with the galvanized carbon steel piping of Class XN1K, the flange connection with insulation kit shall be provided. The flange of galvanized carbon steel piping shall be fabricated and drilled to fit the flange of cast iron piping. 2. If the cast iron piping is connected with the drain hopper of floor or equipment drain, the caulked joint shall be applied. Caulked joints shall be firmly packed with oakum or hemp and filled with molten lead to a depth of not less than 25 mm. 3. If this piping is buried, mechanical joint shall be applied.		

CODE	SPECIAL CLASS	CLASS
KS	GALVANIZED CARBON STEEL	XN1K

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Floor & Equipment Drain	Atmospheric	Ambient
Sanitary Vent		

PIPE	KS D3507, SPP (Galv.)	DN 65 thru 400	ERW
		DN 50 & Smaller	ERW
FITTING (Note 1)	KS B1522, SPP (Galv.)	DN 65 & Larger	Welded, BW
	KS B1531, Malleable Cast Iron (Galv.)	DN 50 & Smaller	Weled, Threaded
FLANGE (Note 2)	KS B1503 SS275 (Galv.)	All Sizes	Class 10 kg/cm², FFSO
BOLTING	KS D3752, SM45C : Hex Head Machine Bolt, Hot dip galvanized KS D3752, SM45C : Hex Nuts, Hot dip galvanized		
GASKET	Spiral Wound Metal and Non-Asbestos Gasket		
PLATE	None		

	Size	Body Material	Class/Ends	Gate	Globe	Check
VALVE	DN 65 & Larger	KS B2361, SCPH2	10K/Flgd	400	408	431
	DN 50 & Smaller	KS D3710, SF440A or ASTM A105	10K/SW	427	429	430

JOINT	DN 65 & Larger	Welded except at Flanged connections
	DN 50 & Smaller	Screwed except at Flanged connections

NOTE

1. ASTM A105, 3000# forged steel screwed type fittings shall be used for DN 50 & Smaller branch connections on DN 65 & Larger pipe.
2. If the galvanized carbon steel piping is connected with the cast iron piping of Class XH1G, the flange connection shall be used.

CODE	SPECIAL CLASS	CLASS
KS	DUCTILE IRON	XR1K

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Raw Water TP Area	10.0	60.0

PIPE	KS D 4311 Class 2	All Sizes	Mechanical Joint Type, Ductile Iron
FITTING	KS D 4308	All Sizes	Mechanical Joint Type, Ductile Iron
FLANGE	KS D 4308	All Sizes	Mechanical Joint Type, Ductile Iron
BOLTING	KS D3752, SM45C : Stud Bolts and Heavy Hex Machine Bolt, Hot dip galvanized KS D3752, SM45C : Heavy Hex Nuts, Heavy Hex Nuts&Flat Washers, Hot dip galvanized		
GASKET	Mechanical Joint	Rubber and Composition Packing Ring with or without a Metal or Canvas Tip or Canvas Backing From Pipe Manufacturer	
	Flanged Connection	Non-Asbestos Rubber (1.5 mm thickness)	
PLATE	None		
VALVE	None		
JOINT	Mechanical Joint except at Flanged Connections where necessary		
BRANCH CONNECTIONS	45° Wye and 90° or 45° long radius fittings		
NOTE	1. Where ductile iron pipe is jointed with carbon steel pipe, the joint shall be SLIP-ON(FF) flange and the carbon steel flange shall be fabricated and drilled to fit the ductile iron flange, by using ASTM A515, Gr.70 or A36 plate.		

CODE	SPECIAL CLASS	CLASS
KS	CPVC	XT1K

DESIGN CONDITIONS

SYSTEM	PRESSURE(bar.g)	TEMPERATURE(℃)
Chemical Dosing : NaOCl (Cooling Tower Basin)	10.0	50.0
Chemical Dosing : H2SO4 (Cooling Tower Basin)	10.0	50.0

PIPE (Note 1)	KS M 3414, CPVC	DN 65 thru 200	PE, MAKER STD
	KS M 3414, CPVC	DN 50 & Smaller	PE, MAKER STD
FITTING (Note 1)	KS M 3415, CPVC	DN 65 thru 200	PE, MAKER STD
	KS M 3415, CPVC	DN 50 & Smaller	PE, MAKER STD
FLANGE	CPVC	DN 65 thru 200	Class 10kg/cm², FFSO
	CPVC	DN 50 & Smaller	Class 10kg/cm², FFSO
BOLTING	KS B 1037 / 1012 : STS304, STUD BOLT / HEAVY HEX NUTS		
GASKET	EPDM Flat Ring FF, KS 10K, 3.0 mm thickness		
PLATE	None		

	Size	Body Material	Class/Ends	Diaphragm	Ball	Check
VALVE	DN 65 & Larger	CPVC	10K/Flgd	612A	604A	637
	DN 50 & Smaller	CPVC	10K/SW	612A	603A	636

JOINT	-
NOTE	1. Pipe Wall thickness 는 용도별 분류 CPVC 2종, 관열 S4에 따른다.

4. **PROCEDURES**

가. **PROCUDURE NO.1 : GlASS FLAKE LINING (CARBON STEEL PIPE)**

1) Fabrication, cutting, forming and welding shall be completed before lining operation are started. (No cutting, welding or forming shall be done on the coated pipe)

2) Weld scale and splatter to be removed and sharp irregularities on the fabricated pipe shall be ground smooth, and sharp edges and corners ground to a 3 mm minimum radius including the edge and face flanges.

3) Surface to be coated shall be cleaned in accordance with SSPC-SP10 "Near White Metal Blast Cleaning". The residue shall be removed by blasting with clean dry air or equally effective means. Keep sand blasted surface free from contamination before lining.

4) Before rusting occurs, but not later than four(4) hours after cleaning, the application of the lining shall begin.

5) If rusting occurs before the coating has begun, the surface shall be reblasted to SSPC-SP10.

6) Glass flake lining procedure should be applied in accordance with maker's standard. One or more cost shall be applied to a total film build of maker's standard for guarantee of 15 years not less than 0.8 mm D.F.T.

7) The thimble of condendser discharge shall be applied with 1.5 mm D.F.T

8) Glass flake lining shall have the requirements of the following :
   - Composite 2-5 micron thickness, 0.2 - 3.2mm large glass flake of 20% content with thermo setting resin such as vinylester, polyestor.
   - In each 1mm thickness of lining, there should be 100 - 150 layers of glass flakes.
   - Adhesion to steel : over 170kg/cm2 (KSM, 3734-96)
   - Tensile Strength : over 330kg/cm2 (ASTM, D638)
   - Flexural Strength : over 650kg/cm2 (ASTM, D790)
   - Adhesive strength : over 70kg/cm2 (ASTM, D4541)
   - Hardness : over BARCOL 35 (ASTM, D2583)
   - Moisture vapour transmission rate : Perm inch 0.0007

- Cathodic disbondment - compatible with Cathodic protection
  (1) Dielectric strength : 25,000 volts/mm
  (2) ARC resistance : 45 seconds - rough surface
  61 seconds - smooth surface
- Perfect diffusion tightness
- Easy to repair

9) Vendor shall submit data sheet of coating materials with minimum of 5 years coating experience record applied on system or piping of similar domestic project and it shall be approved by owner prior to application.

나. **PROCUDURE NO.2 : RUBBER LINING (CARBON STEEL PIPE)**

1) Fabrication, cutting, forming and welding shall be completed before lining operations are started. (No cutting, welding or forming shall be done on the lined pipe).

2) Weld scale and spatter to be removed and sharp irregularities on surfaces to be lined shall be ground smooth, depressions shall filled and sharp edges and corners ground to a 6 mm minimum radius.

3) Surfaces to be lined shall be abrasive cleaned in accordance with SSPC-SP5 "White Metal Blast Cleaning". The angular surface profile shall be 0.08 mm minimum. Grit and residue shall be removed by clean dry air or equally effective means. Keep blasted surfaces free from contamination before lining.

4) Before rusting occurs after blast cleaning, primer shall be applied to the surface to be lined

5) If rusting appears before priming has begun, the surface shall be reblasted.

6) The natural rubber material used for lining shall be suitable for handling a maximum chlorine concentration of 2,000 parts per million with a PH of 3.5 at ambient temperature or a maximum of sulfuric acid and/or sodium hydroxide concenration of ten(10) percent by weight.

7) The pipe lining shall be a minimum of 5 mm thick, hard rubber with a shore D Durometer of 75 ± 8 for non-buried pipe and semi-hard rubber with a shore D Durometer of 63 ± 8 for buried pipe. Thickness of lining on flange faces shall be 3 mm.

8) Primer and adhesive shall be applied to conform to the manufacture's application recommendations. Adhesive system shall be that recommend by lining manufacture.

9) The rubber lining shall be applied so as to ensure all entrapped air between the lining and metal is removed. Joints shall be skived and overlap lenth shall be 10 ~ 15 mm at the shop 15 ~ 25 at the field.

10) Curing shall be accomplished after application of rubber in accordance with the printed instructions of the lining manufacture to achieve the specified Shore 'D' hardness. Acceptable hardness must be confirmed by testing representative area of lined surfaces.

11) Testing of the rubber lining shall be performed with the related codes both prior to and after the curing operation. The test shall consist of probing the entire rubber surface with a high voltage spark tester at a minimum voltage of 12,000volts.(Allen P. Webb type tester or customer approved equal) During testing, the probe shall be moved continuously over the entire areas. Any defects revealed by the spark test shall be repaired by a method approved by the owner and then retested.

12) Cured lining shall demonstrate a minimum adhesion of 16 kilograms when tested in accordance with method B of ASTM Specification D-429 Peel-Pull Strip Tests, Utilizing sample panels which have been lined in an identical manner as the Production lining.

13) The owner's Inspector may witness the aforementioned testing. The owner's Inspector shall be given written notice 5 days prior to testing. Inspection should be accomplished at the following points:

가) Prior to abrasive cleaning.
나) Immediately before and during adhesive system application.
다) After application of lining(before curing)
라) After final curing of lining(including repairs)

Note : Detailed lining application specifications shall be submitted to the owner for approval prior to any application of lining.

다. PROCUDURE NO.3 : POLYPROPYLENE LINING (CARBON STEEL PIPE)

1) Fabrication, cutting, forming and welding shall be completed before lining operations are started. (No cutting, welding or forming shall be done on lined pipe)

2) Weld scale and spatter should be removed and sharp irregularities on surfaces to be lined shall be ground smooth, depressions shall be filled and sharp edges and corners ground to a 6 mm minimum radius.

3) The interior surface of pipe shall be free of all loose mill scale, rust, corrosion products, dirt, grease, moisture or other foreign material. Grease or heavy oil shall be removed with the volatile solvent in accordance with SSPC-SP 1.
Loose rust, mill scale, and dirt shall be removed from steel piping by wire brushing or by grit or sand blasting in accordance with SSPC-SP 6.

4) Cleaned pipe intended for subsequent coating shall be stored, when necessary, in such a manner that it shall remain free from recontamination. In the event of surface contamination, pipe shall be recleaned in accordance with para. 3).

5) Remove welding spatters and other foreign materials on the lining surface completely. The sharp welding parts and edges shall be touched closely by grinding them.

6) The polypropylene shall have the requirements of the following in accordance with ASTM D638 and D1505.
- Density : 0.903 g/㎤
- Elongation : up to 500
- Tensile strength : over 250 Kg/㎠

7) When polypropylene is lined on the inside of steel piping, polypropylene shall stick to steel pipe without any separated part and necessary action shall be taken against thermal expansion and shrinkage.

8) The thickness of liner shall be bearable enough to working pressure and above the requirement of ASTM F1545.

9) The necessary action for polypropylene lined fitting shall be taken action to remove the empty space occurred by thermal shrinkage in the formation of polypropylene liner.

10) TESTING AND INSPECTION

The products shall be inspected by the following method. The result of the resin maker's test on the basic physical properties of resin for coating must meet the requirements specified in ASTM F492.

(1) The appearance, pinhole and film thickness shall be inspected.

(2) The tests are as follows:

(가) Appearance inspection

Observe the hue, luster and surface roughness, and check the appearance of the coating with the naked eye for cracks and other harmful defects.

(나) Pinhole inspection

Use voltage obtained by controlling the voltage developed across the high voltage terminals to 10,000 V by means of holiday detector. Connect the negative of the high voltage terminals to the metal and scan the surface of a coated product with the positive.

Check the product and through presence of a spark, vibration of the buzzer, and lighting of the lamp in the instrument occurring at the same time as the spark, determines that there is a pinhole in the product.

(다) Film thickness inspection

Use the electromagnetic film thickness meter as the tester, and measure the film thickness of the flange face and the internal surface of pipe.

Note : Detailed lining application specifications shall be submitted to Owner for approval prior to any application of lining.

라. PROCUDURE NO.4 : EXTERNAL CLEANING AND POLYETHYLENE COATING OF UNDERGROUND PIPING (CARBON STEEL AND STAINLESS STEEL PIPE)

1) SCOPE

This procedure defines the requirements for external surface treatment and coatings for underground carbon steel and stainless steel pipes.

It also covers material, inspection, testing, and handling procedures and subsequent repair of damage or defective areas on coatings. This procedure is limited to; shop or field Polyethylene or owner accepted equal cleaning and coating; field applied sheet hand wrapping of joints and field sheet wrapping repair or Polyethylene or equivalent coated pipe.

2) GENERAL INSTRUCTIONS

가) This procedure covers all sizes of plain carbon steel and stainless steel piping subassemblies. The temperature of the fluid carried will not exceed 60 ℃. No pipe shall be coated or wrapped that was cleaned on a previous shift. Pipe primer coat shall cover the entire pipe surface without voids or cracks. Primed surfaces that become dusty or that remain uncoated for more than 48 hours shall be reprimed.

나) Pipe coating and wrapping shall provide a complete cover for the pipe, without holes, gaps, breaks or bubbles. Sheet shall be applied with enough tension to make it adhere to the pipe wall. Pipe ends shall be left free of coating and wrapping a distance of 150 mm to allow for connection.

다) Shop and field welds shall be coated only after acceptance of hydrostatic tests.

3) EXTERIOR PIPE SURFACE PREPARATION

가) The exterior pipe surface shall be free of all loose mill scale, rust, corrosion products, dirt, grease, moisture, or other foreign material.

Grease or Heavy oil shall be removed with a volatile solvent in accordance with SSPC-SP1. Loose rust, mill scale, or dirt, shall be removed from steel piping by wire brushing or by grit or sand blasting in accordance with SSPC-SP6.

나) Where possible, all surfaces shall be coated immediately following cleaning and before any visible rusting occurs.

다) Cleaned pipe intended for subsequent coating shall be stored, when necessary, in such a manner that it shall remain free from recontamination. In the event of surface contamination, pipe shall be recleaned in accordance with Para.3).가).

4) MATERIALS

가) Materials used for coating, priming and wrapping pipe shall conform to applicable portions of code of KS D3589, D3607 or owner accepted equivalent.

나) Primer and sheet wrapping produced by the same manufacturer shall be used to assure compatibility.

5) PIPE TREATMENT

가) Polyethylene coating

(1) Polyethylene layer shall be in accordance with KS D3589 or D3607. The Polyethylene shall be mechanically applied to clean dry surfaces. Thickness and uniformity of the film shall be determined by visual inspection.

(2) All materials shall be held in constant tension when wrapped. A continuous ring of coating material shall be visible at each edge of the wrappings as evidence that the bonding coat covers completely.

(3) A sufficient distance shall be left at each end approximately 150 mm of the pipe to permit the proper installation of fittings or the welding of joints without damaging the coating and/or wrapping or interfering with the welding.

나) Coating and wrapping of field joints or field repair of Polyethylene coating

(1) After the separate pipe lengths have been connected and hydrostatic testing is complete, the bare pipe sections shall be cleaned in accordance with Para.3).

(2) Apply one coat of primer to the clean, dry, outside surface of the pipe by brush or spray. The primer coverage shall not exceed 10 m^2/ℓ. Adequate drying time shall be allowed before tube application. Dependent upon ambient temperature, a "dry to touch" time of a few minutes to an hour shall be allowed, per the manufacturer's recommendation.

(3) Apply heat contraction tube or tape wrapping to the primed surface with edge overlap of 13 mm minimum.

(4) Joint shall be overwrapped on the original wrapping by at least one sheet width.

(5) Pipe wrapping or coating shall completely cover the pipe, without holes, gaps, breaks, or bubbles. Pipe ends shall be left free of coating for a distance of 150 mm to allow for hydrostatic testing and connection of adjacent pipe lengths.

6) TESTING AND INSPECTION

가) Testing of materials

When tests are required on materials used in pipe coating or wrapping, then tests will be performed by owner at his expense and under his directions. Samples of materials to be tested shall be obtained from the shop stock by owner's inspector.

나) Testing of coating

(1) After completion of coating, all surfaces excluding flanges shall be inspected for voids, employing a high voltage type holiday detector. Flanges shall be visually inspected for voids.

(2) The electrical equipment used to test the Polyethylene or sheet wrapping shall be the portable, low amperage, adjustable voltage, pulse type holiday detector, Model AP or EP as manufactured by the Tinker and Rasor Company of San Gabriel, California or equivalent approved by owner. The holiday detector shall be furnished with a coil spring electrode for the larger coated areas, and a suitable brush type electrode for the smaller coated bolt and structural surfaces.

(3) The operating voltage of the detector shall in accordance with KS D 3589, KS D 3607. Due to variables, such as relative humidity and temperature, the detector voltage shall be adjusted twice daily ;
once just before starting work in the morning, and again just before starting work in the afternoon.

(4) The operating voltage of the detector shall be determined by the following procedure.

(가) Select a coated and wrapped portion at the overlap of the sheet approximately 380 mm from the end of one pipe length. This location represents the max. thickness of the coating and wrapping on the pipe.

(나) Deliberately puncture the coating and wrapping with a sharp knife point, awl, ice pick, or a similarly sharply pointed tool.

(다) Move the detector electrode back and forth over the puncture and reduce the voltage until the detector does not indicate the known holiday.

(라) Place a strip of Polyethylene, pipeline sheet over the known holiday, move the detector electrode back and forth over the felt strip and slowly increase the Voltage until the detector starts to indicate the known holiday under the sheet strip.

(5) After the voltage has been properly adjusted, as outlined above, the electrode shall be passed over the coated and wrapped surfaces one time only at the rate of approximately 11.5 m to 16.4 m per minute.

(6) Any evidence of holidays or missed places will be indicated by an electric spark between the electrode and the metal surface.All holidays or missed places so indicated shall be marked by chalk or crayon and repaired in accordance with Para.7) and retested in accordance with Para.6).

다) Shop and Field Inspection

Shop and/or field inspection of all piping placed underground are required by owner. Shop and field inspection will be performed by and at the expense of owner. No treated piping shall be processed or buried without inspection by owner or its authorized representative, unless specifically waived by owner. The contractor shall notify owner at least 24 hours in advance of the time pipe processing or underground installation will commence so that inspection can be provided.

7) PIPE COATING REPAIRS

가) All coatings not meeting the specifications shall be repaird and retested according to KS D3589 or KS D3607, this specification, and the satisfaction of owner's inspector. Repair to pipe coating defects shall be done at the Contractor's expense.

나) Repair of Polyethylene or equivalent

Shop repair using Polyethylene or quivalent

(1) The repair process shall provide a finished area that is free from all damage and holidays. Surface prepared for repairs shall be coated before rust appears, otherwise surface must be reworked.

(2) The damaged areas shall be removed by cutting. The edge cut shall be

tapered approximately 45 degrees. The area shall then cleaned by wire brushing removing all loose coating materials.

(3) The damage area shall be repaired using specified materials and following the same sequence as the original coating.

다) Field repair of Polyethylene or equivalent coating using primer and tube or tape.If a Polyethylene coating requires repair using the prime/tube or tape materials system, remove the polyethylene coating a distance of 75 mm back from the area to be repaired.
The pipe shall then be cleaned and primed per Para.3) and 5).나).(1) except that primer shall also cover the portion of the shop coating that is to be covered with tape. Wrapping shall be applied per Para.5).나).(2) and 5).나).(3) extending at least 75 mm from the damaged area over the sound shop coating.

8) PIPE HANDLING

가) Handling of coated and wrapped pipes in the shop
Wrapped pipe shall be handled in a manner to protect the pipe cover from damage. Damage to the pipe cover from any of the Contractor's operations, including transportation, loading, and unloading, shall be repaired by the Contractor at not cost to owner.

나) Handling of coated and wrapped pipe in the field

(1) Site operations involving handling, storing and installing of treated pipe shall be done in a manner which will not damage the pipe cover.

(2) No operation shall be employed which slides or drags the pipe over any surface whatever.No cable or chain sling or choker shall be used to lift the pipe. Forklifts used to lift or transport treated pipe shall be adequately covered to prevent cuts or abrasions to the pipe cover.

(3) Treated pipe to be stock piled or stored shall be placed in a shaded area on wooden supports. The wooden surface in contact with the pipe shall be not less than four inches wide and shall be spaced sufficiently close together to prevent pipe sagging.
Treated pipe stacked in layers shall have wooden supports between layers. Wrapped and treated pipe shall not be stacked higher than the following
:10 layers for DN 50 & Smaller, 5 layers for DN 65 thru 80,
3 layers for DN 100, 2 layers for DN 125 thru 150,
1 layer for DN 200 & Larger

(4) In placing treated pipe in trenches and during backfill operations, extreme care shall be used to protect the pipe cover. In rocky or hard ground, pipe trenches shall be over-excavated in depth and a 75 mm bedding layer or sand placed to receive the pipe. Backfill material, to a point 150 mm above the pipe, shall be selected sandy material free from rocks or broken concrete, etc. Tampers used to compact material around and over pipes shall be of wood and used with care. Shovels, picks or other sharp tools shall be kept away from surfaces of treated pipes. In lowering pipe into the trench, it shall not be allowed to slide over any hard, sharp or abrasive surface or to strike sharp objects protruding from the sides of the trench.

(5) Treated pipe shall not be bent or kinked in any way sufficiently to produce a permanent change in pipe alignment. Pipe bent in this manner shall have the treatment removed from the affected area and then replaced.

(6) Treated pipe subjected to welding or other excessive heating shall have the treatment removed from the affected areas and shall be retreated.

마. **PROCUDURE NO.5: CROSS LINKED EPOXY LINING PIPING (CARBON STEEL PIPE)**

1) Fabrication, cutting, forming and welding shall be completed before lining operations are started. (No cutting, welding or forming shall be done on the coated pipe.)

2) Weld scale and spatter to be removed and sharp irregularities on the fabricated pipe shall be ground smooth, and sharp edges and corners ground to a 3 mm minimum radius including the edge and face of flanges.

3) Surfaces to be coated shall be cleaned in accordance with SSPC-SP5 "White Metal Blast Cleaning" using clean silica sand only. The blasted surface profile shall be 0.08 mm. Grit and residue shall be removed by blasting with clean dry or equally effective means. Keep sand blasted surfaces free from contamination before lining.

4) Before rusting occurs, but not later than four(4) hours after cleaning, the application of the coating shall begin.

5) If rusting occurs before the coating has begun, the surface shall be reblasted to SSPC-SP5.

6) The Cross-Linked Epoxy coating shall have a ratio of at least 15 % epoxy resin and not more than 75 % silica filler.
   Two or more coats shall be applied to a total film build of not less than 188 mil DFT. Application shll be made without primer. The second coat shall be applied within 48 hours after the application of the first coat.

바. **PROCEDURE No. 6 : POLYETHYLENE PIPE**

1) The molding and extrusion material shall be polyethylene plastic in the form of granules, or pellets.

2) The molding and extrusion materials shall be uniform in composition and size as free of contamination as can be achieved by good manufacturing practice.

3) All the Polyethylene straight pipe and fitting materials shall have the durability for environmental condition, coherence for fusion, workability, stability for ultraviolet and stress crack resistance by use of raw material compound which are uniformly distributed additive and carbon black.

4) The polyethylene pipe material shall have the requirements of the following in accordance with KS M 3408 and KWWA M 130 or ASTM D 1248 and ASTM D3350. For the homogeneous dispersion of the carbon black and additive, the materials shall be pre-compounded resin. The blended resin in plant will not be acceptable.

PROPERTY	UNIT	VALUE	TEST METHOD
(1) Density	g/cm³	>0.941	ASTM D 1505
(2) Melt Index (190 ℃, 5kg/cm²)	g/10 min.	<0.4	ASTM D 1238
(3) Flexural Modulus	kg/cm²	>563	ASTM D 790
(4) Tensile Strength at Yield	kg/cm²	>215	KS M 3408 & KWWA M 130 or ASTM D 638
(5) Environmental Stress Crack Resistance			
(가) Test condition		C	ASTM D 1693
(나) Test duration	Hr	192	
(다) Failure, max.	%	20	
(6) Hydrostatic Design Basis	kg/cm2 min	>112.5	ASTM D 3895

5) The mechanical properties (quality), surface appearance, shape, dimension, dimension allowance, color, material & manufacturing procedure, test method, inspection and marking shall be performed to related code and standard as stated (KWWA M 130 & KS M 3408) or equivalent ASTM code.

6) The methods for polyethylene pipe connections are butt fusion as a standard method with the exception of flange type spool ends which provided for periodical rotation against abrasion of pipe inner surface, and the connection works shall be

observed the manufacturer's procedure for detail. For example, the temperature, pressure, time, etc.

7) Only skilled pipe fitter shall perform the joint work by fusion at site to achieve a good quality of connections equivalent to those of original polyethylene pipe.

8) Before the fusion process, it shall be confirmed the presence of any damage, thickness diminution, deviation of roundness and perpendicularity of joint surface and etc.

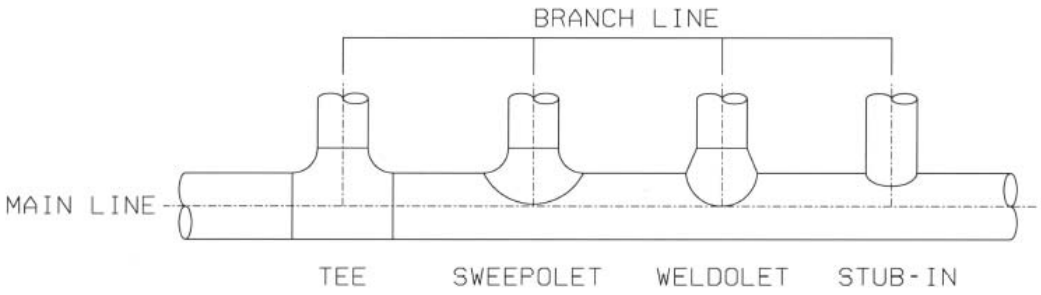
9) To protect the material integrity, it should be pay attention to not to drop the pipe spools and to avoid the excessive external pressure on pipe surface when installing on the site.

10) Non standard pipe thickness shall also be provided when requested by the Owner.

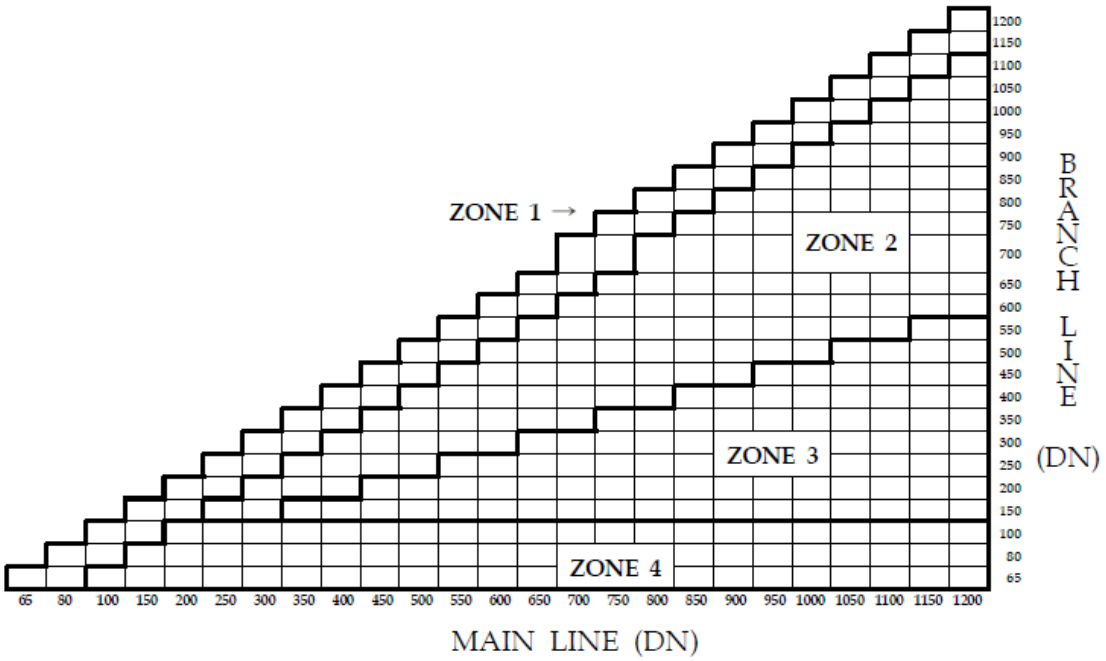
11) When storing the polyethylene pipe, it shall be preserved at indoors or covered by blackout curtain not to expose to direct ray of light.

5. CONNECTIONS

가. BRANCH CONNECTIONS FOR DN 65 & LARGER



Group	Zone 1	Zone 2	Zone 3	Zone 4
Group A	Tee	Tee	Sweepolet	Weldolet
Group B	Tee	Tee	Weldolet	Weldolet
Group C	Tee	Weldolet or Tee	Weldolet	Weldolet
Group D	Tee	Stub-In, Weldolet or Tee	Stub-In, Weldolet or Tee	Stub-In, Weldolet or Tee



ZONE SELECTION CHART

GROUP CRITERIA

GROUP A - ASME B31.1 BOILER EXTERNAL PIPING

- ASME B31.1 NON-BOILER EXTERNAL PIPING as follows :

a. Design Temperature is greater than 400 °C.

b. Design Temperature is 176 °C thru 400 °C, Design Pressure is greater than 72 kg/cm², and Branch Wall Thickness is greater than 19.05 mm.

GROUP B - ASME B31.1 CRTITICAL PIPE not otherwise covered in Group A

GROUP C - ASME B31.1 NON-CRITICAL PIPE with Design Temperature of 149 °C & greater not otherwise covered in Group A

GROUP D - ASME B31.1 NON-CRITICAL PIPE with Design Temperature less than 149 °C

NOTES

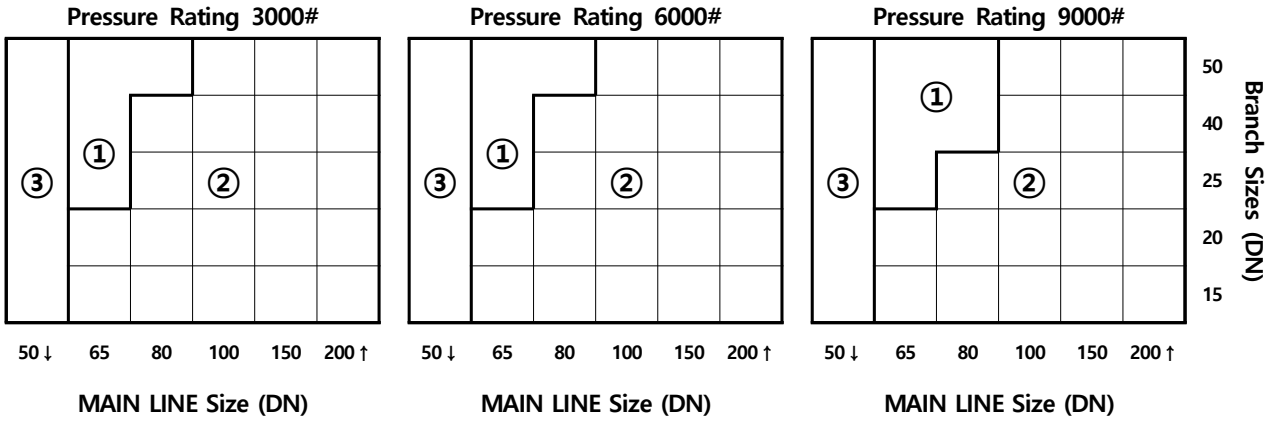
1. Follow the rules below for Zone 2 of Group C and Zones 2,3,4 of Group D.

.Use TEE	for full size	and 1 or 2 step size reduction branch.
.Use WELDOLET	for DN 200 & Smaller	and 3 step & over size reduction branch.
.Use STUB-IN	for DN 250 & Larger	and 3 step & over size reduction branch.

2. STUB-IN shall be reinforced as required by Code.

3. Non critical piping less than 300# can be used nipple outlet instead of weldolet.

나. **BRANCH CONNECTIONS FOR DN 50 & SMALLER**



① Buttwelding TEE, SOCKOLET or THREADOLET*

② HALF COUPLING, SOCKOLET or THREADOLET*

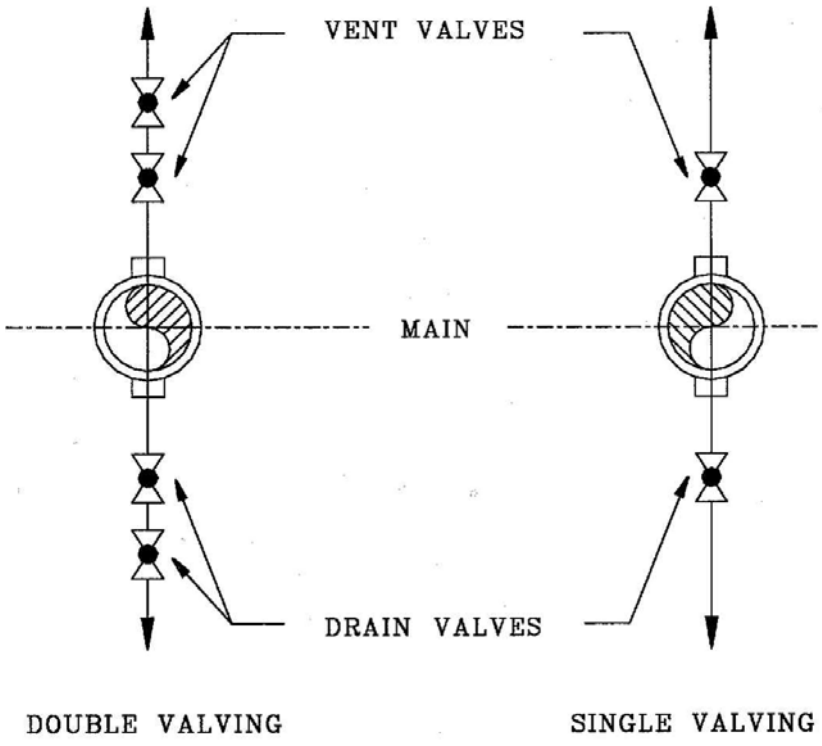
③ socket welding TEE with Reducing Insert or Reducing Tee

* Threadolet may be used only for systems permitted by PMC and seal welding shall be carried out.

HOW TO USE

1. Determine Pressure Rating & Joint Type from PMC.
2. Locate main line and branch size for given Pressure Rating.
3. Determine requirements where vertical line from main line size meets horizontal line from branch size.

다. **VENT AND DRAIN CONNECTIONS**



VENTS & DRAINS	SIZE	DRAIN
General Piping	Minimum DN 25	Globe
Lined Piping	DN 50	Plug

NOTES

1. Detail specification of valves shall be in compliance with the applicable PMC.

2. Double valving shall be used on all piping classes with Pressure Temperature Rating of 600# & Over unless otherwise specified.

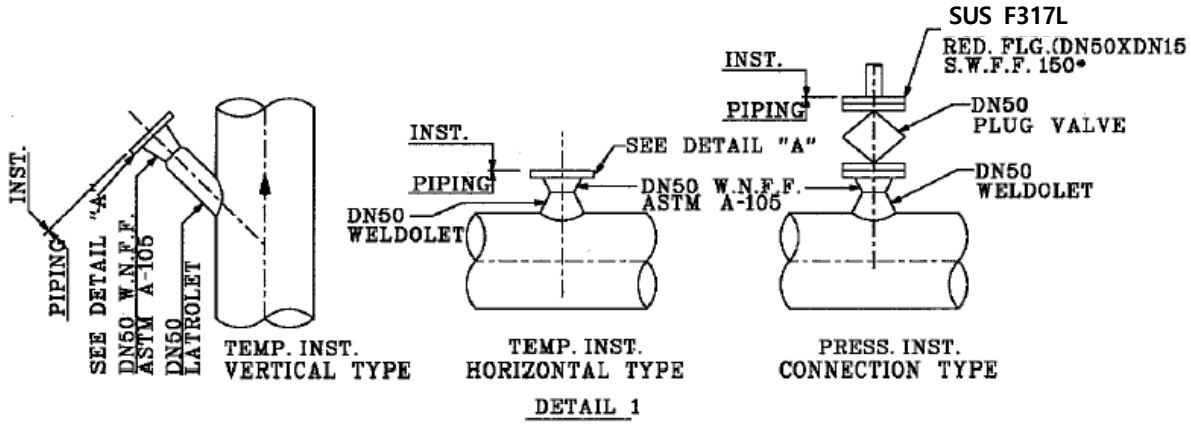
3. The design drawings will indicate where the larger than specified minimum size or other type valves are required.

4. The smaller than DN 25 valves shall be used only where the size of main line is DN 20 & Smaller.

5. Connections for Lined Piping shall be in accordance with Chapter 5. 라.

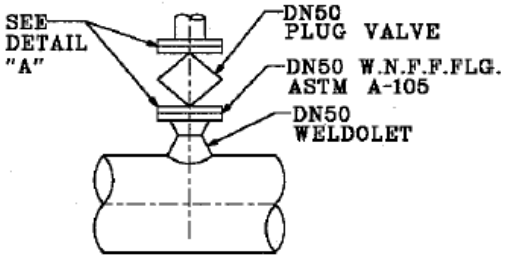
6 The type of cap for the drain and vent piping shall be threaded.

라. **LINED PIPING CONNECTIONS**



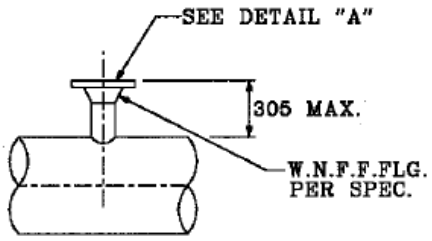
DETAIL 1

TEMPERATURE, PRESSURE INSTRUMENT CONNECTION



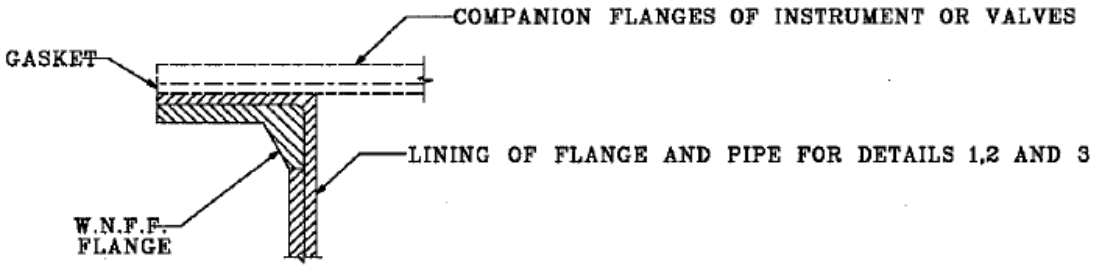
DETAIL 2

VENTS, DRAIN AND DN50 CONNS.



DETAIL 3

BRANCH CONNECTIONS (DN65 AND LARGER PIPE)



DETAIL "A"

NOTES

1. Sharp corners shall be removed before lining.

마. **PRESSURE & TEMPERATURE INSTRUMENT CONNECTIONS**

MAIN PIPE LINE CLASS	PRESSURE INSTRUMENT CONNECTIONS	TEMPERATURE INSTRUMENT CONNECTIONS
2500# & Higher	DN 20 SW HALF COUPLING (See Chapter 5. 바, 사)	Pipe Wall Thickness > 19.05 mm (See Chapter 5. 아) (TYPE A) Pipe Wall Thickness ≤ 19.05 mm (See Chapter 5. 자, 차) (TYPE B, C) DN 80 & Smaller Main Pipe Line (See Chapter 5. 타, 카) (TYPE D, E)
1500# & 900#	DN 20 SW HALF COUPLING (See Chapter 5. 바, 사)	
600# & Lower	DN 20 SW HALF COUPLING (See Chapter 5. 바, 사)	DN 25 THREADED HALF COUPLING (See Chapter 5. 바, 사) DN 80 & Smaller Main Pipe Line (See Chapter 5. 타, 카) (TYPE D, E)
Lined Piping	DN 50 FFWN ASTM A105 150# Flange (See Chapter 5. 라)	

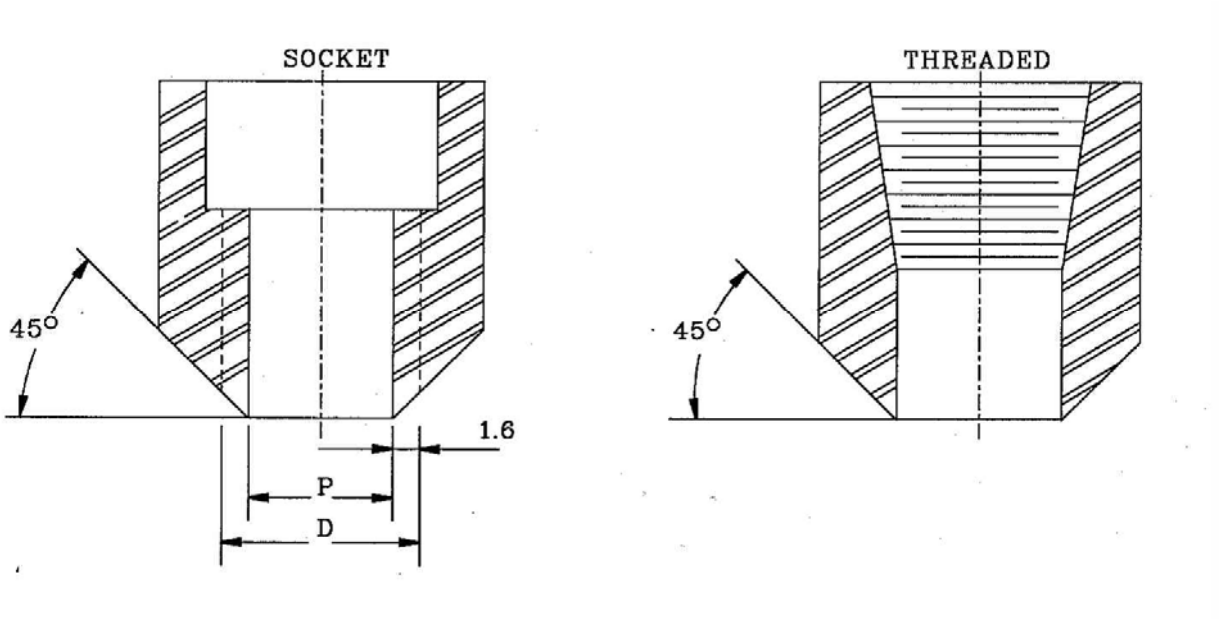
NOTES : 1. HALF COUPLING or SOCKOLET material shall be in accordance with PMC.
2. Threaded connections may be used for systems permitted by PMC and seal welding shall be carried out.
3. Calculations showing adequate reinforcement are required when HALF COUPLING nominal size exceeds ¼ times the main pipe nominal size for ASME B31.1.

THERMOWELL MATERIAL SELECTION TABLE

PIPE MATERIAL SPECIFICATION ASTM (Note 1)		FITTING	TEHRMOWELL	
			BAR	FORGING
CARBON STEEL	A106,Gr.B, A53,Gr.B, A106,Gr.C	A105	A479, Gr.316L	A182, Gr.316L
			Monel (for lined pipe)	Monel (for lined pipe)
LOW AND INTERMEDIATE STEEL	A335P92	A182F92	N/A	A182F92
	A335P91	A182F91		A182F91
	A335P22	A182F22		A182F22
	A335P11 or A691,Gr.1-1/4Cr. CL.42	A182F11		A182F11
STAINLESS STEEL	A312,Gr.304L, A358,Gr.304L CL.1	A182F316L or A182F304L	A479Gr.316L or 304L	A182F316L or A182F304L

NOTES : Use ASME SA Material for ASME Section I Applications.

바. **HALF COUPLING FABRICATION DETAIL**



NOTES : 1. Socket type HALF COUPLING is purchased as blanks, i.e., no bore "D".

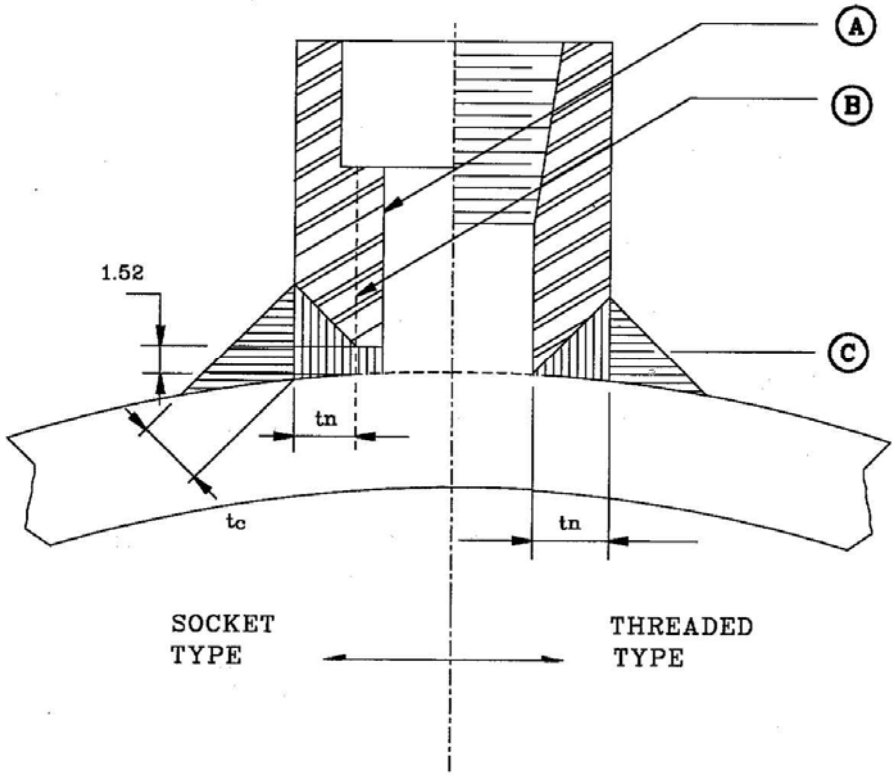
2. Fitting dimensions per ASME B16.11 except as shown above.

3. P Pilot Bore Diameter) = D (Fitting Bore Diameter) - 3.2 mm.

4. For drilling sequence of "P" and "D", refer to Chapter 5. 사.

5. Threaded type HALF COUPLING is purchased as standard ASME B16.11 fitting.

사. **HALF COUPLING INSTALLATION DETAIL**



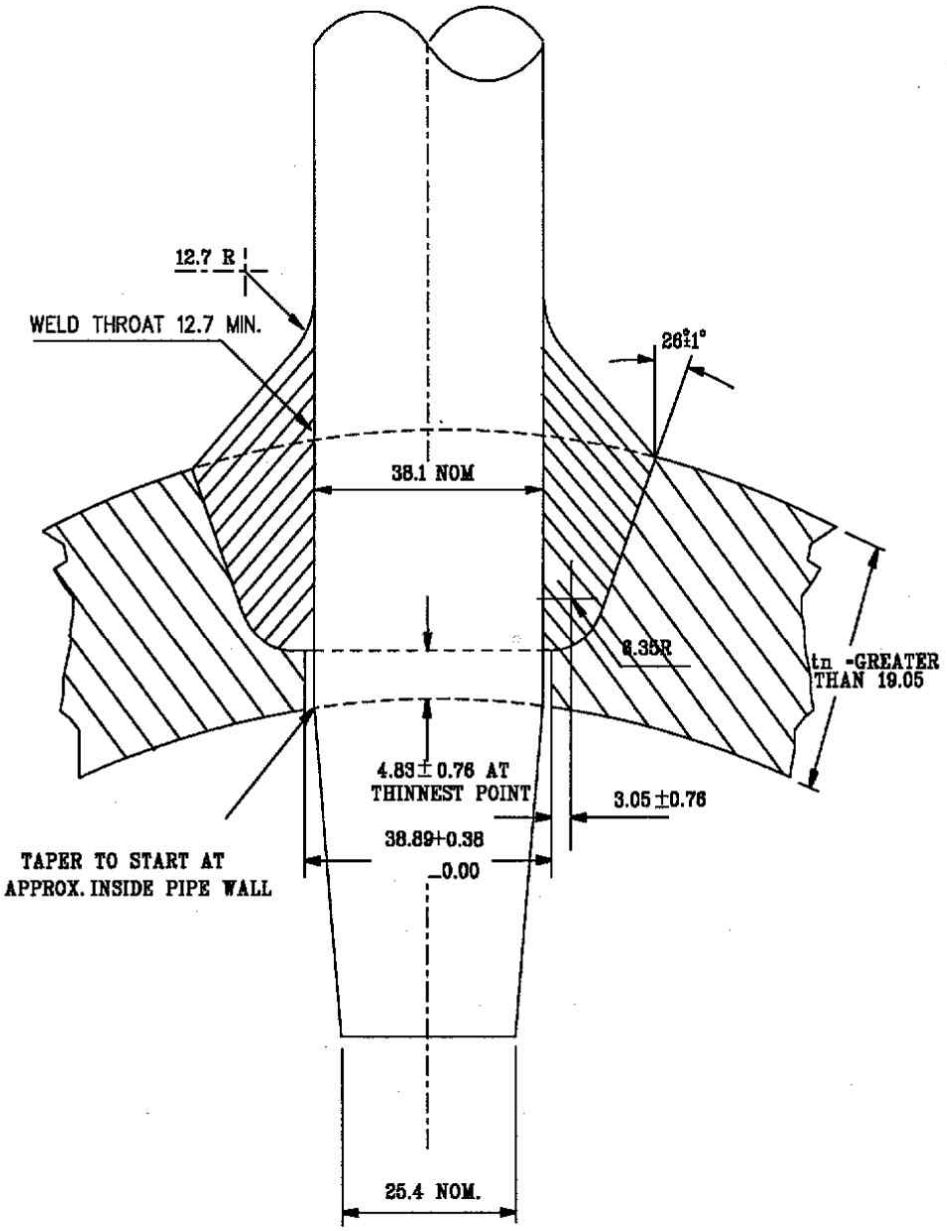
DESCRIPTION OF PARTS

Ⓐ Bore pilot hole "P" in HALF COUPLING prior to fit up.

Ⓑ Drill out to final bore diameter "D" for socket type after full penetration weld.

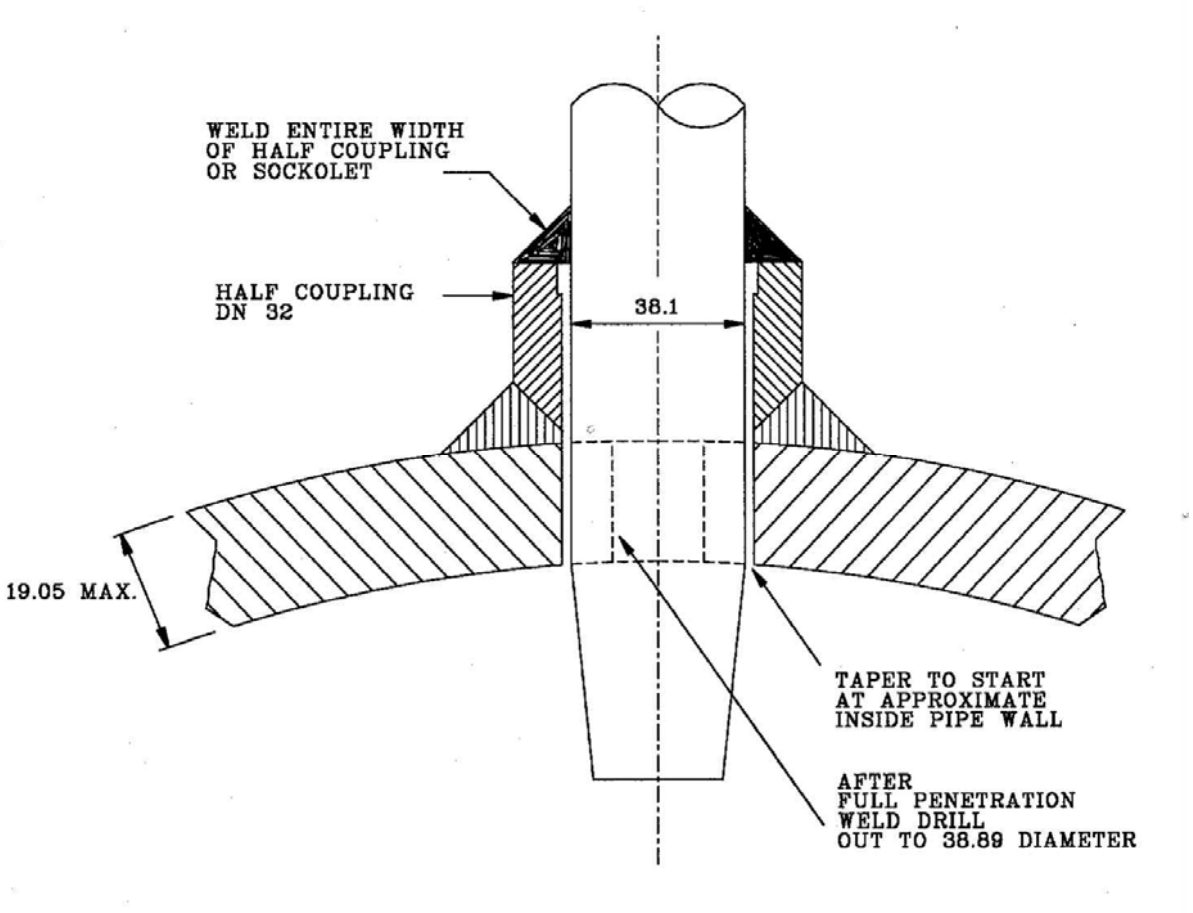
Ⓒ Gas Tungsten Arc Welding (GTAW) is not mandatory.
tn = Nominal Thickness of HALF COUPLING wall.
tc = 5mm Min – According to ASME B31.1 Fig.127.4.8-6.

아. **THERMOWELL INSTALLATION DETAIL (TYPE A)**
FOR NOMINAL PIPE WALL THICKNESS GREATER THAN 19.05 mm



NOTE : All around shall be welded and stress relieved in accordance with the applicable Codes and Standards.

자. **THERMOWELL INSTALLATION DETAIL (TYPE B)**
FOR DN 250 & LARGER WITH NOMINAL PIPE WALL THICKNESS 19.05 MM & LESS

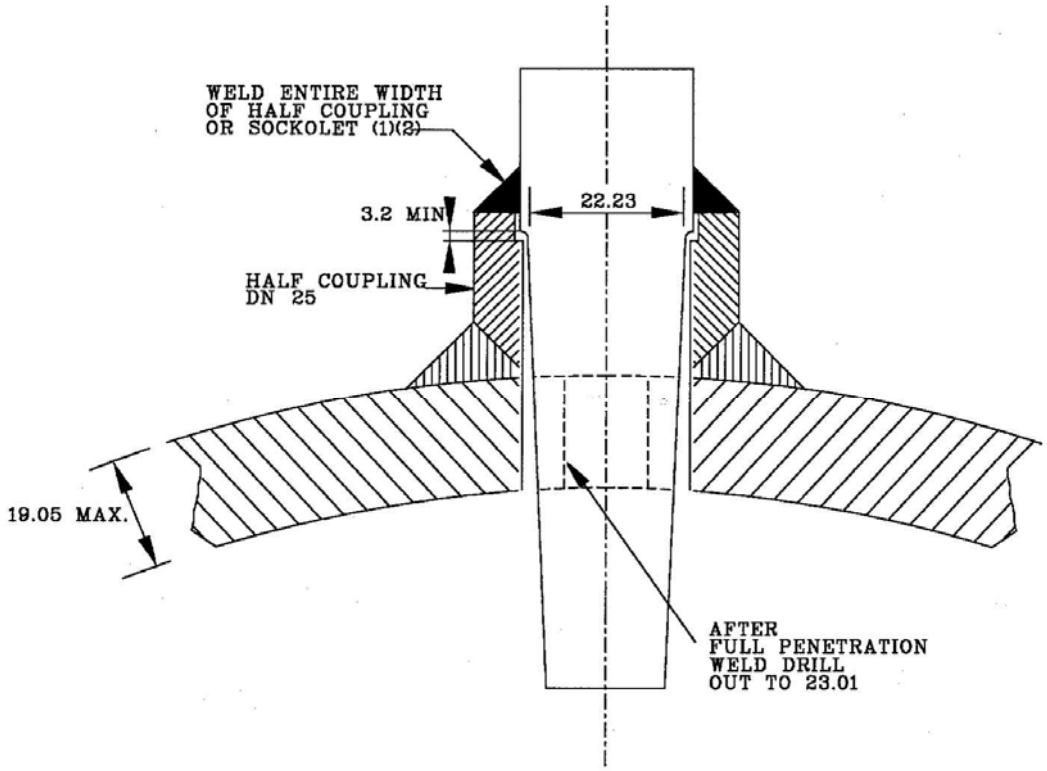


NOTES for TYPE B

1. THERMOWELL : Standard Thermowell per Instrument drawings.

2. INSTALLATION : Drill sequence per Chapter 5. 사.
Welding requirements dimensions per ASME B16.11 except final bore.
Heat treatment per applicable Codes & Standards.

차. **THERMOWELL INSTALLATION DETAIL (TYPE C)**
FOR DN 100 thru DN 200 WITH NOMINAL PIPE WALL THICKNESS 19.05 MM & LESS

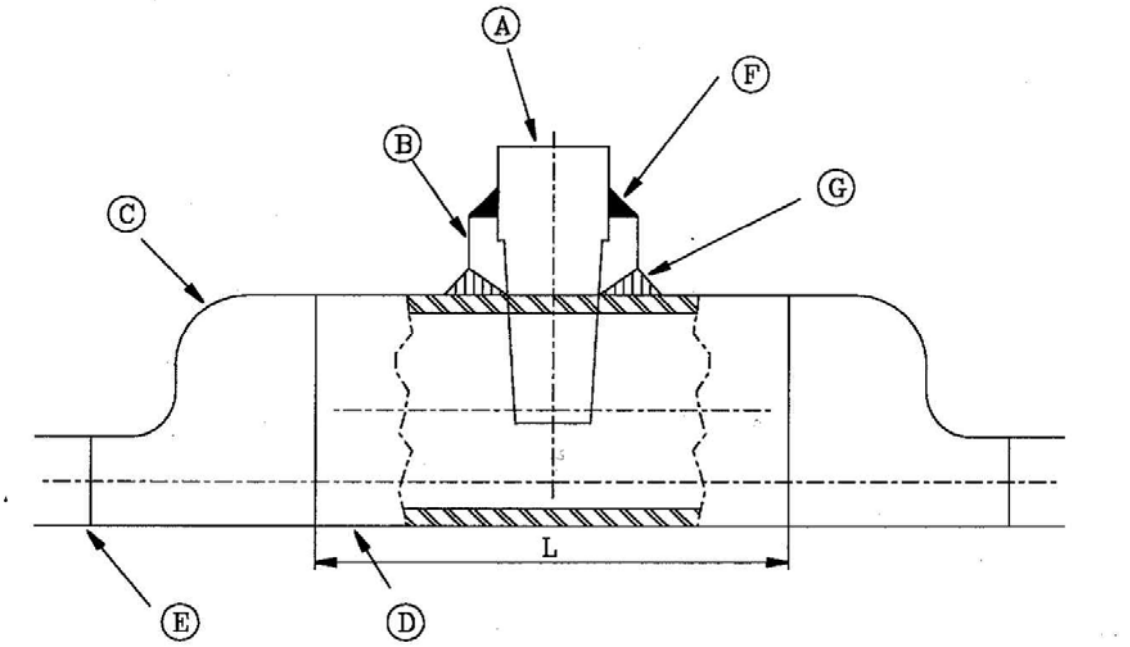


NOTES for TYPE C

1. THERMOWELL : Standard Thermowell per Instrument drawings.

2. INSTALLATION : Drill sequence per Chapter 5. 사.
Welding requirements dimensions per ASME B16.11 except final bore.
Heat treatment per applicable Codes & Standards.

카. **THERMOWELL INSTALLATION DETAIL (TYPE D) FOR DN 80 & SMALLER**



DESCRIPTION OF PARTS

Ⓐ Standard Thermowell according to Instrument drawing

Ⓑ HALF COUPLING per Chapter 5. 바 & 사

Ⓒ Reducer : DN 100 to main pipe size, material according to PMC, butt welded
- Vertical line - Concentric Reducer
- Horizontal line - Concentric or Eccentric Reducer

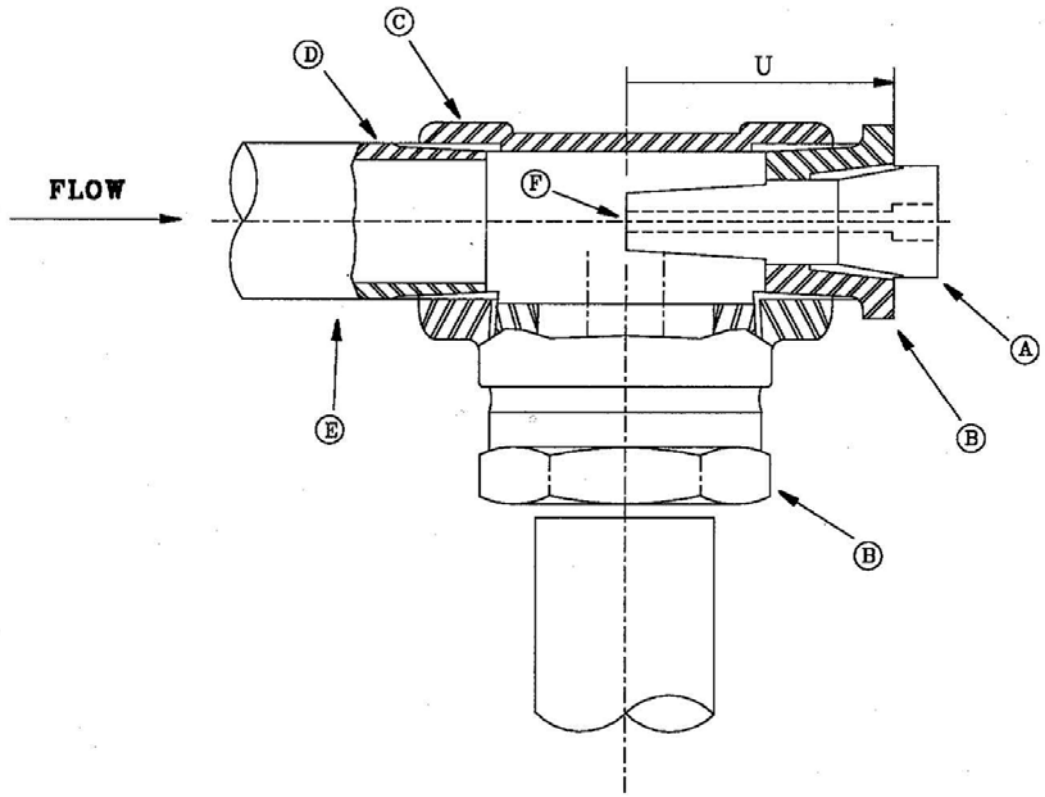
Ⓓ Pipe : DN 100 per PMC, Minimum L = 150 mm long

Ⓔ Line pipe, butt welded

Ⓕ Weld entire width of half coupling

Ⓖ Full penetration weld according to Charpter 5. 바

타. THERMOWELL INSTALLATION DETAIL (TYPE E) FOR DN 50 & SMALLER (ALTERNATIVE OF TYPE D)



DESCRIPTION OF PARTS

Ⓐ Standard Thermowell according to Instrument drawing

Ⓑ Bushing : Threaded to suit thermowell or line size

Ⓒ Threaded TEE : Material according to PMC, Size DN 50

Ⓓ Threaded NIPPLE : Used in conjunction with required size reducing coupling

Ⓔ Reducing COUPLING as applicable

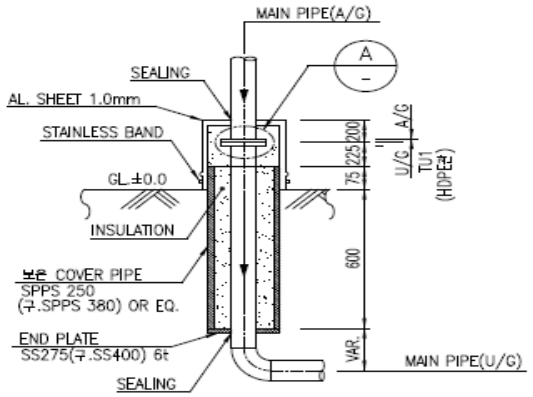
Ⓕ Insertion Length(U) = 75.0 mm Max.

파. PIPING MATERIAL SPECIFICATION FOR PRE INSULATED PIPING

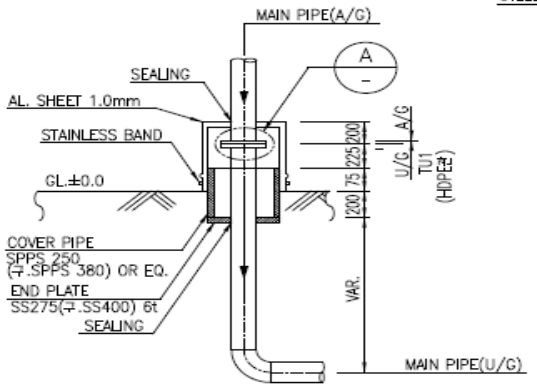
PIPING MATERIAL SPECIFICATION FOR PRE INSULATED PIPING									
PRIMARY SERVICE RATING			SERVICE						
KS 20K									
MATERIAL		RATING	PRESS bar.g	16					
CARBON STEEL			TEMP.℃	120					
ITEM	NOM. SIZE (A)	MATERIAL		DESCRIPTION			REMARKS	REFERENCE	
	FROM-TO			PRODUCT	END	WALL THICK			
PIPE	15 - 50	SPPS 250		SMLS/E	FE	SCH. 40	KS D 3562		
	65 - 150	SPPS 250		SMLS/E	BE	SCH. 20	KS D 3562		
	200 - 300	SPPS 250		ERW	BE	SCH. 20	KS D 3562		
	350 - 500	SPPS 250		ERW	BE	SCH. 10	KS D 3562		
	550 - OVER	SPW 400		SAW	BE	CALC.	KS D 3583		
FITTING ELBOW TEE RED.	15 - 50	A105		-	SW	SCH. 80	ASME B16.11		
	65 - 150	PG 38		-	BW	SCH. 20	KS B 1541		
	200 - 300	PG 38W		WELD	BW	SCH. 20	KS B 1543		
	350 - 500	PG 38W		WELD	BW	SCH. 10	KS B 1543		
	550 - OVER	PG 38W		WELD	BW	CALC.	KS B 1522		
FLANGE	FROM - TO	MATERIAL		RATING	TYPE	FACE	REMARKS	REFERENCE	
	15 - 50	SF 440A		KS 20K	SW	RF	KS B 1511		
	65 - 600	SF 440A		KS 20K	SO	RF	KS B 1511		
GASKET	15 - 50	COMP.ABS.FREE		KS 20K	FLAT RING	RF	KS B 1519	1.5 mm	
	65-OVER	COMP.ABS.FREE		KS 20K	FLAT RING	RF	KS B 1519	3.0 mm	
BOLT/NUT	-	SNB 7			STUD BOLT		KS B 1037		
	-	SM 45C							
ITEM	ND (A)	MATERIAL		RATING & CONN.	TYPE		PACKING	REFERENCE	
	FROM - TO	BODY	TRIM						
VALVES BALL	20-50	A105, SPPS 380 OR EQ.		300#	BW				
	65-125	A105, SPPS 380 OR EQ.		150#	BW				
	150-600	A105, SPPS 380 OR EQ.		150#	BW				
BUTT	650 - 850	St37, H Ⅱ,A216 WCB OR EQ.		150#	BW				

NOTE:
1.PIPE WALL THICKNESS 550A. 600A. 650A. 700A : 8.7 mm, 800a.: 9.5 mm, 850A. 900A: 10.3 mm, 1000A. 1100A. 1200A : 11.1 mm
2.SPW 400(배관용 아크 용접 탄소강 강관 KS D 3583)의 경우 스파이럴 심 용접으로 제조하는 관은 제외 한다.
3.SOCKET WELDING TYPE FITTING(ND15-50)의 구멍지름은 KS B 1542 부표 1의 스케줄 80 1란의 구멍지름을 따른다.
4.PIPE 및 FITTING류의 재질은 이중보온관의 내관에 대한 사양이며 밸브(BALL, BUTTERFLY) 사양은 별도로 정해진 사양에 따른다.

하. AG/UG 변환 구간 보온부 & HDPE 플랜지 연결 DETAIL



AG/UG 변환 구간 & HDPE 플랜지 연결 DETAIL
(보온)

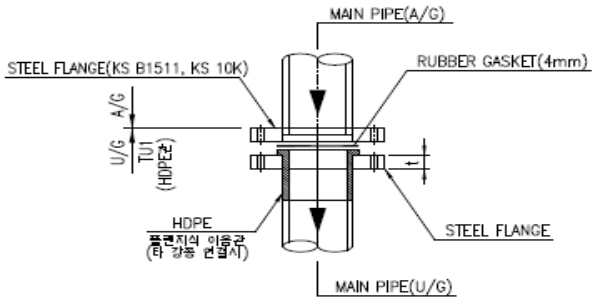


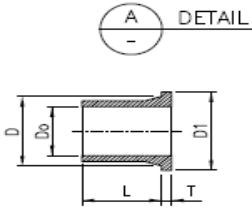
AG/UG 변환 구간 & HDPE 플랜지 연결 DETAIL
(비보온)

AG/UG 변환 구간 COVER PIPE & HDPE 연결부 STEEL FLANGE(판플랜지) SIZE

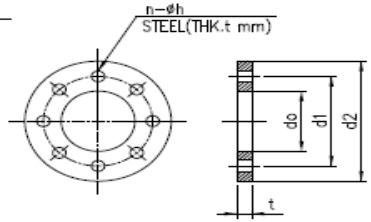
MAIN PIPE		보온 COVER PIPE			비보온 COVER PIPE			HDPE 플랜지 이음관(*) (KS M 3408-3)						STEEL FLANGE (판플랜지)						
관경(A)	보온두께 (NOTE.4)	관경(A)	O.D	t	관경(A)	O.D	t	HDPE 호칭경 (mm)	D1 (ADD)	D (OD)	Do (ID)	T	L	do	d1	d2	t	h(ø)	n (BOLT 구멍 수)	볼트 나사의 호칭
15	100	250	267.4	6.4	100	114.3	4.85	20	34	27	19	12	50	28	70	95	12	15	4	M12
20	100	300	318.5	7.0	100	114.3	4.85	20	34	27	19	12	50	28	75	100	14	15	4	M12
25	100	300	318.5	7.0	150	165.2	4.85	25	41	33	23	12	50	34	90	125	14	19	4	M16
40	100	300	318.5	7.0	150	165.2	4.85	40	61	50	39	15	58	51	105	140	16	19	4	M16
50	100	300	318.5	7.0	150	165.2	4.85	50	73	61	48	17	60	62	120	155	16	19	4	M16
65	65	250	267.4	6.4	200	216.3	5.85	63	90	76	61	17	88	78	140	175	18	19	4	M16
80	40	200	216.3	5.85	200	216.3	5.85	90	128	98	71	20	118	102	150	185	18	19	8	M16
100	25	250	267.4	6.4	250	267.4	6.4	110	158	118	87	23	135	122	175	210	18	19	8	M16
125	25	250	267.4	6.4	250	267.4	6.4	140	186	143	114	24	121	150	210	250	20	23	8	M20
150	25	300	318.5	7.0	300	318.5	7.0	160	212	165	127	26	151	169	240	280	22	23	8	M20
200	25	350	355.6	7.6	350	355.6	7.6	225	266	228	179	32	168	232	290	330	22	23	12	M20
250	25	450	457.2	7.9	450	457.2	7.9	280	320	290	223	35	190	294	355	400	24	25	12	M22
300	25	500	508	7.9	500	508	7.9	315	370	323	251	41	195	327	400	445	24	25	16	M22
350	25	550	558.8	7.9	550	558.8	7.9	355	416	358	283	45	188	362	445	490	26	25	16	M22
400	25	600	609.6	7.9	600	609.6	7.9	400	482	408	319	45	226	412	510	560	28	27	16	M24

(*) HDPE 플랜지 이음관의 치수는 VENDOR STANDARD(한국PEM)이며, 참고용 치수임.





HDPE 플랜지식 이음관 DETAIL



STEEL FLANGE DETAIL

NOTES
1. 모든 치수 단위는 별도의 지시가 없는 한 밀리미터(mm)이다.
2. A/G와 U/G 구분 지점은 GL.+300 지점으로 반영한 치수임.
3. COVER PIPE, END PLATE OUTSIDE 에는 부식 방지를 위해 시공 후 COATING 할 것.
4. MAIN PIPE의 보온두께는 각 PROJECT 에서 규정하고 있는 동결방지 보온 두께를 확인하여 반영 할 것.
5. HDPE관의 규격은 신규격(KS M 3408-2,3)을 따른다.
6. STEEL FLG의 재질은 MAIN PIPE FLG.재질의 등등이상으로 할 것.