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1. SCOPE

Scope of the present specification is to give the necessary criteria to choose the materials for piping to be installed in Direct Reduction Plant of "Tooba GISD Mega Module Project" , taking into account the operating and climatic conditions.

2. SPECIFICATION FOR PIPING MATERIAL

Specification of piping material, design pressure and temperature of each fluid is shown in table 2.1.

Note:

1) Design pressure of suction line shall be the max. Operating pressure of each line.

SPEC. NO.	SERVICE	SERVICE INDEX		MATERIAL & FLANGE RATING
		TEMP °C	PRESS BAR	
C1	Injection Water, Makeup Water, Machinery Cooling Water, Drain Water, Seal Water, Process Water, Plant Air, Chemical Additives	90	15	C.S. 150 lb. R.F.
C2	Process Gas, Top Gas Fuel, Reformed Gas Cold, Cooling Gas	185	2.5	C.S. 150 lb. R.F.
C3	Top Gas, Reformed Gas, Reformer Feed Gas, Flue Gas, Cooling Gas, Bottom Seal Gas Hot, Carburizing Gas, Hot Air Bleed, Combustion Air (For Refractory Lined Piping Systems)	260	2.5	C.S. 150 lb. R.F.
C4	Auxiliary Air, Combustion Air (Main Air), Flue Air, Dilution Air	65	0.35	C.S. 150 lb. R.F.
C5	Instrument Air, Potable Water	80	10.0	Galvanized C.S. 150 lb. F.F.
C6	Natural Gas Cold, Impulse Purge Gas, Nitrogen, Purge Gas, Inert Gas, Dry Seal Gas, Wet Seal Gas, Bottom Seal Gas Cold	80	16.5	C.S. 150 lb. R.F.
C7	Slurry, Thick and Thin	90	7.5	C.S. 150 lb. F.F.
C8	Reformer Feed Gas, Natural Gas Hot, Combustion Air Hot	425	3.0	C.S. 150 lb. R.F.
C9	Hydraulic and Grease Piping, Lube Oil	100	200	C.S. 3000 lb. SAE
C10	Dust Collection, Vapor Removal	150	0.1 VAC	C.S. 150 lb. F.F.
C11	Natural Gas Hot	500	3.0	C.S. 150 lb. R.F.
C12	Firefighting Water	80	17.9	C.S. 150 lb. R.F.
C14	Oxygen (Gaseous)	35	6	C.S. 150 lb. R.F.
C16	Hydraulic	100	400	C.S. 6000 lb. SAE
P1	Chemical Additives (Water Treatment)	50	2	UPVC 150 lb. F.F.
P2	Firefighting Water(Buried)	30	11	HDPE-100,SDR9
P3	Make up Water(Buried)	30	5	HDPE- 100,SDR13.6
S1	Seal Gas Condensate	90	2.5	S304L 150 lb. R.F.
S2	Reformer Feed Gas	600	2.5	S316L 150 lb. R.F.
S3	Oxygen (Gaseous)	35	6	S304L 150 lb. R.F.

Table 2.1

3. PIPING IDENTIFICATION CODES

System Designation	Piping Class	System Description
AA	C4	Auxiliary Air
BSG	C3	Bottom Seal Gas (Hot)
BSG	C6	Bottom Seal Gas (Cold)
CA	C3	Combustion Air (Refractory Lined)
CA	C4	Combustion Air
CA	C8	Combustion Air (Hot)
CG	C2	Cooling Gas
CG	C3	Cooling Gas (Refractory Lined)
CHB	P1	Chemical Additive (Biocide)
CHD	C1	Chemical Additive (Dispersant)
CHM	P1	Chemical Additive (Anticorrosion)
CHF	C1	Chemical Additive (Flocculant)
CRG	C3	Carburizing Gas (Refractory Lined)
CWS	C1	Makeup Water
CWS	P3	Makeup Water, (Buried)
DA	C4	Dilution Air
DMW	S1	Demineralized Water
DP	C10	Dust Collection, Vapor Removal
DW	C1	Drain Water
FA	C4	Flue Air
FG	C3	Flue Gas (Refractory Lined)
FW	C12	Fire Fighting Water
FW	P2	Fire Fighting Water(Buried)
HF	C9/C16	Hydraulic and Grease Piping
IA	C5	Instrument Air
IG	C6	Inert Gas

System Designation	Piping Class	System Description
IP	C6	Impulse Purge Gas
IW	C1	Injection Water
TGF	C2	Top Gas Fuel
MWR	C1	Machinery Cooling Water Return
MWS	C1	Machinery Cooling Water Supply
NG	C6	Natural Gas (Cold)
NG	C11	Natural Gas (Hot)
NI	C6	Nitrogen
OX	C14	Oxygen (Gaseous)
OX	S3	Oxygen (Gaseous)
PA	C1	Plant Air
PG	C6	Purge Gas
PRG	C2	Process Gas
PW	C5	Potable Water
PWS	C1	Process Water Supply
PWR	C1	Process Water Return
PWR	S1	Seal Gas Condensate
RF	C3	Reformer Feed Gas (Refractory Lined)
RF	C8	Reformer Feed Gas (Hot)
RF	S2	Reformer Feed Gas (Hot, Alloy)
RG	C3	Reformed Gas (Refractory Lined)
SG	C6	Seal Gas (Dry, Wet , Bottom)
SL	C7	Slurry, Thick and Thin
SW	C1	Seal Water
TG	C3	Top Gas (Refractory Lined)

4.DETAILED PIPING CLASSES

SPECIFICATION:	C1	SERVICE LIMIT 15 BAR @ 90 °C	ASME CODE: B31.3	RT:5 %

SERVICE:		Injection Water, Makeup Water, Machinery Cooling Water, Drain Water, Seal Water, Process Water, Plant Air, Chemical Additives,	
ITEM		SIZE (mm)	DESCRIPTION
PIPE		8-40	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE
		50-250	Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE
		300-600	Material A53 Gr. B, ASME B36.10, 9.53 mm wall, ERW, BE
		650-1000	Material A139 Gr. B, ASME B36.10, 9.53 mm wall, spiral or straight, EFW, BE
		1050-1300	Material A139 Gr. B, ASME B36.10, 11.13 mm wall, spiral or straight , EFW, BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to have brass to iron seats.
	BUTT WELD	50-250 300-600 650-1300	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch.40 Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, 9.53 mm wall Material A234 Gr. WPBW, ASME B16.9,sch. same as pipe, Mitered elbows fabricated from pipe per drawing TGMM-M3140.
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F*, Serrated Finish.
	SLIP-ON	50-600 650-1300	Material A105. ASME B16.5, 150# R.F*, Serrated Finish. Material A105, R.F.* Class 125. Drilling and flange dia. to conform to ASME B16.1, Serrated Finish.
	ORIFICE	25-200 250-1300	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 125# or 150# slip-on flgs. (see above) and ½" NPT radius taps.
	BLIND	50-600 650-1300	Material A105. ASME B16.5, 150# R.F.* Material A105, R.F.* Class 125. Drilling and flange dia. to conform to ASME B16.1.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
GASKETS		All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,RF,150#, match to related FLG.
BOLTING		All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH ,heavy hex nuts, dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2

VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	BA08	Ball Valve:	50-200	150#, Body A216 Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.
	GL05	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, rising stem, socket weld ends.
	GL07	Globe Valve:	50-300	150#, Body A216 Gr. WCB, renewable S.S. seat and disc, rising stem, B.B., flanged ends.
	CK04	Check Valve:	8-40	800#, Body A105, A182-F6a, swing disc and seat, socket weld ends.
	CK06	Check Valve:	50-1300	125#, Body A126 Gr. B, wafer style, spring loaded S.S. swing disc.
	BF04	Butterfly Valve:	50-1300	125#, Body A126 Gr. B, Disc A536 Gr. 65, Buna-N liner/seat, lug style. 200 mm and up to have gear operator.

SPECIFICATION:	C1	SERVICE LIMIT 15 BAR @ 90 °C	ASME CODE: B31.3	RT:5 %
SERVICE:	Injection Water, Makeup Water, Machinery Cooling Water, Drain Water, Seal Water, Process Water, Plant Air, Chemical Additives,			

ITEM			SIZE (mm)	DESCRIPTION
VALVES	KG01	Knife Gate Valve:	50-900	125#, Body A126 Gr. B, Gate 304 S.S., EPDM seat, wafer style body, 100% tight shutoff. 200 mm and up to have gear operator.
	PL03	Plug Valve	50-300	125#, Lubricated, Body and plug A126 Gr. B, flanged ends. 200 mm and up to have gear operator.
Spectacle Blind		SB01	40-300	Material A36, 150#, R.F., size to fit flanges made per ASME B16.5, thickness to be based on ASME B31.3, Weamco type 8F or equal.

Note: Corrosion allowance :1.6 mm

SPECIFICATION:	C2	SERVICE LIMIT 2.5 BAR @ 185 °C	ASME CODE: B31.3	RT:25 %
SERVICE:	Process Gas, Top Gas Fuel, Reformed Gas Cold, Cooling Gas			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	8-40 50-250 300-600 650-1600	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE Material A53 Gr. B, ASME B36.10, 9.53 mm wall, ERW., BE Material A139 Gr. B, ASME B36.10, 9.53 mm wall, straight EFW., BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to be integral seat.
	BUTT WELD	50-250 300-600 650-1600	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. 40 Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, 9.53 mm wall Material A234 Gr. WPBW, ASME B16.9,sch. same as pipe,Mitered elbows fabricated from pipe per drawing TGMM-M3140.
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F.* ,Serrated Finish.
	SLIP-ON	50-600 650-1600	Material A105, ASME B16.5, 150# R.F.* ,Serrated Finish. Material A105, R.F.* Class 125. Drilling and flange dia. to conform to ASME B16.1, Serrated Finish
	ORIFICE	25-200 250-1600	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 125# or 150# slip-on flgs. (See above) and ½" NPT radius taps.
	BLIND	50-600	Material A105, ASME B16.5, 150# R.F.* ,Serrated Finish.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
	GASKETS	All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal, ASME B16.21,RF,150#, match to related FLG.
	BOLTING	All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/ A194 Gr. 2H heavy hex nuts, dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	BA08	Ball Valve:	50-200	150#, Body A216 Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.
	GL05	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, rising stem, socket weld ends.
	CK04	Check Valve:	8-40	800#, Body A105, A182-F6a, swing disc and seat, socket weld ends.
	CK06	Check Valve:	50-900	125#, Body A126 Gr. B, wafer style, spring loaded S.S. swing disc.
	BF04	Butterfly Valve:	50-1600	125#, Body A126 Gr. B, Disc A536 Gr. 65, Buna-N liner/seat, lug style. 200 mm and up to have gear operator. (Max. temp. 100°C)
	GA01	Gate Valve:	8-40	800#, Body A105, hard faced chrome trim, O.S. & Y., B.B., full port opening, high temperature packing and socket weld ends.
SPECTACLE BLIND		SB01	40-300	Material A36, 150# R.F., size to fit flanges made per ASME B16.5, thickness to be based on ASME B31.3, Weamco type 8F or equal. (Note 1)

Note: Corrosion allowance :1.6 mm

Note 1: In case of using spectacle blind on nozzle, Standard of flange shall be in comply with equipment nozzle (example: compressor, inlet) /or use TGMMUG00M3140

SPECIFICATION:	C3	SERVICE LIMIT 2.5 BAR @ 260 °C	ASME CODE: B31.3	RT:25 %
SERVICE:	Top Gas, Reformed Gas, Reformer Feed Gas, Flue Gas, Cooling Gas, Bottom Seal Gas Hot, Carburizing Gas, Hot Air Bleed, Combustion Air (For Refractory Lined Piping Systems)			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	8-40 50-150 200-300 350-1200 1300-3800	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE Material A53 Gr. B, ASME B36.10, 9.53 mm wall (per dwg.), BE Material A36 Rolled Plate, 6 to 10 mm wall (per dwg.), welded, BE Material A36 Rolled Plate, 6 to 20 mm wall (per dwg.), welded, BE
FITTINGS	SOCKET WELD	15-40	Material A105, ASME B16.11, 3000#, unions to be integral seat.
	BUTT WELD	50-250 300-600 650-3800	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. to match pipe. Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, sch. to match pipe. Material A234 Gr. WPBW, ASME B16.9,sch. same as pipe, Mitered elbows fabricated from pipe per drawing TGMM-M3140.
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F*, Non Serrated.
	WELD NECK	50-600	Material A105, ASME B16.5, 150# R.F* , Sch. To match pipe , Non Serrated.
	SLIP-ON	50-600 650-3800	Material A105, ASME B16.5, 150# R.F*, Non Serrated. Material A105, R.F. Class 125. Drilling and flange dia. to conform to ASME B16.1. /Refer to mechanical dwg of each duct.
	ORIFICE	25-200 250-3800	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 125# or 150# slip-on flgs. (see above) and ½" NPT radius taps.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
GASKETS		All	Material 304 S.S. with ceramic filler, spiral wound style, 4.5 mm thick, with inner & outer ring, ASME B16.20,RF,150# / match to related FLG.
BOLTING		All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/ A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	GL03	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, O.S. & Y., B.B., high temperature packing, socket weld ends.
	GA01	Gate Valve:	8-40	800#, Body A105, hard faced chrome trim, O.S. & Y., B.B., full port opening, high temperature packing and socket weld ends.
	BA05	Ball Valve	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	SPL	Valves:	50-3800	All high temperature valves to be designed on a case specific basis by valve supplier.

SPECIFICATION:		C4	SERVICE LIMIT 0.35 BAR @ 65 °C	ASME CODE: B31.3	RT:5 %
SERVICE:		Auxiliary Air, Combustion Air (Main Air), Vent, Flue Air, Dilution Air			
ITEM		SIZE (mm)	DESCRIPTION		
PIPE		8-40 50-250 300-600 650-1600 1700-2000	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE Material A53 Gr. B, ASME B36.10, 6.35 mm wall, ERW., BE Material A139 Gr. B ,ASME B36.10,9.53 mm wall, spiral EFW, BE / A36 Rolled Plate, 6 mm wall, welded A36 Rolled Plate, 6 mm wall, welded		
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to have integral seats.		
	BUTT WELD	50-250 300-600 650-2000	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. 40 Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, 6.35 mm wall Material A234 Gr. WPBW, ASME B16.9 , sch. same as pipe, Mitered elbows fabricated from pipe per drawing TGMM-M3140.		
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#		
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F*, Serrated Finish.		
	SLIP-ON	50-600 650-2000	Material A105, ASME B16.5, 150# R.F*, Serrated Finish. Material A105, R.F.* Class 125.Drilling and flange dia. To conform to ASME B16.1, Serrated Finish.		
	ORIFICE	25-200 250-2000	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 125# or 150# slip-on flgs. (see above) and ½" NPT radius taps.		
	BLIND	50-600	Material A105, ASME B16.5, 150# R.F.*, Serrated Finish.		
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment				
GASKETS		All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,RF,150# / match to related FLG.		
BOLTING		All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH ,heavy hex nuts, dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.		
VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.	
	BA08	Ball Valve:	50-200	150#, Body A216, Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.	
	GL05	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, rising stem, socket weld ends.	
	CK04	Check Valve:	8-40	800#, Body A105, 13% Cr., swing disc and seat, socket weld ends.	
	CK06	Check Valve:	50-900	125#, Body A126 Gr. B, wafer style, spring loaded S.S. swing disc.	
	BF04	Butterfly Valve:	50-2000	125#, Body A126 Gr. B, Disc A536 Gr. 65, Buna-N liner/seat, lug style. 200 mm and up to have gear operator.	
Note: Corrosion allowance :1.6 mm					

SPECIFICATION:	C5	SERVICE LIMIT 10 BAR @ 80 °C	ASME CODE: B31.3	RT:- %
SERVICE:	Instrument Air, Potable Water			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE / TUBE	8-10	Tube, seamless, annealed, 1.0 mm wall, material ASTM A269, Gr. TP304 or TP316.
		8-40	Material A53 Gr. B, ASME B36.10, sch. 80, galvanized, seamless. Threaded and coupled ends.(NPT)
		50-100	Material A53 Gr. B, ASME B36.10, sch. 40, galvanized, seamless. Threaded and coupled ends.(NPT)
FITTINGS	SCREWED	8-100	A105, ASME B16.11, 3000# galvanized, unions to be ground joint.
IFLANGES	SCREWED	15-100	Material A105, ASME B16.5, 150# R.F.* , Serrated Finish, galvanized.
	BLIND	15-100	Material A105, ASME B16.5, 150# R.F.* , Serrated Finish, galvanized.
	ORIFICE	50-100	Material A105, ASME B16.36, 300#, screwed, R.F. w/bolts, gaskets and jack screws.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
GASKETS		All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,RF,150#, match to related FLG.
BOLTING		All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH ,heavy hex nuts, dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA01	Ball Valve:	8-40	400#, Body B62, Chrome plated bronze ball, Teflon seat and seal, screwed ends.
	BA08	Ball Valve:	50-100	150#, Body A216 Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.
	GL01	Globe Valve:	8-40	200#, Body B62, renewable bronze seat and disc, rising stem, screwed ends.
	CK01	Check Valve:	8-40	200#, Body B62, renewable bronze swing disc and seat, screwed ends.
	CK06	Check Valve:	50-100	125#, Body A126 Gr. B, wafer style, spring loaded S.S. swing disc.
	BF01	Butterfly Valve:	50-100	125#, Body A126 Gr. B, Disc 316 S.S., EPDM liner/seat, lug style.

Note: Corrosion allowance :1.6 mm

SPECIFICATION:	C6	SERVICE LIMIT 16.5 BAR @ 80 °C	ASME CODE: B31.3	RT:25 % & 10% NOTE
SERVICE:	Natural Gas Cold, Impulse Purge Gas, Nitrogen, Purge Gas, Inert Gas, Dry Seal Gas, Wet Seal Gas, Bottom Seal Gas Cold			

ITEM		SIZE(mm)	DESCRIPTION
PIPE		8-40 50-250 300-600 650-800	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE Material A53 Gr. B, ASME B36.10, 9.53 mm wall, ERW, BE Material A139 Gr. B, ASME B36.10, 9.53 mm wall, straight EFW., BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to have integral seats.
	BUTT WELD	50-250 300-600	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. 40 Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, 9.53 mm wall
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F.*, Serrated Finish.
	WELD NECK	50-600	Material A105, ASME B16.5, 150# R.F.*, Sch. To match pipe, Serrated Finish, (just for natural gas)
	SLIP-ON	50-600	Material A105, ASME B16.5, 150# R.F.*, Serrated Finish.
	BLIND	50-600	Material A105, ASME B16.5, 150# R.F.*, Serrated Finish.
	ORIFICE	25-200 250-600	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 150# slip-on Flgs. (see above) and 1/2" NPT radius taps.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
GASKETS		All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,RF,150# / match to related FLG.
BOLTING		All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2

VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	BA06	Ball Valve:	8-40	600#, Body A105, S.S. ball, fire safe seat, full port, and socket weld ends (for natural gas service).
	BA08	Ball Valve:	50-200	150#, Body A216 Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.
	BA09	Ball Valve:	50-400	150#, Body A216 Gr. WCB, S.S. ball, fire safe seat, full port, flanged ends (for natural gas service).
	GL05	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, rising stem, socket weld ends.
	CK04	Check Valve:	8-40	800#, Body A105, A182-F6a, swing disc and seat, socket weld ends.
	CK06	Check Valve:	50-600	125#, Body A126 Gr. B, wafer style, spring loaded S.S. swing disc.
	BF03	Butterfly Valve:	50-600	150#, Body A216 Gr. WCB, Disc A351 Gr. CF8M, fire safe seat, (high performance) lug style. 200 and up to have gear operator. (for natural gas services)

SPECIFICATION:	C6	SERVICE LIMIT 16.5 BAR @ 80 °C	ASME CODE: B31.3	RT:25 % & 10% NOTE
SERVICE:	Natural Gas Cold, Impulse Purge Gas, Nitrogen, Purge Gas, Inert Gas, Dry Seal Gas, Wet Seal Gas, Bottom Seal Gas Cold			

ITEM			SIZE(mm)	DESCRIPTION
VALVES	BF04	Butterfly Valve:	50-600	125#, Body A126 Gr. B, Disc A536 Gr. 65 Buna-N liner/seat, lug style. 200 mm and up to have gear operator.
	PL01	Plug Valve:	8-40	150#, Lubricated, Body A216 Gr. WCB, plug A126 Gr. B, socket weld.
	PL03	Plug Valve:	50-300	200#, Lubricated, Body and plug A126 Gr. B, flanged ends. 200 mm and up to have gear operator.
	PL05	Plug Valve:	50-300	150#, Lubricated, Body and plug A216 Gr. WCB, flanged ends. 200 mm and up to have gear operator. (For N.G. service)
	NL01	Needle Valve:	15-50	800#, Body A105, Disc 13% Cr S.S. (A276-410), STELLITE Seat, flanged ends.
Spectacle Blind		SB01	40-300	Material A36, 150#, R.F., size to fit flanges made per ASME B16.5, thickness to be based on ASME B31.3, Weamco type 8F or equal.

Note: Corrosion allowance :1.6 mm

NOTE: NATRUAL GAS COLD ONLY 25% RT

SPECIFICATION:	C7	SERVICE LIMIT 7.5 BAR @ 90 °C	ASME CODE: B31.3	RT:5 %
SERVICE:	Slurry, Thick and Thin			

	ITEM	SIZE(mm)	DESCRIPTION
	PIPE	8-250 300-600	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., BE Material A53 Gr. B, ASME B36.10, 9.53 mm wall, ERW., BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to be integral seat.
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
	BUTT WELD	50-250 300-600	Material A234 Gr. WPB, Sch. to match pipe, elbows to be 3D radius. 80 mm (3") long pipe tangent required to be welded on each end when used with mechanical coupling. Material A234 Gr. WPBW, Sch. to match pipe, elbows to be 3D radius. Mechanical contractor may substitute 4 weld miters minimum, fabricated from pipe.
	MECHANICAL COUPLING	50-250	Heavy Duty, Victaulic Style 99 or equal. For use on elbows and every two random lengths of pipe, 40 feet (12.2 meters) maximum.
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# F.F*, Serrated Finish.
	WELD NECK	50-600	Material A105, ASME B16.5, 150# F.F* ,Sch. To match pipe, Serrated Finish.
	SLIP-ON	50-600	Material A105, ASME B16.5, 150# F.F.*, Serrated Finish.
	ORIFICE	25-200 250-600	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 150# slip-on FLGS. (see above) and 1/2" NPT radius taps.
	BLIND	50-600	Material A105, ASME B16.5, 150# F.F.* Serrated Finish.
	*Note: R.F. Flanges to be used with R.F. Valves and Equipment		
	GASKETS	All	Non-asbestos, ASTM F104, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,150# / match to related FLG.
	BOLTING	All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH heavy hex nuts, dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2

VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	BA08	Ball Valve:	50-200	150#, Body A216 Gr. WCB, S.S. ball, PTFE seat, full port, flanged ends.
	KG01	Knife Gate:	50-300	125#, Body A126 Gr. B, gate 304 S.S., EPDM seat, wafer style body, 100% tight shut-off. 200 mm and up to have gear operator.
	BF02	Butterfly:	50-600	125#, Body A126, Gr. B, Disc A536 Gr. 65 Buna-N liner/seat and disc cover, lug style. 200 mm and up to have gear operator.
	PN01	Pinch Valve:	25-40	125#, A126-B, Rubber tube style, 100% opening, hand wheel operated slip-on type.
	PN02	Pinch Valve:	50-250	150#, A216-WCB Rubber tube style, 100% opening, hand wheel operated slip-on type.
	CK09	Check Valve:	80-400	125#, Body A126 Gr. B, rubber lined swing check.
	CK04	Check Valve:	8-40	800#, Body A105, A182-F6a, swing disc and seat, socket weld ends..

Note: Corrosion allowance :3 mm

SPECIFICATION:	C8	SERVICE LIMIT 3.0 BAR @ 425 °C	ASME CODE: B31.3	RT:30 % & 5%
SERVICE:	Reformer Feed Gas, Combustion Air Hot			

ITEM		SIZE (mm)	DESCRIPTION
PIPE		8-40 50-250 300-1050 1100-1800	Material A106 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A106 Gr. B, ASME B36.10, sch. 40, seamless., BE Material API-5L Gr. B, 9.53 mm wall, LSAW, E=0.9., BE Material API-5L Gr. B, 11.13 mm wall, LSAW, E=0.9., BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to be integral seat.
	BUTT WELD	50-250 300-600 650-1800	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. 40 Material A234 Gr. WPBW, ASME B16.9, L.R. elbows, 9.53 mm wall Material A234 Gr. WPBW, ASME B16.9 , sch. same as pipe, Mitered elbows fabricated from pipe per drawing TGMM-M3140.
	THREADED FULL COUPLINGS	8-80	Material A105, ASME B16.11, 3000#
	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F, Non Serrated.
	WELD NECK	50-600	Material A105, ASME B16.5, 150# R.F, Non Serrated. sch. to match pipe.
	SLIP-ON	650-1800	Material A105, R.F. Class 125. Non Serrated, Drilling and flange dia. to conform to ASME B16.1.
	BLIND	50-600	Material A105, ASME B16.5, 150# R.F
	ORIFICE	25-200 250-1500	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 125# or 150# slip-on flgs. (see above) and 1/2” NPT radius taps.
GASKETS		All	Material 304 S.S. with “Grafoil” filler, spiral wound style, 4.5 mm thick, with inner & outer ring, ASME B16.20, 150#, RF/ match to related FLG.
BOLTING		All	Material A193 Gr. B16, stud bolts or heavy hex head bolts w/ A194 Gr. 4 heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.
	GL03	Globe Valve:	8-40	800#, Body A105, renewable S.S. seat and disc, O.S. & Y., B.B., high temperature packing, socket weld ends.
	GA01	Gate Valve:	8-50	800#, Body A105, hard faced chrome trim, O.S. & Y., B.B., full port opening, high temperature packing and socket weld ends.
	CK02	Check Valve:	8-40	800#, Body A105, A182-F316. BC, swing type, socket weld ends.
	CK07	Check Valve:	50-1500	150#, Body A216 Gr. WCB, 13% Cr. Trim, wafer style, R.F., S.S. spring loaded swing disc.
	BF07	Butterfly Valve:	50-1800	150#, Body and Disc A216 Gr. WCB, Seat 316 S.S., High performance, lug style. 200 mm and up to have gear operator.

Note: Corrosion allowance :1.6 mm

NOTE:REFORMER FEED GAS ONLY 30% RT

SPECIFICATION:	C9	SERVICE LIMIT 200 BAR @ 100 °C	ASME CODE: B31.3	RT:100 %
SERVICE:	Hydraulic and Grease Piping, Lube Oil			

	ITEM	SIZE (mm)	DESCRIPTION
	HOSE	6-20	Hydraulic Hose, SAE J517-3000 psi.
	PIPE / TUBE	8-10 15 20-50	Tube, seamless, annealed, 1.6 mm wall, material ASTM A179. Tube, seamless, annealed, 2.3 mm wall, material ASTM A179. Pipe seamless, ASME B36.10, material A106 Gr. B, sch. 80.
FITTINGS	HOSE	6-20	Similar to SAE J516, 3000#.
	FLARELESS TUBE	8-15	Swagelok, Material Steel.
	TUBE	8-10	Swagelok, Flareless, Material 316 S.S.
	SOCKET WELD	20-50	Material ASTM A105, ASME B16.11, 3000#.
	S.W. FLANGE	20-50	SAE Flange, Material ASTM A105, SAE J518, 3000#.
	GASKETS	20-50	O-Ring Seal, SAE J518, Material FPM (Viton).
	BOLTING	All	Material A193 Gr. B7, stud bolts w/A194 Gr. 2 heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA12	Ball Valve:	6-50	3000#, Body A105, ball stainless steel, seat: PTFE or ultra-high molecular weight material, female thread connection, SAE J475/J514.
	BA13	Ball Valve:	20-50	3000#, Body A105, ball stainless steel, seat: PTFE or ultra-high molecular weight material, socket weld ends.
	GL06	Globe Valve:	6-20	3000#, Body A105, stainless trim, rising hand wheel, female thread SAE J475/J514.

SPECIFICATION:	C10	SERVICE LIMIT 0.1 BAR VAC @ 150 °C	ASME CODE: B31.3	RT:- %
SERVICE:	Dust Collection, Vapor Removal			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	100-1500	Material ST37-2 Rolled Plate, 6. mm wall, welded.
FITTINGS	BUTT WELD	100-1500	Mitered elbows fabricated from rolled plate per drawing TGMM-M3140.
FLANGES	FLAT RING	100-250	Material A36, 10 mm plate. Bolt holes and flange diameters to match ASME B16.1, Class 125 standards / Refer to related drawing (General Drawing for flange & gasket.)
		300-650	Material A36, 12 mm plate. Bolt holes and flange diameters to match ASME B16.1, Class 125 standards / Refer to related drawing (General Drawing for flange & gasket.)
		700-1500	Material A36, 16 mm plate. Bolt holes and flange diameters to match ASME B16.1, Class 125 standards / Refer to related drawing (General Drawing for flange & gasket.)
	GASKETS	100-150	Non-asbestos, ASTM F104, 2 mm thick (1/16”), Garlock Style 3200 or equal. ASME B16.21,150#,RF/ match to related FLG.
		200-1500	Non-asbestos, ASTM F104, 3 mm thick (1/16”), Garlock Style 3200 or equal. ASME B16.21,150#,RF / match to related FLG.
	BOLTING	All	Material DIN 933, 934/A307BV stud bolts or heavy hex head bolts w/heavy hex nuts, dacromet coating.

VALVES	DA01	Damper:	100-1500	Fabricated from plate as per dwg.
	BF04	Butterfly Valve:	50-350	125#, Body A126 Gr. B, Disc A536 Gr. 65, Buna-N liner/seat, lug style. 200 mm and up to have gear operator. (Max. temp. 100°C)
	BA05	Ball Valve:	10-40	600#, Body A105, S.S. ball, PTFE seat, full port, socket weld ends.

Note: Corrosion allowance :1.6 mm

SPECIFICATION:	C11	SERVICE LIMIT 3.0 BAR @ 500 °C	ASME CODE: B31.3	RT:100 %
SERVICE:	Natural Gas Hot			

ITEM		SIZE (mm)	DESCRIPTION
PIPE		8-40 50-250 300-400 450-600	Material A335 P11, ASME B36.10, sch. 80, seamless., PE Material A335 P11, ASME B36.10, sch. 40, seamless., BE Material A335 P11, ASME B36.10, 9.53 mm wall, seamless., BE Material A691 Gr.11/4 Cr CL11, ASME B36.10, 9.53 mm wall, EFW BE
FITTINGS	SOCKET WELD	8-40	Material A182 F11 CL2, ASME B16.11, 3000#, unions to be integral seat.
	BUTT WELD	50-250 300-600	Material A234 WP11 CL2, ASME B16.9, L.R. elbows, sch. 40 Material A234 WP11 CL2, ASME B16.9, L.R. elbows, 9.53 mm wall
	THREADED FULL COUPLINGS	8-80	Material A182 F11 CL2, ASME B16.11, 3000#
FLANGES	SOCKET WELD	15-40	Material A182 F11 CL2, ASME B16.5, 150# R.F, Non serrated.
	WELD NECK	50-600	Material A182 F11 CL2, ASME B16.5, 150# R.F, Non serrated, sch. to match pipe.
	BLIND	50-600	Material A182 F11 CL2, ASME B16.5, 150# R.F
GASKETS		All	Material 304 S.S. with “Grafoil” filler, spiral wound style, 4.5 mm thick, with inner & outer ring, ASME B16.20,150#,RF/ match to related FLG.
BOLTING		All	Material A193 Gr. B16, stud bolts or heavy hex head bolts w/ A194 Gr. 4 heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BF08	Butterfly Valve:	50-600	150#, Body and Disc A217 Gr. WC6, Seat 316 S.S., High performance, lug style. 200 mm and up to have gear operator.

Note: Corrosion allowance :1.6 mm

SPECIFICATION:	C12	SERVICE LIMIT 17.9 BAR @ 80 °C	ASME CODE: B31.3	RT:5 %
SERVICE:	Firefighting Water			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	8-40 50-300	Material A53 Gr. B, ASME B36.10, sch. 80, seamless., PE Material A53 Gr. B, ASME B36.10, sch. 40, seamless., BE
FITTINGS	SOCKET WELD	8-40	Material A105, ASME B16.11, 3000#, unions to have brass to iron seats.
FITTINGS	BUTT WELD	50-300	Material A234 Gr. WPB, ASME B16.9, L.R. elbows, sch. 40
FLANGES	SOCKET WELD	15-40	Material A105, ASME B16.5, 150# R.F, Serrated Finish.
FLANGES	SLIP-ON	50-300	Material A105, ASME B16.5, 150# R.F, Serrated Finish.
FLANGES	ORIFICE	25-300	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws.
FLANGES	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
GASKETS		All	Non-asbestos, 2 mm (1/16") thick, Garlock Style 3200 or equal. ASME B16.21,150#,RF, match to related FLG.
BOLTING		All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA02	Ball Valve:	8-40	600#, Body A105, S.S. ball, PTFE seat, threaded ends.
VALVES	CK10	Check Valve:	50-300	300 WWP, Body A216 Gr. WCB, wafer style, spring loaded S.S. swing disc.
VALVES	CK11	Check Valve:	20-40	300 WWP, Bronze, Swing disc & Seat, Threaded ends.
VALVES	GA10	Gate Valve:	50-300	175 WWP, Iron Body, Bronze Trim, OS&Y, Flanged ends.
VALVES	GA11	Gate Valve:	50-300	300 WWP, Iron Body, Bronze Trim, OS&Y, Flanged ends.
VALVES	GA12	Gate Valve:	20-40	175 WWP, Bronze, OS&Y, Threaded ends.
VALVES	GA13	Gate Valve:	20-40	300 WWP, Bronze, OS&Y, Threaded ends.

Note: Corrosion allowance :1.6 mm

SPECIFICATION:	C14	SERVICE LIMIT 6 BAR @ 35 °C	ASME CODE: B31.3	RT:30 %
SERVICE:	Oxygen (Gaseous)			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	15-40 50-200	Material A106 Gr. B, ASME B36.10, sch. 80, seamless. PE Material A106 Gr. B, ASME B36.10, sch. 40, seamless. BE
FITTINGS	SOCKET WELD	15-40	Material A105, ASME B16.11, 3000#, unions to have integral seats.
FITTINGS	BUTT WELD	15-200	Material A234, Gr. WPB, ASME 16.9, L.R. elbows, sch. To match pipe
FLANGES	WELD NECK	15-200	Material A105, ASME B16.5, 150# R.F. Sch.to match pipe, Serrated Finish.
FLANGES	ORIFICE	25-200	Material A105, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws.
	GASKETS	All	ASTM F104, 2 mm (1/16") thick, Garlock Style 3505 or equal. ASME B16.21,150#,RF, match to related FLG.
	BOLTING	All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA17	Ball Valve:	15-40	600#, 316 S.S. Body or A351 Gr. CF8M, 316 S.S. ball, fire safe seat, full port, socket weld ends, Antistatic mechanism .
	BA18	Ball Valve:	25-200	150#, 316 S.S. Body or A351 Gr. CF8M, 316 S.S. ball, fire safe seat, full port, flanged ends.
	GL08	Globe Valve:	15-40	600#, 316 S.S. Body or A351 Gr. CF8M, renewable monel seat and disc, fire safe, OS & Y, B.B. socket weld ends.
	GL09	Globe Valve:	50-200	150#, 316 S.S. Body or A351 Gr. CF8M, renewable monel seat and disc, fire safe, OS & Y, B.B. flanged ends.
	CK12	Check Valve:	15-40	600#, Body A182 F316, Disc A351 CF8M renewable stainless steel swing disc and seat, socket weld ends.
	CK13	Check Valve:	50-200	150#, Body A351 Gr. CF8M, wafer style, spring loaded stainless steel swing disc.

Notes: 1. Maximum velocity must conform to Compressed Gas Association regulation CGA-4.4.
2. Oxygen piping shall be color coded and identified per ASME A13.1
3. All valves shall be cleaned, sealed and/or bagged and tagged "For Oxygen Service."
4. All valve material shall be suitable for Oxygen Service.
5- Corrosion allowance :1.6 mm

SPECIFICATION:	C16	SERVICE LIMIT 400 BAR @ 100 °C	ASME CODE: B31.3	RT:100 %
SERVICE:	Hydraulic			

ITEM		SIZE (mm)	DESCRIPTION
HOSE		6-20	Hydraulic Hose, SAE J517, Type A & AT
PIPE / TUBE		8-10 15 20-50	Tube, seamless, annealed, 1.6 mm wall, material ASTM A179. Tube, seamless, annealed, 2.3 mm wall, material ASTM A179. Pipe seamless, ASME B36.10, material A106 Gr. B, sch. XXS
FITTINGS	HOSE	6-20	Similar to SAE J516, 6000#.
	FLARELESS TUBE	8-15	Swagelok, Material Steel, 6000#.
	TUBE	8-10	Swagelok, Flareless, Material 316 S.S., 6000#
	SOCKET WELD	20-50	Material ASTM A105, ASME B16.11, 6000#.
S.W. FLANGE		20-50	SAE Flange, Material ASTM A105, SAE J518, 6000#.
GASKETS		20-50	O-Ring Seal, SAE J518, Material FPM (Viton).
BOLTING		All	Material A193 Gr. B7, stud bolts w/A194 Gr. 2 heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA20	Ball Valve:	6-50	6000#, Body A105, ball stainless steel, seat: PTFE or ultra-high molecular weight material, female thread connection, SAE J475/J514.
	BA21	Ball Valve:	20-50	6000#, Body A105, ball stainless steel, seat: PTFE or ultra-high molecular weight material, socket weld ends.
	GL11	Globe Valve:	6-20	6000#, Body A105, stainless trim, rising hand wheel, female thread SAE J475/J514.

SPECIFICATION:	P1	SERVICE LIMIT 2 BAR @ 50 °C	ASME CODE: B31.3	RT:- %
SERVICE:	Chemical Additives (Water Treatment)			

ITEM		SIZE (mm)	DESCRIPTION
PIPE		8-100	Material UPVC Type 4 Gr. 1, ASTM D-1784, sch. 80 ASTM F-441, seamless.
FITTINGS	SOCKET END	8-100	Material UPVC Type 4 Gr. 1, ASTM D-1784, sch. 80 ASTM F-439, unions supplied with Viton “O” rings.
FLANGES	SOCKET END	15-100	Material UPVC Type 4 Gr. 1, ASTM D-1784, sch. 80 ASTM F-439, ASME B16.1, 150# F.F.
JOINT MATERIAL		All	UPVC solvent, heavy-duty industrial grade, for use with sch. 80 pipe and fittings. ASTM F-493, UPVC primer solvent, ASTM F-493.
GASKETS		All	Material PTFE, 3 mm (1/8”) thick, full face, Garlock style, Chemrex 3570 or equal. ASME B16.21,150#,RF, match to related FLG.
BOLTING		All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH heavy hex nuts,dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.
VALVES	BA14	Ball Valve: 10-100	All UPVC construction, union style, full port, socket end, Teflon seat

Note: Corrosion allowance :0 mm

SPECIFICATION:	P2	SERVICE LIMIT 11 BAR @ 30 °C		RT:- %
SERVICE:	Fire Water (Buried)			

ITEM		SIZE (mm)	DESCRIPTION
PIPE		63-315	Material HDPE-100, FIT TO SDR 9.0 DIN8074
FITTING	BUTT FUSION	63-315	Material HDPE-100 ,FIT TO SDR 9.0 DIN 8074,PER DIN 16963 – PART1
FLANGES	Adopter	63-315	Material HDPE-100 ,FIT TO SDR 9.0 DIN 8074,PER DIN 16963 (short/ long) – PART1
	BLIND	63-315	Material HDPE-100 ,FIT TO SDR 9.0 DIN 8074,PER DIN 16963– PART1
	BACK RING	63-315	A105 GLV,FF, DRILLED PER ASME B16.5#150
GASKETS		All	NEOPRENE 65 SHORE A. FLAT SHEET150#,3.0 T, ASME B16.21
BOLTING		All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

Note: Corrosion allowance :0 mm

SPECIFICATION:	P3	SERVICE LIMIT 5 BAR @ 30 °C		RT:- %
SERVICE:	Make up Water (Buried)			

ITEM		SIZE (mm)	DESCRIPTION
PIPE		63-315	Material HDPE-100, FIT TO SDR 13.6 DIN8074
FITTING	BUTT FUSION	63-315	Material HDPE-100 ,FIT TO SDR 13.6 DIN 8074,PER DIN 16963
FLANGES	Adopter	63-315	Material HDPE-100 ,FIT TO SDR 13.6 DIN 8074,PER DIN 16963 (short/ long)
	BLIND	63-315	Material HDPE-100 ,FIT TO SDR 13.6 DIN 8074,PER DIN 16963
	BACK RING	63-315	A105 GLV,FF, DRILLED PER ASME B16.5#150
GASKETS		All	NEOPRENE 65 SHORE A. FLAT SHEET 150#,3.0 T, ASME B16.21
BOLTING		All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH heavy hex nuts,dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

Note: Corrosion allowance :0 mm

SPECIFICATION:	S1	SERVICE LIMIT 2.5 BAR @ 90 °C	ASME CODE: B31.3	RT:5 %
SERVICE:	Seal Gas Condensate			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	8-40 50-300 350-600	Material A312 Gr. TP304L, ASME B36.19, Sch. 40, seamless (for inst. connections)., PE Material A312 Gr. TP304L, ASME B36.19, Sch. 10, seamless. BE Material A409 Gr. TP, EFW, BE
FITTINGS	SOCKET WELD	8-40	Material A182 Gr. F304L, ASME B16.11, 3000#, unions to have integral seats.
	BUTT WELD	50-600	Material A403 Gr. WP304L, MSS SP-43 sch. 10, L.R. elbows, sch. to match pipe.
	STUB ENDS	15-600	MSS SP-43 Type B for slip on flanges, sch. to match pipe.
	THREADED FULL COUPLINGS	8-80	Material A182 Gr. F304L, ASME B16.11, 3000#
FLANGES	SLIP-ON	15-600	Material A182 Gr. F304L, ASME B16.5, 150# R.F* Serrated Finish.
	ORIFICE	25-200 250-600	Material A182 Gr. F304L, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 150# slip-on Flgs. (see above) and 1/2" NPT radius taps.
	*Note: F.F. Flanges to be used with F.F. Valves and Equipment		
	GASKETS	All	Material EPDM rubber compound, ASTM F104, 2 mm (1/16") thick, Garlock Style 3700 or equal, ASME B16.21,150#,RF, match to related FLG.
	BOLTING	All	Material A307 Gr. B, stud bolts or heavy hex head bolts w/ A563 Gr. DH heavy hex nuts,dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA07	Ball Valve:	8-40	600#, Body A182-F316, Disc 316 S.S. ball, PTFE seat, full port, socket weld ends.
	BA10	Ball Valve:	50-200	150#, Body A351 Gr. CF8M, 316 S.S. ball, PTFE seat, full port, flanged ends.
	GL02	Globe Valve:	8-40	600#, Body A351 Gr. CF8M, renewable 316 S.S. seat and disc, OS & Y, B.B. socket weld ends.
	CK03	Check Valve:	8-40	600#, Body A351 Gr. CF8M, renewable swing disc and seat, socket weld ends.
	CK05	Check Valve:	50-600	150#, Body A351 Gr. CF8M, wafer style, spring loaded 316 S.S. swing disc.
	BF01	Butterfly Valve:	50-600	125#, Body A126 Gr. B, Disc 316 S.S., EPDM liner, lug style. 200 mm and up to have gear operator.

Note: Corrosion allowance :0 mm

		S2	SERVICE LIMIT 2.5 BAR @ 600 °C	ASME CODE: B31.3	RT:100 %
SERVICE:		Reformer Feed Gas			
ITEM		SIZE (mm)	DESCRIPTION		
PIPE		8-40 50-65	Material A312 Gr. TP316L, ASME B36.19, sch. 40s, seamless. PE Material A312 Gr. TP316L, ASME B36.19, sch. 40s, seamless. BE		
FITTINGS	SOCKET WELD	8-40	Material A182 Gr. F316L, ASME B16.11, 3000#, unions to have integral seats.		
	BUTT WELD	50-65	Material A403 Gr. WP316L, ASME B16.9, L.R. elbows, sch. to match pipe. For size 65 and above use mitered elbows fabricated from pipe per drawing TGMM-M3140		
	STUB ENDS	65	MSS SP-43 Type A for Lap Joint flanges, sch. 40s		
	THREADED FULL COUPLINGS	8-80	Material A182 Gr. F316L, ASME B16.11, 3000#		
FLANGES	*WELD NECK	15-65	Material A182 Gr. F316L, ASME B16.5, 150# R.F, Non Serrated , sch. to match pipe, (To be used against butt weld fittings only).		
	LAP JOINT	50-65	Material A182 Gr. F304L, ASME B16.5, 150#.		
	*Note: Flanges that are to be insulated shall be 300# R.F.				
GASKETS		All	Material 304 S.S. with “Grafoil” filler, spiral wound style, 4.5 mm thick. with inner & outer ring, ASME B16.20,150#,RF, match to related FLG.		
BOLTING		All	Material A193 Gr. B16, stud bolts w/ A194 Gr. 4 heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.		
VALVE	GA03	Gate Valve:	8-40	800#, Body A182 F316, WEDGE A351-CF8M, O.S. & Y., B.B. Full port opening, high temperature packing, socket weld ends.	

Note: Corrosion allowance :0.75 mm

SPECIFICATION:	S3	SERVICE LIMIT 6 BAR @ 35 °C	ASME CODE: B31.3	RT:30 %
SERVICE:	Oxygen (Gaseous)			

	ITEM	SIZE (mm)	DESCRIPTION
	PIPE	8-40 50-300	Material A312 Gr. TP304L, ASME B36.19, sch. 40s, seamless., PE Material A312 Gr. TP304L, ASME B36.19, sch. 40s, seamless., BE
FITTINGS	SOCKET WELD	8-40	Material A182 Gr. F304L, ASME B16.11, 3000#, unions to have integral seats.
	BUTT WELD	25-300	Material A403 Gr. WP304L, ASME B16.9, L.R. elbows, sch. to match pipe
	THREADED FULL COUPLINGS	8-80	Material A182 Gr. F304L, ASME B16.11, 3000#
FLANGES	WELD NECK	15-300	Material A182, Gr. F304L, ASME B16.5, 150# R.F. sch. to match pipe, Serrated Finish
	BLIND	15-600	Material A182. Gr. F304L, ASME B16.5, 150# R.F.
	ORIFICE	25-200 250-600	Material A182 Gr. F304L, ASME B16.36, 300#, weld neck, R.F. w/bolts, gaskets and jack screws. Std. 150# slip-on flgs. (see above) and 1/2" NPT radius taps.
GASKETS		All	ASTM F104, 2 mm (1/16") thick, Garlock Style 3505 or equal. ASME B16.21,150#,RF, match to related FLG.
BOLTING		All	Material A193 Gr. B7, stud bolts or heavy hex head bolts w/A194 Gr. 2H heavy hex nuts. dacromet coating, Acc. To ASME B18.2.1 & ASME B18.2.2.

VALVES	BA17	Ball Valve:	8-40	600#, 316 S.S. Body, 316 S.S. ball, fire safe seat, full port, socket weld ends / Antistatic mechanism
	BA18	Ball Valve:	25-200	150#, 316 S.S. Body or A351 Gr. CF8M, 316 S.S. ball, fire safe seat, full port, flanged ends / Antistatic mechanism
	GL08	Globe Valve:	8-40	600#, 316 S.S. Body or A351 Gr. CF8M, renewable monel seat and disc, fire safe, OS & Y, B.B. socket weld ends.
	GL09	Globe Valve:	50-200	150#, 316 S.S. Body or A351 Gr. CF8M, renewable monel seat and disc, fire safe, OS & Y, B.B. flanged ends.
	CK12	Check Valve:	8-40	600#, 316 S.S. Body or A351 Gr. CF8M, renewable stainless steel swing disc and seat, socket weld ends.
	CK13	Check Valve:	50-200	150#, 316 S.S. Body or A351 Gr. CF8M wafer style, spring loaded stainless steel swing disc.

Notes:

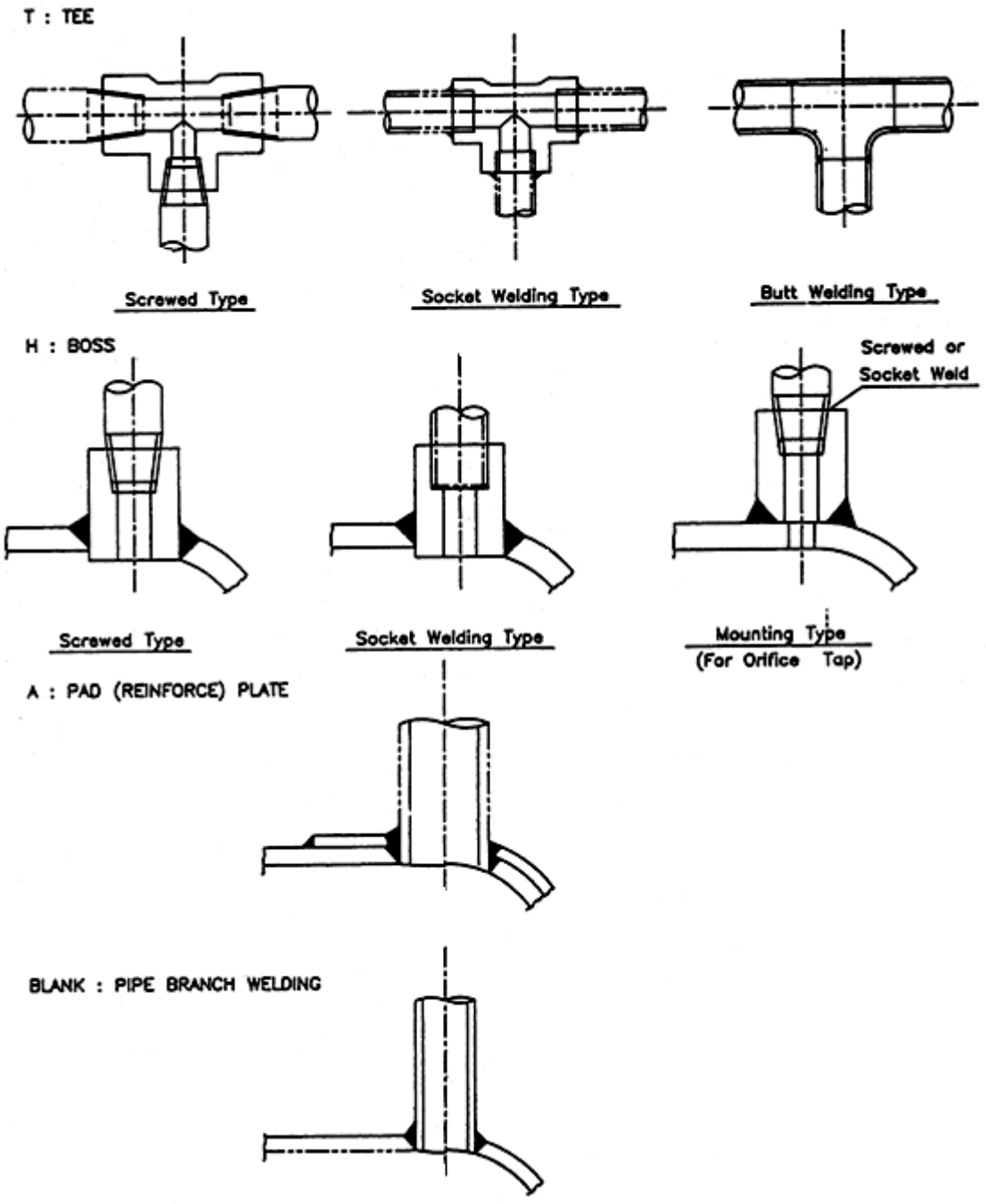
1. Oxygen piping shall be color coded and identified per ASME A13.1
2. All valves shall be cleaned, sealed and/or bagged and tagged "For Oxygen Service."
3. All valve material shall be suitable for Oxygen Service.

5. BRANCH TABLE

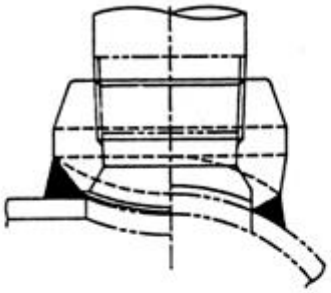
Branch table shall specify all piping branches.

Branch table begins on the next page.

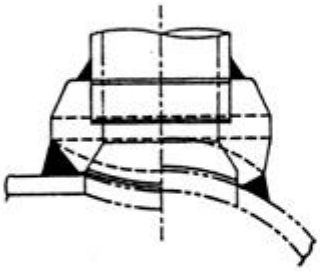
The symbols in these tables show the following branch types.



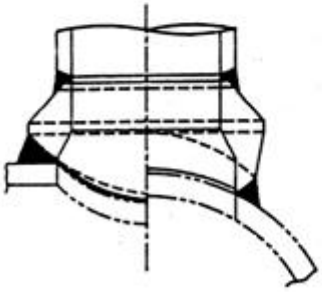
OLET



Threaded Olet (Threadolet)



Socket Welding Olet (Sockolet)



Butt Welding Olet (Weldolet)

PIPE SIZE (B)		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40	44	48
(B)	(A)	15	20	25	32	40	50	65	80	90	100	125	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	000	100	200
3/8																															
1/2	15	T																													
3/4	20	T	T																												
1	25	T	T	T																											
1 1/4	32	T	T	T	T																										
1 1/2	40	T	T	T	T	T																									
2	50	O	T	T	T	T	T																								
2 1/2	65	O	O	T	T	T	T	T																							
3	80	O	O	O	T	T	T	T	T																						
3 1/2	90	O	O	O	O	T	T	T	T	T																					
4	100	O	O	O	O	O	T	T	T	T	T																				
5	125	O	O	O	O	O	O	T	T	T	T	T																			
6	150	O	O	O	O	O	O		T	T	T	T	T																		
8	200	O	O	O	O	O	O			T	T	T	T	T																	
10	250	O	O	O	O	O	O				T	T	T	T	T																
12	300	O	O	O	O	O	O					T	T	T	T	T															
14	350	O	O	O	O	O	O						T	T	T	T	T														
16	400	O	O	O	O	O	O							T	T	T	T	T													
18	450	O	O	O	O	O	O								T	T	T	T	T												
20	500																														
22	550																														
24	600																														
26	650																														
28	700																														
30	750																														
32	800																														
34	850																														
36	900																														
40	1000																														
44	1100																														
48	1200																														

MAIN PIPE SIZE

T : TEE O : OLET

(BLANK): DO NOT MAKE REDUCING BRANCH.

APPLICABLE SPEC. DESIGN: C7

PIPE SIZE	(B)		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40	44	48
MAIN PIPE SIZE	(B)	(A)	15	20	25	32	40	50	65	80	90	100	125	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	000	100	200
	3/8	10																														
	1/2	15	T																													
	3/4	20	T	T																												
	1	25	T	T	T																											
	1 1/4	32	T	T	T	T																										
	1 1/2	40	T	T	T	T	T																									
	2	50	R	T	T	T	T	T																								
	2 1/2	65	R	T	T	T	T	T	T																							
	3	80	R	T	T	T	T	T	T	T																						
	3 1/2	90																														
	4	100	R	T	T	T	T	T	T	T		T																				
	5	125																														
	6	150																														
	8	200																														
	10	250																														
	12	300																														
	14	350																														
	16	400																														
	18	450																														
	20	500																														
	22	550																														
	24	600																														
	26	650																														
	28	700																														
	30	750																														
	32	800																														
	34	850																														
	36	900																														
	40	1000																														
	44	1100																														
	48	1200																														

T : TEE

(BLANK): DO NOT MAKE REDUCING BRANCH.

R : COMBINATION OF TEE & REDUCE APPLICABLE SPEC DESIGN: C5

MAIN PIPE SIZE (B)	(A)	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40	44	48	52	56	60	64	68
(B)	(A)	15	20	25	32	40	50	65	80	90	100	125	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	1000	1100	1200	1300	1400	1500	1600	1700
1/2	15	T																																		
3/4	20	T	T																																	
1	25	T	T	T																																
1 1/4	32	T	T	T	T																															
1 1/2	40	T	T	T	T	T																														
2	50	O	T	T	T	T	T																													
2 1/2	65	O	O	T	T	T	T	T																												
3	80	O	O	O	T	T	T	T	T																											
3 1/2	90	O	O	O	O	T	T	T	T	T																										
4	100	O	O	O	O	T	T	T	T	T	T																									
5	125	O	O	O	O	O	T	T	T	T	T	T																								
6	150	O	O	O	O	O		T	T	T	T	T	T																							
8	200	O	O	O	O	O				T	T	T	T	T																						
10	250	O	O	O	O	O					T	T	T	T	T																					
12	300	O	O	O	O	O						T	T	T	T	T																				
14	350	O	O	O	O	O											T																			
16	400	O	O	O	O	O																														
18	450	O	O	O	O	O																														
20	500	O	O	O	O	O																														
22	550	O	O	O	O	O																														
24	600	O	O	O	O	O																														
26	650	O	O	O	O	O																														
28	700	O	O	O	O	O																														
30	750	O	O	O	O	O																														
32	800	O	O	O	O	O	PIPE BRANCH WELDING SEE NOTE												STUB - INN																	
34	850	O	O	O	O	O																														
36	900	O	O	O	O	O																														
40	1000	H	H	H	H	H																														
44	1100	H	H	H	H	H																														
48	1200	H	H	H	H	H																														
52	1300	H	H	H	H	H																														
56	1400	H	H	H	H	H																														
60	1500	H	H	H	H	H																														
64	1600	H	H	H	H	H																														
68	1700	H	H	H	H	H																														
72	1800	H	H	H	H	H																														

T: TEE
O: SOCKOLET
H: HALF COUPLING
STUB – INN: PIPE BRANCH WELDING ACC. TO ASME B31.3 FIG. 328.5.4D TYPE (2) OR (4) OR FIG. 328.5.4.E
APPLICABLE SPEC. DESIGN: C1, C4, C12, S1
NOTE: IF REINFORCEMENT IS REQUIRED, PAD PLATE SHALL BE USED

MAIN PIPE SIZE	(B)	(A)		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40	44	48	52	56	60	64
		(A)		15	20	25	32	40	50	65	80	90	100	125	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	1000	1100	1200	1300	1400	1500	1600
MAIN PIPE SIZE	3/8																																				
	1/2	15		T																																	
	3/4	20		T	T																																
	1	25		T	T	T																															
	1 1/4	32		T	T	T	T																														
	1 1/2	40		T	T	T	T	T																													
	2	50		O	T	T	T	T	T																												
	2 1/2	65		O	O	T	T	T	T	T																											
	3	80		O	O	O	T	T	T	T	T																										
	3 1/2	90		O	O	O	O	T	T	T	T	T																									
	4	100		O	O	O	O	T	T	T	T	T	T																								
	5	125		O	O	O	O	O	T	T	T	T	T	T																							
	6	150		O	O	O	O	O		T	T	T	T	T	T																						
	8	200		O	O	O	O	O				T	T	T	T	T																					
	10	250		O	O	O	O	O					T	T	T	T	T																				
	12	300		O	O	O	O	O						T	T	T	T	T																			
	14	350		O	O	O	O	O							T	T	T	T	T																		
	16	400		O	O	O	O	O							T	T	T	T	T	T																	
	18	450		O	O	O	O	O								T	T	T	T	T	T																
	20	500		O	O	O	O	O								T	T	T	T	T	T	T															
	22	550		O	O	O	O	O									T	T	T	T	T	T	T														
	24	600		O	O	O	O	O										T	T	T	T	T	T	T													
	26	650		O	O	O	O	O											T	T	T	T	T	T	T												
	28	700		O	O	O	O	O												T	T	T	T	T	T	T											
	30	750		O	O	O	O	O													T	T	T	T	T	T	T										
	32	800		O	O	O	O	O														T	T	T	T	T	T	T									
	34	850		O	O	O	O	O															T	T	T	T	T	T	T								
	36	900		O	O	O	O	O																T	T	T	T	T	T	T							
	40	1000		H	H	H	H	H																	T	T	T	T	T	T	T						
	44	1100		H	H	H	H	H																		T	T	T	T	T	T	T					
	48	1200		H	H	H	H	H		PIPE BRANCH WELDING SEE NOTE									STUB - INN								T	T	T	T	T	T	T				
	52	1300		H	H	H	H	H																						T	T	T	T	T			
	56	1400		H	H	H	H	H																							T	T	T	T	T		
	60	1500		H	H	H	H	H																								T	T	T	T	T	
	64	1600		H	H	H	H	H																									T	T	T	T	T

T: TEE

O: OLET

H: HALF COUPLING

STUB – INN: PIPE BRANCH WELDING ACC. TO ANSI B 31.3 FIG. 327.4.4D TYPE (2) OR (4) OR FIG. 327.4.4.E

NOTE: IF REINFORCEMENT IS REQUIRED, PAD PLATE SHALL BE USED

APPLICABLE SPEC. DESIGN: C2, C6, C8, C11, S3

MAIN PIPE SIZE (B)	MAIN PIPE SIZE (A)	(B)	(A)	1/2	3/4	1	1/1 4	1 1/2	2
				15	20	25	32	40	50
1/2	15			A					
3/4	20			B	A				
1	25			B	B	A			
1 1/4	32			B	B	B	A		
1 1/2	40			B	B	B	B	A	
2	50			B	B	B	B	B	A

A: EQUAL TEE

B: REDUCING TEE OR REDUCING BUSHES + TEE

APPLICABLE SPEC. DESIGN: P1

RUN SIZE	20	25	32	50	63	90	110	160	225	250	280	315
20	TE											
25	T+R	TE										
32	T+R	T+R	TE									
50	T+R	T+R	T+R	TE								
63	HC	HC	HC	HC	TE							
90	HC	HC	HC	HC	T+R	TE						
110	HC	HC	HC	HC	T+R	T+R	TE					
160	HC	HC	HC	HC	T+R	T+R	T+R	TE				
225	HC	HC	HC	HC	T+R	T+R	T+R	T+R	TE			
250	HC	HC	HC	HC	T+R	T+R	T+R	T+R	T+R	TE		
280	HC	HC	HC	HC	T+R	T+R	T+R	T+R	T+R	T+R	TE	
315	HC	HC	HC	HC	T+R	T+R	T+R	T+R	T+R	T+R	T+R	TE
	20	25	32	50	63	90	110	160	225	250	280	315

BRANCH SIZE

TE: EQUAL TEE

T+R: REDUCING TEE OR TEE AND REDUCER

HC: HALF COUPLING

APPLICABLE SPEC. DESIGN: P2, P3

6. BOLT TABLE

Bolt table shall specify the fastening bolts and nuts among a couple of pipe flange, or flange and flanged components. Each stud bolt will be fastening with 2 heavy hexagon nuts.

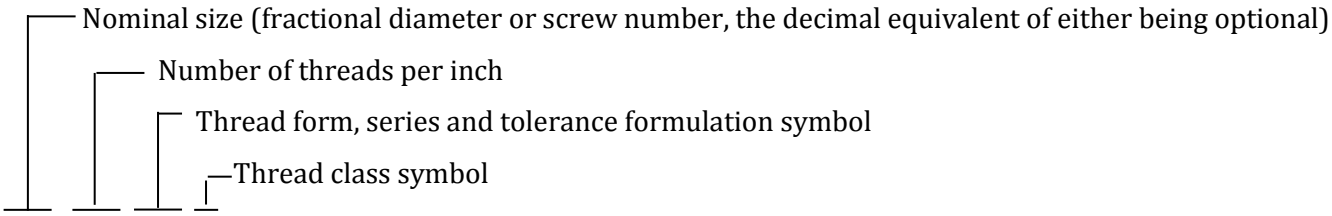
Details are shown on the subsequent pages.

Detailed designations of bolts and nuts applied are as follows:

BOLT SIZE	BOLT	NUT
1/2"	1/2-13UNC-2A	1/2-13UNC-2B
5/8"	5/8-11UNC-2A	5/8-11UNC-2B
3/4"	¾-10UNC-2A	3/4-10UNC-2B
7/8"	7/8-9UNC	7/8-9UNC-2B
1"	1-8UNC-2A	1-8UNC-2B
1-1/8"	1-1/8-8UN-2A	1-1/8-SUN-2B
1-1/4"	1-1/4-8UN-2A	1-1/4-SUN-2B
1-1/2"	1-1/2-8UN-2A	1-1/2-SUN-2B
1-3/4"	1-3/4-8UN-2A	1-3/4-SUN-2B
2"	2-8UN-2A	2-SUN-2B

Note: Threads UNRC and 8UNR may be used instead of UNC and 8UN respectively, when rolled.

- Reference of Designation Methods



1/2 – 13UNC-2A

- Thread series Designations

DESIGNATION	THREAD SERIES	ASME
UN	Unified constant-pitch thread series	B1.1
UNC	Unified coarse thread series	B1.1
UNR	Unified constant-pitch thread series with a 0.108p to 0.144p	
UNRC	Unified coarse thread series with a 0.108p to 0.144p controlled root radius	B1.1

BOLT TABLE

BOLT TABLE CODE : J2
FLANGE RATING : ASME # 150
BOLT/NUT TYPE :STUD BOLT WITH 2 HEAVY HEX. NUT

FLANGE SIZE (A)	FLANGE SIZE (B)	NO. BOLTS PER SET	BOLT SIZE METRIC	BOLT SIZE UNIFIED	BOLT LENGTH
15	1/2	4		U1/2	60
20	3/4	4		U1/2	65
25	1	4		U1/2	65
32	1.1/4	4		U1/2	70
40	1.1/2	4		U1/2	70
50	2	4		U5/8	85
65	2.1/2	4		U5/8	90
80	3	4		U5/8	90
90	3.1/2	8		U5/8	90
100	4	8		U5/8	90
125	5	8		U3/4	95
150	6	8		U3/4	100
200	8	8		U3/4	110
250	10	12		U7/8	115
300	12	12		U7/8	120
350	14	12		U1	135
400	16	16		U1	135
450	18	16		U1.1/8	150
500	20	20		U1.1/8	160
550	22	20		U1.1/4	170
600	24	20		U1.1/4	175

BOLT TABLE				
BOLT TABLE CODE : H1 FLANGE RATING : ASME #150(B16.47-SERIES B) BOLT/NUT TYPE :STUD BOLT WITH 2 HEAVY HEX. NUT				
FLANGE SIZE		NO. BOLTS PER SET	BOLT SIZE	BOLT LENGTH
(A)	(B)		METRIC UNIFIED	
650	26	36	U3/4	140
700	28	40	U3/4	150
750	30	44	U3/4	150
800	32	48	U3/4	150
850	34	40	U7/8	160
900	36	44	U7/8	165
950	38	40	U1	180
1000	40	44	U1	180
1050	42	48	U1	185
1100	44	52	U1	190
1150	46	40	U1 1/8	205
1200	48	44	U1 1/8	205
1300	52	52	U1 1/8	215
1400	56	60	U1 1/8	225
1500	60	52	U1 1/4	235

BOLT TABLE				
BOLT TABLE CODE : H2 FLANGE RATING :ASME#150(ASMEB16.1)TAYLOR FLANGE BOLT/NUT TYPE :STUD BOLT WITH 2 HEAVY HEX. NUT				
FLANGE SIZE		NO. BOLTS PER SET	BOLT SIZE	BOLT LENGTH
(A)	(B)		METRIC UNIFIED	
650	26	24	U1 1/4	185
700	28	28	U1 1/4	190
750	30	28	U1 1/4	195
800	32	32	U1 1/2	210
850	34	32	U1 1/2	215
900	36	32	U1 1/2	220
950	38	32	U1 1/2	220
1000	40	36	U1 1/2	225
1050	42	36	U1 1/2	230
1100	44	40	U1 1/2	230
1150	46	40	U1 1/2	235
1200	48	44	U1 1/2	240
1300	52	44	U1 3/4	255
1350	54	44	U1 3/4	260
1400	56	48	U1 3/4	265
1500	60	52	U1 3/4	270
1800	72	60	U1 3/4	290

BOLT TABLE				
BOLT TABLE CODE : M1 FLANGE RATING : ASME # 300 BOLT/NUT TYPE :STUD BOLT WITH 2 HEAVY HEX. NUT				
FLANGE SIZE		NO. BOLTS PER SET	BOLT SIZE	BOLT LENGTH
(A)	(B)		METRIC UNIFIED	
15	1/2	4	U1/2	65
20	3/4	4	U5/8	75
25	1	4	U5/8	80
32	1.1/4	4	U5/8	85
40	1.1/2	4	U3/4	90
50	2	8	U5/8	90
65	2.1/2	8	U3/4	100
80	3	8	U3/4	110
90	3.1/2	8	U3/4	110
100	4	8	U3/4	115
125	5	8	U3/4	120
150	6	12	U3/4	125
200	8	12	U7/8	140
250	10	16	U1	160
300	12	16	U1.1/8	170
350	14	20	U1.1/8	175
400	16	20	U1.1/4	190
450	18	24	U1.1/4	195
500	20	24	U1.1/4	205
600	24	24	U1.1/2	230

BOLT TABLE				
BOLT TABLE CODE : 92 FLANGE RATING : DIN16963-PIPE DIN8074 SRD9.0 BOLT/NUT TYPE :STUD BOLT WITH 2 HEAVY HEX. NUT				
FLANGE SIZE		NO. BOLTS PER SET	BOLT SIZE	BOLT LENGTH
(A)MM	(B)MM		METRIC UNIFIED	
20	15	4	U 1/2	
25	20	4	U 1/2	
32	25	4	U 1/2	
40	32	4	U 1/2	
50	40	4	U 1/2	
63	50	4	U 5/8	
75	65	4	U 5/8	
90	80	4	U 5/8	
110	100	8	U 5/8	
180	150	8	U 3/4	
200	200	8	U 3/4	
250	250	12	U 7/8	

APPENDIX 1

ABBREVIATION LIST

ABBREVIATION LIST

This list indicates the abbreviations used in piping design, specifications, drawings, material list, and etc.

ABBREV.	**DESCRIPTION**
	-------- (A) --------
A	MILLIMETER (FOR NOMINAL SIZE)
-A	ARC WELDING
ABBREV.	ABBREVIATION
ABS	ABSOLUTE
AC	ANTI CORROSION
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.
AISI	AMERICAN IRON AND STEEL INSTITUTE
AJS	ASBESTOS JOINT SHEET
ALLOW.	ALLOWANCE
(ALP)	MOLTEN ALUMINIUM PLATED
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
API	AMERICAN PETROLEUM INSTITUTE
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AVCL	ASPHALT VINYLON CLOTH LINING
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION

ABBREV.	DESCRIPTION
	-------- (B) --------
B	INCH (FOR NOMICAL SIZE)
-B	FURNACE BUTT WELDING
BB	BOLTED BONNET
BC	BOLTED COVER
BE	BEVELLED END
BG	BOLTED GLAND
B.F	BLIND FLANGE
	BOTTOM FLAT (FOR ECCENTRIC REDUCER)
B.L	BATTERY LIMIT
BL.	BLIND
B.O.P	BOTTOM OF PIPE
BR	BUTADIENE RUMMER
BW	BUTT WELD

ABBREV.	DESCRIPTION
	-------- (C) --------
CALC.	CALCULATION
CL	CLASS
CS	CARBON STEEL
CC	CONCENTRIC REDUCER
CON.	CONICAL
C.O.P	CENTER OF PIPE
CORRO.	CORROSION
CPLG	COUPLING
CR	CHLOROPRENE RUBBER
	-------- (D) --------
DBL	DOUBLE
D-PIPE	DOUBLE PIPE
DESIG.	DESIGNATION
DIA.	DIAMETER
DIAPH.	DIAPHRAGM
DIN	GERMAN INDUSTRIAL STANDARD (DEUTSCHE INDUSTRIE NORMEN)
DWG	DRAWING

ABBREV.	DESCRIPTION
	-------- (E) --------
E	QUALITY FACTOR (IN ANSI B31.3 PAR.302.3.1 (a))
-E	ELECTRIC RESISTANCE WELDING (IN JIS)
(EC)	EXTERNAL COATING
EC	ECCENTRIC REDUCER
-E-C	ELECTRIC RESISTANCE WELDED, COLD (IN JIS)
E.F.	EAST FLAT (FOR ECCENTRIC REDUCER)
EFW	ELECTRIC FUSION (ARC) WELDED (IN ASTM)
ERW	ELECTRIC RESISTANCE WELDED (IN ASTM)
-E-G	DITTO, GENERAL (IN JIS)
-E-H	ELECTRIC RESISTANCE WEDED, HOT FINISHRF (IN JIS)
EJMA	EXPANSION JOINT MANUFACTURERS ASSOCIATION, INC.
EL	ELEVATION
(EPDML)	ETHYLYENE PROPHLENE RUBBER LINING
EPR	ETHYLENE PROPYLENE RUBBER
EQ.	EQUIVALENT
EXT.	EXTENSION (TYPE)

ABBREV.	DESCRIPTION
	-------- (F) --------
F	FEMALE (FOR FLANGE FACE)
FA	FIELD ADJUSTMENT
FAB.	FABRICATION
FB	FULL BORE
FE	FLANGE END
FEP	POLY-FLUORINATED ETHYLENE-PROPYLENE
FF	FULL FACE (FLAT FACE)
FFW	FIELD FITTED WELDING
FIG.8	FIGURE EIGHT
FL.	FLOOR
FLG	FLANGE
FLGD	FLANGED
FLR	FLARE
FLRLS	FLARELESS
FM	FACTORY MUTUAL SYSTEM (U.S.A)
FPM	FLUORO-RUBBER (BYTONE)
FREQ	FREQUENCY
FRP	FIBER REINFORCED PLASTICS
F TO F	FACE TO FACE
FW	FIELD WELDING

ABBREV.	DESCRIPTION
	-------- (G) --------
G	GROOVE (FOR FLANGE FACE)
GL	GROUD LEVEL
(GLV)	GALVANIZED
(GLL)	GLASS LINED
GR.	GRADE
	-------- (H) --------
(HCR)	HARD CHROME PLATED
HEX.	HEXAGONAL (STANDARD)
HF	HARD FACE
H.HEX	HEAVY HEXAGONAL
HOR.	HORIZONTAL
HSTLY	HASTELLOY
HVY	HEAVY
HYDRO.	HYDROSTATIC

ABBREV.	**DESCRIPTION**
	-------- (I) --------
ID	INSIDE DIAMETER
IIR	BUTYL RUBBER
(IL)	INTERNAL LINING
INS.	INSULATION (TYPE)
IR	ISOPRENE RUBBER
I.R	INNER RING (FOR SPIRAL GASKET)
ISNS	INSIDE SCREW AND NON-RISING STEM
ISO	INTERNATIONAL ORGANI ZATION FORSTANDARDIZATION
ISRS	INSID SCREW AND RISING STEM
	-------- (J) --------
JIS	JAPANESE INDUSTRIAL STANDARDS
JPI	JAPAN PETROLEUM INSTITUTE
	-------- (K) --------
K	KG/CM^2 (GAUGE)

ABBREV.	DESCRIPTION
	-------- (L) --------
LB	POUND
LGTH	LENGTH
LIFT	LIFE TYPE
LJ	LAPPED JOINT
L.N	LONG NECK (FOR VALVE)
(LND)	LINED (LINING)
L.R.J	LENS RING JOINT (FOR FLANGE FACE)
L-ST	LONG STEM
LTJ	LENS RING TYPE JOINT
LW	LIGHT WEIGHT (FOR FLANGE CLASS)
LR	ELBOW LONG RADIUS
	-------- (M) --------
M	MALE (FOR FLANGE FACE)
(M)	METRIC THREAD (CONFORM TO ISO)
MAT'L	MATERIAL
MAX	MAXIMUM
M.BOLT	MACHINE BOLT
MDL	MODEL
MFS	MANUFACTURER'S STANDARD
MIN.	MINIMUM
MJ	MECHANICAL JOINT
M.L	MATCH LINE
MSL	MEAN SEA LEVEL
MSS	MANUFACTURERS STANDA
MTL	
M & F	

ABBREV.	DESCRIPTION
	-------- (N) --------
NB	NON-BONNET
NBR	ACRYRONITRILE AND BUTADIENE RUBBER
N.F	NORTH FLAT (FOR ECCENTRIC REDUCER)
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION.INC.
NO.	NUMBER
NOM.	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE TAPER (CONFORM TO ANSI B2-1)
NR	NATURAL RUBBER
(NRL)	NATURAL RUBBER LINED
	-------- (O) --------
OCT.	OCTAGONAL RING
OD	OUTSIDE DIAMETER
OPER.	OPERATION
O.R	OUTER RING (FOR SPIRAL GASKET)
OSNB	OUTSIDE SCREW NON-BONNET
OS&Y	OUTSIDE SCREW AND YOKE TYPE
OVAL	OVAL RING

ABBREV.	DESCRIPTION
	-------- (P) --------
PB	PRESSURE SEAL BONNET
PC	PRESSURE SEAL CAP
PE	PLAIN END (END CONNECTION)
PE	POLYETHYLENE (MATERIAL)
(PEL)	POLYETHYLENE LINED
P.F	PARALLEL PIPE THREADS
P#	NIPPON PILLAR GASKET NUMBER
P.N	PLANT NORTH
PNEUM.	PNEUMATIC
PP	POLYPROPHYLENE
(PPL)	POLYPROPHYLENE LINED
PRESS.	PRESSURE
PT	PIPE THREAD (CONFORM TO ISO)
(PVCL)	PVC LINED

ABBREV.	DESCRIPTION
	-------- (R) --------
R	RADIUS
(RBL)	RUBBER LIND
(RC)	REDUCER CONCENTRIC TYPE
(RE)	REDUCER ECCENTRIC TYPE
RED.	REDUCING
REF.	REFERENCE
REV.	REVISIO
RF	RAISED FACE
RFD.	REINFORCED
RTJ	RING TYPE JOINT

ABBREV.	DESCRIPTION
	-------- (S) --------
-S	SEAMLESS
SB	SCREWED BONNET
S.BOLT	STUD BOLT
SBR	STYRENE-BUTADIENE RUBBER
SC	SCREWED COVER
-S-C	SEAMLESS COLD FINISHED
SCH	SCHEDULE
SCRD	SCREWED
S.F.	SMALL FEMALE (FOR FLANGE FACE) SOUTH FLAT (FOR ECCENTRIC REDUCER)
S.G	SMALL GROOVE (FOR FLANGE FACE)
-S-H	SEAMLESS HOT FINISHED
SIR	STYRENE – ISOPRENE RUBBER
(STL)	STEELITE HARD FACINGBER (FOR VALVE SEAT)
S.M	SMALL MALE (FOR FLANGE)
SMLS	SEAMLESS
SR	ELBOW SHORT RADIUS

ABBREV.	DESCRIPTION
SO	SLIP-ON WELD
SOL	SOCKOLET
S.P	STEAM PRESSURE, SATURATED (FOR VALVE RATING)
SPEC.	SPECIFICATION
SPWD	SPIRAL WOUND
SSP	STRAIGHT SEAM PRODUCTS
S.T	SMALL TONGUE (FOR FLANGE FACE)
STD	STANDARD
SUP.	SUPPORT
SW	SOCKET WELD
SWNG	SWING TYPE

ABBREV.	DESCRIPTION
	-------- (T) --------
T	THICKNESS (IN MM)
T	TONGUE (FOR FLANGE FACE)
TBL	TABLE
TE	THREADED END
(TEC)	TAR EPOXY COATING FACE
TEMP.	TEMPERATURE
T.F	TOP FLAT (FOR ECCENT TRIC REDUCER)
TFE	TEFLON
(TFL)	TEFLON LINED
TFS	TAYLOR FORGE STANDARD
THICK.	THICKNESS
TOL	THREDOLET
T.O.P	TOP OF PIPE
(TR)	TEE REDUCED TYPE
TS	TAPER SLEEVE
(TS)	TEE STRAIGHT TYPE
T&G	LARGE TONGUE AND GROOVE FACE
T#	TOMBO PRODUCTS NUMBER (JAPAN)
	-------- (U) --------
(U)	UNIFED THREAD (CONFORM TO ANSI B1.1)
UB	UNION BONNET
UC	UNION COVER
UL	UNDERWRITERS LABORATORIES, INC. (U.S.A)
UNC	UNION CONNETION (FOR FITTING & VALVE)

ABBREV.	**DESCRIPTION**
	-------- (V) --------
VERT.	VERTICAL
V#	VALQUA PRODUCTS NUMBER (JAPAN)
	-------- (W) --------
W	WELDED
(W)	WHIT WORTH THREAD
-W	WELDED PRODUCT
WCR	WHITE CHLOROPOPRENE RUBBER
WELD	WELDED
W.F	WEST FLAT (FOR ECCENTRIC REDUCER)
WN	WELDING NECK
W.O.G	WATER, OIL, GAS, NON-SHOCK (FOR VALVE RATING)
WOL	WELDOLET
W.P	WORKING POINT
WT	WEIGHT
#	PRESSURE RATING (POUNDS PER SQ. INCH)

APPENDIX 2

MATERIAL DESIGNATION

This list covers the typical materials which are applied to the “Piping Specification” and The “Valve Specification “ for TOOBA DRI PLANT .

MATERIAL DESIGNATION

1. ASTM

STANDARD NO.	DESIGNATION
A36	Structural Steel
A53	Pipe, Steel, Black and Hot-Dipped, Coated Welded and Seamless
A105	Forgings, Carbon Steel, for Piping Components
A126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A134	Pipe, Steel, Electric-Fusion (ARC) – Welded (Sizes NPS 16 IN. and Over)
A139	Electric – Fusion (Arc) Welded Steel Pipe (Sizes NPS 4 IN. and over)
A167	Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip
A182	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A193	Alloy–Steel and Stainless Steel Bolting Materials for High-Temperature Service
A194	Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service
A197	Cupola Malleable Iron
A204	Pressure Vessel Plates, Alloy Steel Molybdenum
A216	Specification for Steel Castings, Carbon Suitable for Fusion Welding for High Temperature Service.
A217	Martensitic Stainless Steel and Alloy Steel Castings for Pressure-Containing Parts Suitable for High-Temperature Service
A234	Piping Fittings of Wrought Carbon Steel and Alloy for Moderate and Elevated Temperatures

STANDARD NO.	DESIGNATION
A240	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
A276	Stainless and Heat-Resisting Steel Bars and Shapes
A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
A285	Pressure Vessel Plates, Carbon Steel Low and Intermediate Tensile Strength
A312	Seamless and Welded Austenitic Stainless Steel Pipe
A313	Chromium-Nickel Stainless and Heat-Resisting Steel Billets
A335	Seamless Ferretic Alloy Steel Pipe for High-Temperature Service
A351	Specification for Steel Castings, Austenitic, for High-Temperature Service
A387	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A403	Wrought Austenitic Stainless Steel Piping Fittings
A515	Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher-Temperature Service
A564	Specification for Hot-Rolled and Cold Finished Age-Hardening Stainless and Heat Resisting Steel Bars, Wire, and Shapes
A691	Carbon and Alloy Steel Pipe, Electric-Fusion welded for High Pressure Service at High Temperatures
B21	Specification for Naval Brass Rod, Bar, and Shapes
B61	Specification for Steam or Valve Bronze Castings
B62	Specification for Composition Bronze or Ounce Metal Castings
B124	Specification for Copper and Copper-Alloy Forging rod, Bar, and Shapes.
B283	Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)

2. API

SPEC. NO.	DESIGNATION
API 5L	Line Pipe
API 5LX	High-Test Line Pipe

3. AISI

MATERIAL NO.	DESIGNATION	AISI ST'D NO.
201 TO 202	Stainless and Heat	13
301 TO 384	Resisting Steels	
403 TO 502		

4. JIS or Other Japanese Material

MATERIAL SYMBOL	DESIGNATION	AISI ST'D NO.
SS-	Rolled Steel for General Structure	G3101
SM-	Rolled Steel for Welded Structure	G3106
SB-	Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and other Pressure Vessels	G3103
SGP	Carbon Steel Pipes for Ordinary Piping	G3452
STPG-	Carbon Steel Pipes for Pressure Service	G3454
STPT-	Carbon Steel Pipes for High Temperature Service	G3456
STPY-	Arc Welded Carbon Steel Pipes	G3457
STPA-	Alloy Steel Pipes	G3458
SUS-TP	Stainless Steel Pipes	G3459
S-C	Carbon Steels for Machine Structural Use	G4051
SUS-	Stainless Steel Bars, Sheets and Plates Strips, Wires	G4303 to G4318

MATERIAL SYMBOL	DESIGNATION	AISI ST'D NO.
13 CR	13% Chromium Stainless Steel (General Name for Combination of Valve Seat Materials)	--------
CS CAST	Carbon Steel Castings (General Name)	--------
SC-	Carbon Steel Castings	G5102
SCPH-	Steel Castings for High Temperature and High Pressure Service	G5151
SCS-	Stainless Steel Castings	G5121
FC-	Gray Iron Casting	G5501
FCD-	Spheroidal Graphite Iron Castings	G5502
FCD-S	Ductile Iron Casting (For Valve Body Material)	--------
FCMB-	Blackheart Malleable Iron Castings	G5702
FCMB-S35	Malleable Iron Casting (For Valve Body Material)	--------
BC-	Bronze Casting	H5111
ADC	Aluminum Alloy Die Castings	H5302