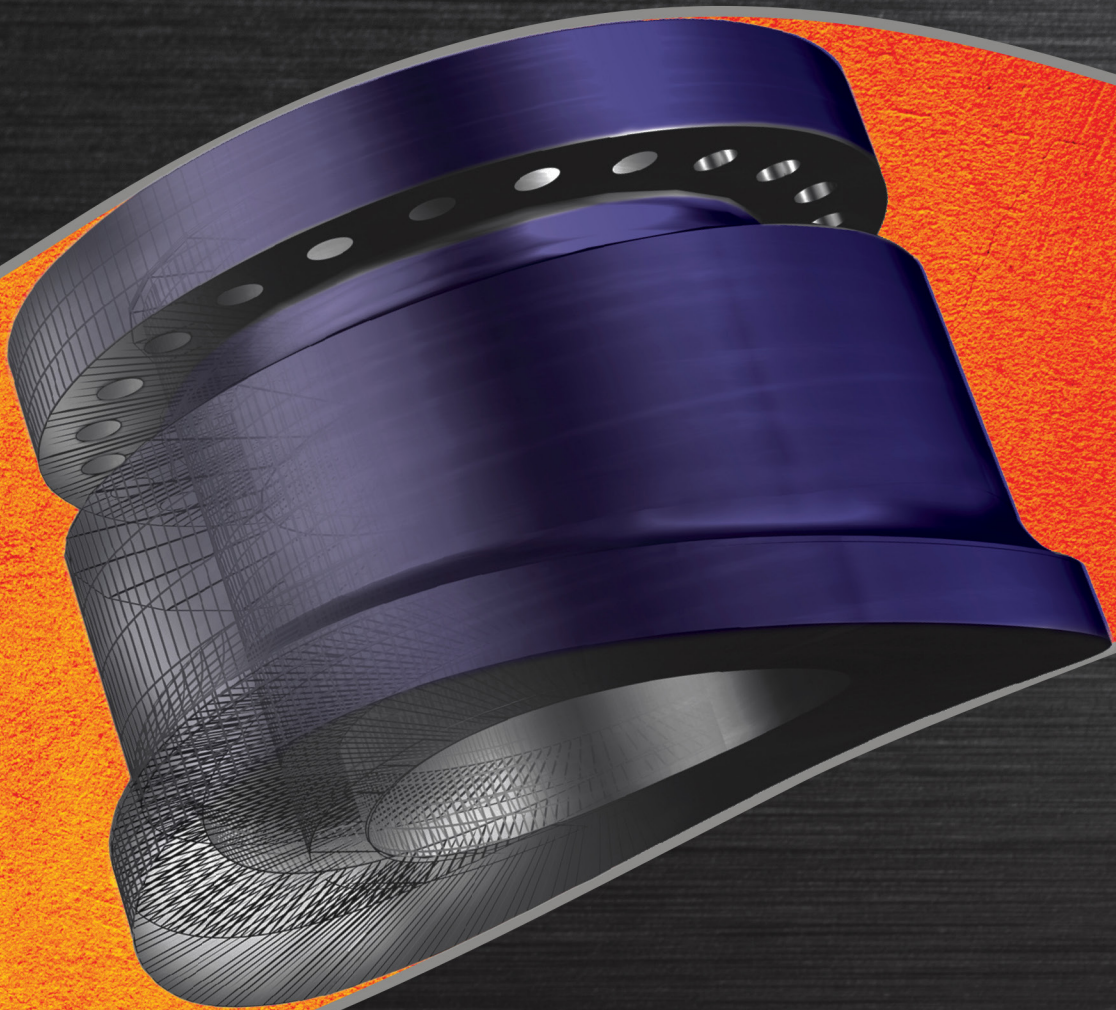




FORGED CONNECTIONS

FOR ASME AND API PRESSURE-CONTAINING COMPONENTS



LWN



HB



***I-1**



***I-2**



***I-3**



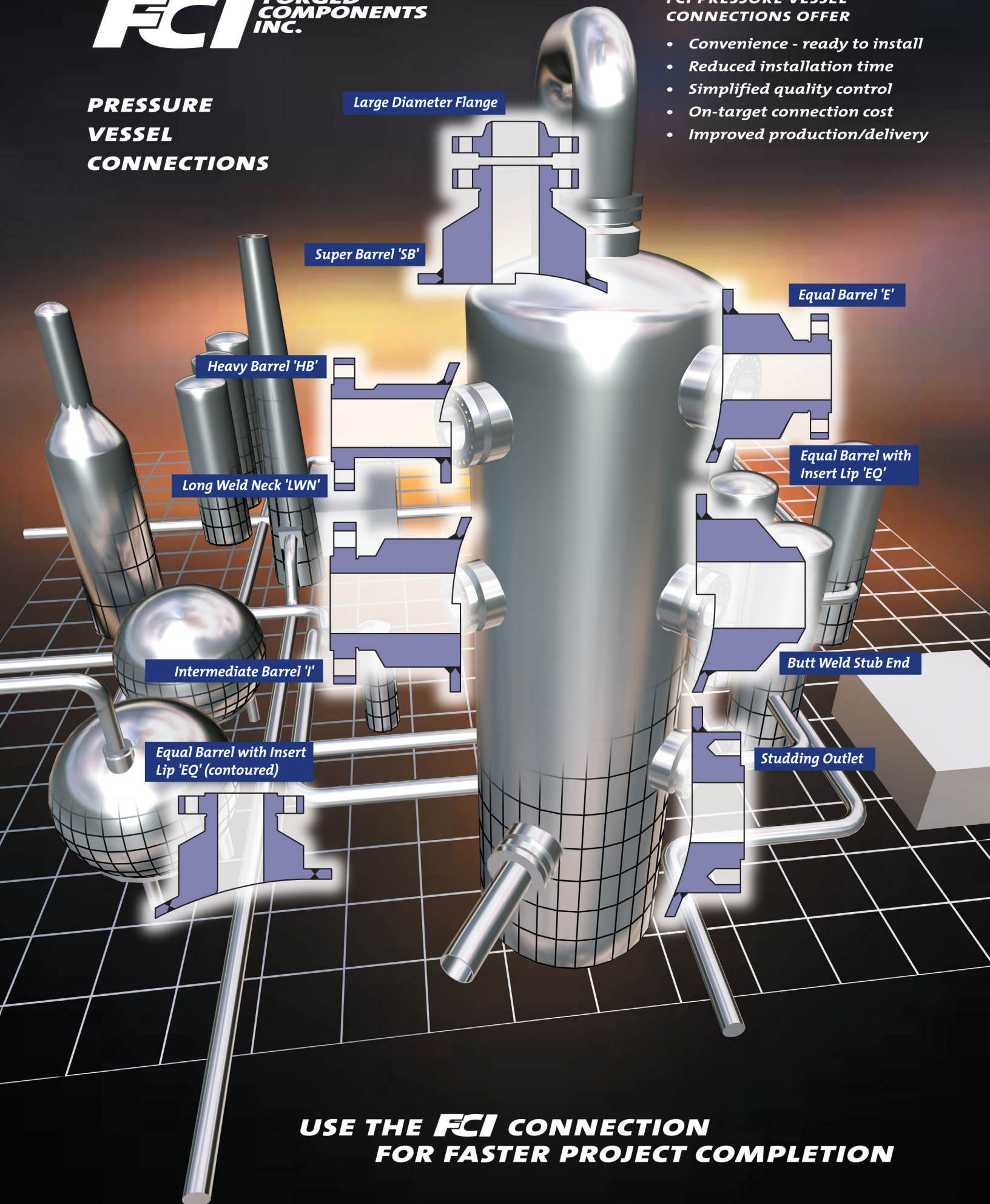
***E**

*Denotes I-1, I-2, I-3, & E are trademarks of FCI

**PRESSURE
VESSEL
CONNECTIONS**

**FCI PRESSURE VESSEL
CONNECTIONS OFFER**

- Convenience - ready to install
- Reduced installation time
- Simplified quality control
- On-target connection cost
- Improved production/delivery



**USE THE *FCI* CONNECTION
FOR FASTER PROJECT COMPLETION**

FORGED CONNECTIONS FOR PRESSURE VESSELS

LONG WELD NECK CONNECTIONS_____ LWN

HEAVY BARREL CONNECTIONS_____ HB

INTERMEDIATE BARREL CONNECTIONS_____ I₁, I₂ & I₃

EQUAL BARREL CONNECTIONS_____ E

SUPER BARREL CONNECTIONS_____ SB

INSERT LIP CONNECTIONS_____ Q

BUTT WELD STUB END CONNECTIONS

STUDDING OUTLETS

LARGE DIAMETER FLANGES ASME B16.47 SERIES A & B

CUSTOM PRODUCTS

ROUGH FORGINGS



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Edmonton, Alberta Canada
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7-1-2015



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14527 Smith Road, Humble, Texas 15 Acre Complex
Manufacturing & Corporate Office
1700 Ton Forge Press



9292 Industrial Dr, Navasota, Texas 7 Acre Complex
2500 Ton Forge Press & Ring Roll – Heavy Forging Facility



4323 E. Mt. Houston, Houston, Texas 3 Acre Complex
CNC Machining Facility

Forged Components, Inc. (FCI) is a global leader in the forging, machining and manufacture of integral self-reinforced connections for ASME pressure vessels – LWN, HB, I₁, I₂, I₃ E, Q-Lip nozzles, butt weld stub end connections, studding outlets, and ASME B.16 Series A & B large diameter flanges and blinds.

FCI operates from 95,000 sq. ft. of manufacturing facilities at five (5) locations in Houston, Humble, Porter and Navasota, Texas. The forging and manufacturing facilities are equipped with 350 ton, 1700 ton and 2500 ton open-die hydraulic forge presses, 300 ton ring roll, heat treatment furnaces, and a wide range of machine tools including manual and CNC lathes, VTL's, milling machines and drills. Our corporate office, main manufacturing and storage facility in Humble, Texas is located on 15 acres adjacent to a rail spur, near major freeways and within 5 miles of the Bush International Airport.

In addition to pressure vessel connections, FCI produces forgings for the energy, petrochemical, refinery, power generation and the oil & gas exploration and production industries. Our extensive range of API-6A wellhead products include casing heads, tubing heads, casing hangers, tubing head adapters, casing and tubing spools, flanges, tees, crosses, and other wellhead components. Custom forged products include; extended barrel connections, large rolled ring forgings, cylinders, discs to 95" OD, mandrel rings, bar products, valve bonnets, high pressure valve bodies, elbows, tees, square and rectangular blocks. FCI is capable of producing open-die and semi-closed die forged shapes that weigh from 5 to 35,000 lbs.

In addition to an extensive finished product inventory FCI maintains a large inventory of bar, billet and ingot material in carbon, alloy and stainless steel in ASME, API and ANSI material grades to service our customer's special orders without delay. We also forge product in nickel, titanium and other specialty alloys on request.

FCI's Quality Manual utilizes ASME, API and the ISO 9000 Program Guidelines in its quality system to continually monitor the manufacturing processes. FCI standard connections are manufactured in compliance with ASME Section II and Section VIII, Div. 1 and ASME B16.5. Products may be ordered to special/custom requirements or other codes such as ASME Section I and Section VIII, Div. 2 and Div. 3, ASME B16.47 Series A & B, ASTM, API 6A, API 16A, API 934, other.

Forged Components, Inc. throughout the last decade has invested and re-invested in forging and machining equipment to expand its production capacity to stay a step ahead of our customer's needs. FCI will continue to meet the needs of the industry by manufacturing and providing quality products and services.

INTERMEDIATE BARREL “I” CONNECTIONS

FCI Intermediate Barrel “I” connections, I_1 , I_2 and I_3 , provide three (3) standard intermediate barrel connections having progressively larger outside diameter barrels to provide added reinforcement greater than that of the “HB” connections and less than the Equal Barrel “E” connection. Within the flange hub area, the outside diameter of the barrel provides an automatic nut stop, but the remaining portion of the barrel is larger in outside diameter providing additional reinforcement. Intermediate Barrel “I” connections 12” and smaller have Sch. 80 bores as standard; in sizes 14” and greater, bores are equal to nominal pipe sizes. Barrel nut relief, special bores and contoured bottoms are available upon request.

EQUAL BARREL “E” CONNECTIONS

The FCI Equal Barrel “E” connection provides the most reinforcement of all standard connections produced by FCI. The barrel outside diameter equals the outside diameter of the bolting flange. Within the flange hub area, the outside diameter of the barrel provides an automatic nut stop. A nut relief in the barrel, special bores and contoured bottoms are available upon request.

SUPER BARREL “SB” CONNECTIONS

The FCI Super Barrel “SB” connection is identical to the Equal Barrel “E” connection with the exception of the barrel outside diameter exceeding that of the bolting flange to provide additional reinforcement when required for an integrally reinforced connection. A nut relief in the barrel, special bores and contoured bottoms are available upon request. Purchaser to advise barrel outside diameter for required reinforcement.

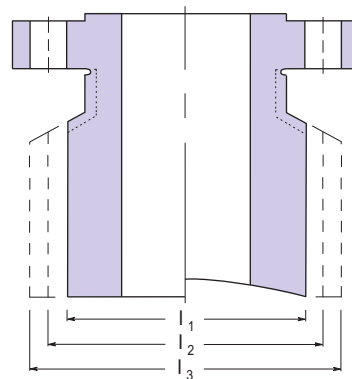
INSERT LIPS

Insert Lips are available on all connections. The letter “Q” appended to the above connection designations indicates an insert lip. For example, I_3Q designates an Intermediate Barrel type 3 connection with an insert lip. Purchaser to advise insert lip details.

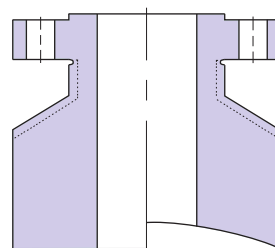
Insert lips offer:

- ease and economy of installation,
- easier and less expensive weld inspections,
- superior toughness and ductility in high stress areas.

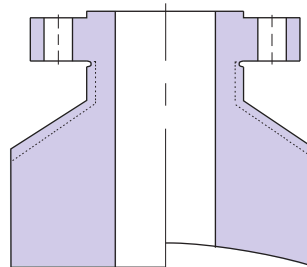
INTERMEDIATE BARREL “I” CONNECTIONS



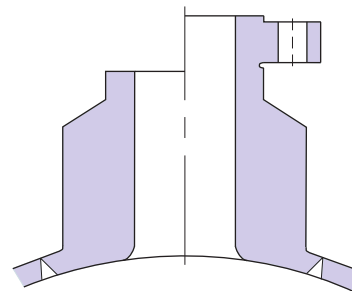
EQUAL BARREL “E” CONNECTIONS



SUPER BARREL “SB” CONNECTIONS



INSERT LIPS



BUTT WELD STUB END CONNECTIONS

The Butt Weld Stub End connection outside diameter can be identical to any of the above mentioned connections. Ends may be plain and square or:

- one end faced and tapped,
- one end tapered and with weld groove preparation to ASME B16.25, contoured as specified by Purchaser,
- one end prepared for a pipe butt weld connection, other end (reinforced barrel end) either flat or contoured to fit any shell or head mount,
- both ends prepared for butt welding – used as a seamless shell section.

Purchaser to advise all dimensional sizing.

Seamless forged rings and cylinders can be manufactured for custom high pressure components as per Purchaser's design.

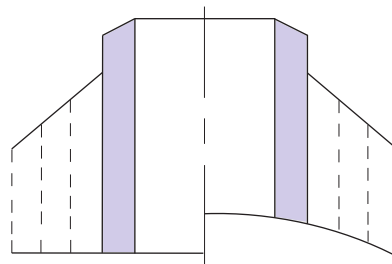
STUDDING OUTLETS

Studding Outlets provide a unique compact design with inherent reinforcement offering distinct advantages to designers and fabricators. The low profile of this connection provides for the lowest projection of a bolted connection where clearance may be a factor in connection selection. The outside diameter and/or body thickness may be increased where additional reinforcement is required. In addition, the Studding Outlet can be supplied with an optional contoured bottom and/or insert lip for simplified installation and reduction in cost of positional welding. Other common Studding Outlet options are air test holes, top or side connecting, special gasket surface faces, and custom machining of the mating surface to accommodate sight glass assemblies. The Studding Outlet is the most economical of bolted connections.

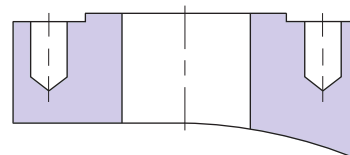
LARGE DIAMETER FLANGES

Large diameter flanges and blind flanges are produced in accordance with ASME B16.47 Series A and Series B for sizes NPS 26" to NPS 60" in pressure/temperature rating classes 75 through 900. Dimensional standards generally conform to both MSS SP44 (B16.47 Series A) and API 605 (B16.47 Series B). FCI can furnish flanges and blinds that meet other dimensional specifications upon request, when the Purchaser accepts responsibility for verifying that the flange geometry is suitable for the design conditions.

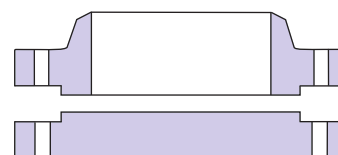
BUTT WELD STUB END CONNECTIONS

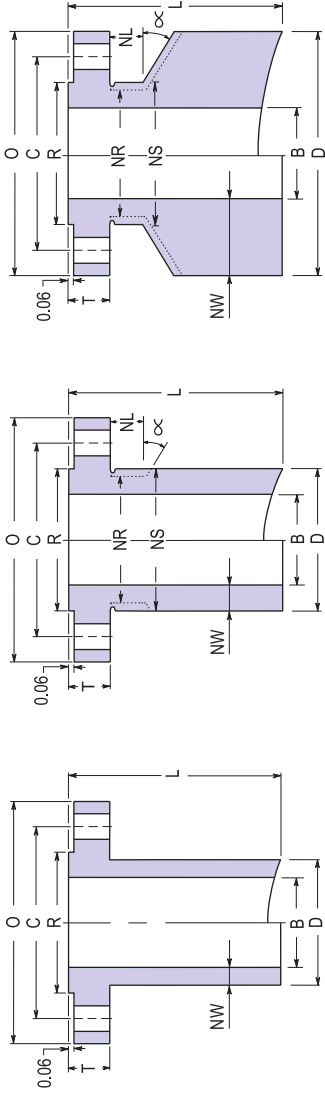


STUDDING OUTLETS



LARGE DIAMETER FLANGES





CROSS REFERENCE CHART				
Connection Description		FCI		Other Designations
Long Weld Neck		LWN	LWN	LWN
Heavy Barrel		HB	HB	HB
Intermediate Barrel	- light	I ₁	*	V ₁
	- medium	I ₂	*	V ₂
	- heavy	I ₃	*	V ₃
Equal Barrel		E	S	F
Super Barrel		SB*	Super S*	*
Insert Lip		Q*	M*	Q*

*Denotes Custom Order

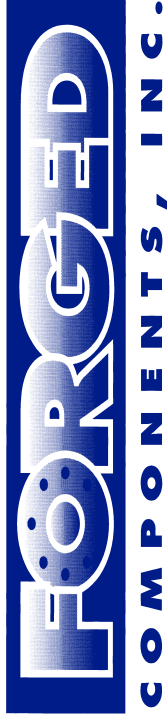
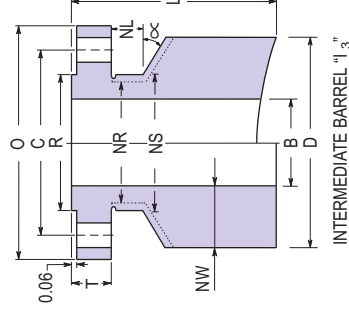
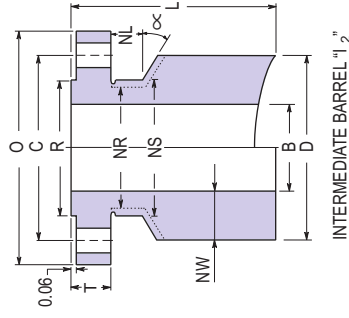
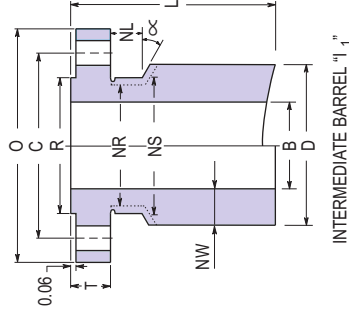
Size				Flange			Barrel OD			Wall Thickness				Bolting			Nut			Stud Bolt			Weights				Length			
Nom	Bore LWN & HB	Bore		OD	Thk	RF OD	LWN	HB	E	D	D	D	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB		E		
		B	B																							Base		Per 1"	Base	Per 1"
1/2	0.50	0.55	3.50	0.44	1.38	1.25	1.50	3.50	0.38	0.48	1.50	1.25	0.75	1/2	2 1/4	2 3/4	3	0.3	5	0.4	21	2.7	9							
3/4	0.75	0.74	3.88	0.50	1.69	1.62	1.88	3.88	0.44	0.57	1.57	1.88	1.62	0.75	1/2	2 1/2	3	5	0.5	7	0.7	27	3.2	9						
1	1.00	0.96	4.25	0.56	2.00	2.00	2.25	4.25	0.50	0.65	1.63	2.25	2.00	0.75	1/2	2 1/2	3	7	0.7	10	0.9	30	3.8	9						
1 1/4	1.25	1.28	4.62	0.62	2.50	2.38	2.62	4.62	0.57	0.67	1.69	2.62	2.38	0.75	1/2	2 3/4	3 1/4	10	0.9	12	1.2	36	4.4	9						
1 1/2	1.50	1.50	5.00	0.69	2.88	2.62	3.00	5.00	0.56	0.75	1.75	3.00	2.62	0.75	1/2	2 3/4	3 1/4	12	1.0	16	1.5	41	5.1	9						
2	2.00	1.94	6.00	0.75	3.62	3.06	3.69	6.00	0.53	0.88	2.00	4	3.75	0.88	5/8	3 1/4	3 3/4	15	1.2	23	2.2	57	7.1	9						
2 1/2	2.50	2.32	7.00	0.88	4.12	3.75	4.44	7.00	0.63	1.06	2.25	4	4.44	0.88	5/8	3 1/2	4	22	1.7	34	3.2	79	10	9						
3	3.00	2.90	7.50	0.94	5.00	4.25	4.94	7.50	0.63	1.02	2.25	4	4.94	0.88	5/8	3 1/2	4 1/4	25	2.0	38	3.6	86	11	9						
3 1/2	3.50	3.36	8.50	0.94	5.50	4.88	5.94	8.50	0.69	1.29	2.50	8	5.94	0.88	5/8	3 1/2	4 1/4	32	2.6	55	5.3	110	13	9						
4	4.00	3.83	9.00	0.94	6.19	5.50	6.44	9.00	0.75	1.31	2.50	8	6.44	0.88	5/8	3 1/2	4 1/4	47	3.2	78	6.0	164	14	12						
5	5.00	4.81	10.00	0.94	7.31	6.50	7.25	10.00	0.75	1.22	2.50	8	7.25	6.50	1.00	3/4	3 3/4	57	3.8	87	6.5	189	17	12						
6	6.00	5.76	11.00	1.00	8.50	7.75	8.25	11.00	0.88	1.25	2.50	8	8.25	7.75	1.00	3/4	4	75	5.4	103	7.8	216	19	12						
8	8.00	7.62	13.50	1.12	10.62	9.75	10.50	13.50	0.88	1.44	2.75	8	10.50	9.75	1.00	3/4	4 1/4	102	6.9	157	11	292	26	12						
10	10.00	9.56	16.00	1.19	12.75	12.00	12.81	16.00	1.00	1.63	3.00	12	12.81	12.00	1.12	7/8	4 3/4	143	9.8	214	16	382	35	12						
12	12.00	11.38	19.00	1.25	15.00	14.38	15.56	19.00	1.19	2.09	3.50	12	15.56	14.38	1.12	7/8	4 3/4	205	14	329	25	535	48	12						
14	14.00	14.00	21.00	1.38	16.25	16.00	17.12	21.00	1.00	1.56	3.50	12	17.12	16.00	1.25	1	5 1/4	211	13	296	22	585	55	12						
16	16.00	16.00	23.50	1.44	18.50	18.00	19.62	23.50	1.00	1.81	3.75	16	19.62	18.00	1.25	1	5 1/2	246	15	388	29	714	66	12						
18	18.00	18.00	25.00	1.56	21.00	20.00	20.94	25.00	1.00	1.47	3.50	16	20.94	20.00	1.38	1 1/8	6	270	17	362	25	711	67	12						
20	20.00	20.00	27.50	1.69	23.00	22.00	23.19	27.50	1.00	1.60	3.75	20	23.19	22.00	1.38	1 1/8	6 1/4	311	19	434	31	840	79	12						
24	24.00	24.00	32.00	1.88	27.25	26.25	27.50	32.00	1.13	1.75	4.00	20	27.50	26.25	1.50	1 1/4	7	423	25	574	40	1046	100	12						

NOTE

- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

class 150

FCI INTERMEDIATE CONNECTIONS



Size		Flange			Barrel OD			Wall Thickness			Bolting		Nut			Stud Bolt			Weights						Length	
Nom	Bore	OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	I ₁		I ₂		I ₃		Base
	B	O	T	R	D	D	D	NW	NW	NW			C	NS	NR	NL				Base	Per 1"	Base	Per 1"	Base	Per 1"	L
1	0.96	4.25	0.56	2.00	2.75	3.25	4.00	0.90	1.15	1.52	4	0.62	3.12	2.25	2.00	0.75	1/2	2 1/2	3	19	1.5	26	2.2	38	3.4	12
1 1/2	1.50	5.00	0.69	2.88	3.25	4.00	4.62	0.88	1.25	1.56	4	0.62	3.88	3.00	2.62	0.75	1/2	2 3/4	3 1/4	25	1.9	37	3.1	49	4.3	12
2	1.94	6.00	0.75	3.62	4.00	4.62	5.50	1.03	1.34	1.78	4	0.75	4.75	3.69	3.06	0.88	5/8	3 1/4	3 3/4	35	2.7	48	3.9	67	5.9	12
2 1/2	2.32	7.00	0.88	4.12	4.62	5.75	6.00	1.15	1.72	1.84	4	0.75	5.50	4.44	3.75	0.88	5/8	3 1/2	4	48	3.5	73	6	81	7	12
3	2.90	7.50	0.94	5.00	5.75	6.00	6.38	1.43	1.55	1.74	4	0.75	6.00	4.94	4.25	0.88	5/8	3 1/2	4 1/4	69	5.5	75	6	85	7	12
3 1/2	3.36	8.50	0.94	5.50	6.38	7.00	7.75	1.51	1.82	2.20	8	0.75	7.00	5.94	4.88	0.88	5/8	3 1/2	4 1/4	83	7	102	8	126	11	12
4	3.83	9.00	0.94	6.19	7.00	7.75	8.25	1.59	1.96	2.21	8	0.75	7.50	6.44	5.50	0.88	5/8	3 1/2	4 1/4	95	8	119	10	137	12	12
5	4.81	10.00	0.94	7.31	7.75	8.25	8.88	1.47	1.72	2.04	8	0.88	8.50	7.25	6.50	1.00	3/4	3 3/4	4 1/2	104	8	121	10	144	12	12
6	5.76	11.00	1.00	8.50	8.88	9.88	10.38	1.56	2.06	2.31	8	0.88	9.50	8.25	7.75	1.00	3/4	4	4 1/2	126	10	167	14	188	17	12
8	7.62	13.50	1.12	10.62	11.00	11.50	12.12	1.69	1.94	2.25	8	0.88	11.75	10.50	9.75	1.00	3/4	4 1/4	4 3/4	180	14	205	17	236	20	12
10	9.56	16.00	1.19	12.75	13.50	14.25	15.12	1.97	2.35	2.78	12	1.00	14.25	12.81	12.00	1.12	7/8	4 3/4	5 1/4	337	20	399	25	474	31	16
12	11.38	19.00	1.25	15.00	16.25	17.38	18.25	2.44	3.00	3.44	12	1.00	17.00	15.56	14.38	1.12	7/8	4 3/4	5 1/2	494	30	606	38	696	45	16
14	14.00	21.00	1.38	16.25	18.25	19.38	20.12	2.13	2.69	3.06	12	1.12	18.75	17.12	16.00	1.25	1	5 1/4	6	501	31	622	40	705	47	16
16	16.00	23.50	1.44	18.50	20.12	21.00	22.25	2.06	2.50	3.13	16	1.12	21.25	19.62	18.00	1.25	1	5 1/2	6	562	33	666	41	820	53	16
18	18.00	25.00	1.56	21.00	22.25	23.25	24.12	2.13	2.63	3.06	16	1.25	22.75	20.94	20.00	1.38	1 1/8	6	6 1/2	624	38	751	48	864	57	16
20	20.00	27.50	1.69	23.00	24.12	25.00	26.25	2.06	2.50	3.13	20	1.25	25.00	23.19	22.00	1.38	1 1/8	6 1/4	7	684	41	804	50	978	64	16
24	24.00	32.00	1.88	27.25	27.75	29.25	30.75	1.88	2.63	3.38	20	1.38	29.50	27.50	26.25	1.50	1 1/4	7	7 3/4	772	43	1007	62	1246	82	16

NOTE

- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.

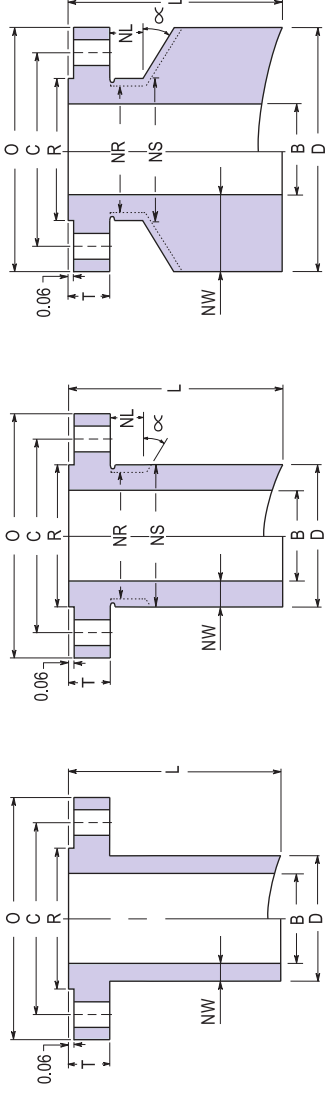
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.



class 300 FCI STANDARD CONNECTIONS

FORGED

COMPONENTS, INC.



CROSS REFERENCE CHART

Connection Description	FCI	Other Designations
Long Weld Neck	LWN	LWN
Heavy Barrel	HB	H
Intermediate Barrel	- light - medium - heavy	I ₁ * I ₂ * I ₃ *
Equal Barrel	E	S
Super Barrel	SB*	Super S*
Insert Lip	Q*	M* Q*

*Denotes Custom Order

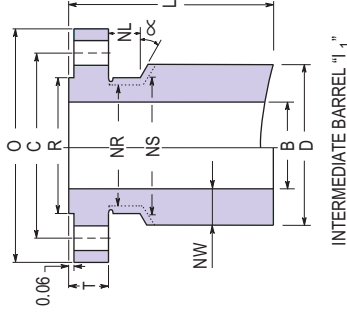
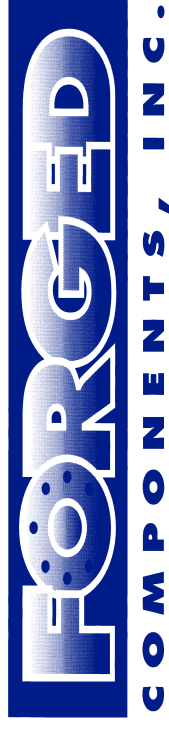
Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights				Length			
Nom	Bore LWN & HB		OD	Thk	RF OD	LWN		HB	E	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB		E		Base	
	B	B				D	D																D	D	D	D		Base
1/2	0.50	0.55	3.75	0.56	1.38	1.5	1.75	3.75	D	D	D	D	4	0.62	2.62	1.75	1.50	0.75	1/2	2 1/2	3	5	0.4	7	0.6	24	3.1	9
3/4	0.75	0.74	4.62	0.62	1.69	1.88	2.19	4.62	1.94	0.57	0.73	1.94	4	0.75	3.25	2.19	1.88	0.88	5/8	3	3 1/2	9	0.7	11	0.9	37	4.6	9
1	1.00	0.96	4.88	0.69	2.00	2.12	2.44	4.88	2.00	0.56	0.74	1.94	4	0.75	3.50	2.44	2.12	0.88	5/8	3 1/4	3 1/2	9	0.8	12	1.1	40	5.1	9
	1 1/4	1.25	1.28	5.25	0.75	2.50	2.81	5.25	2.00	0.63	0.77	2.00	4	0.75	3.88	2.81	2.50	0.88	5/8	3 1/4	3 3/4	13	1.0	15	1.4	45	5.8	9
1 1/2	1.50	1.50	6.12	0.81	2.88	2.75	3.25	6.12	2.31	0.63	0.88	2.31	4	0.88	4.50	3.25	2.75	1.00	3/4	3 1/2	4	15	1.2	21	1.9	61	7.8	9
2	2.00	1.94	6.50	0.88	3.62	3.31	3.94	6.50	2.25	0.66	1.00	2.25	8	0.75	5.00	3.94	3.31	0.88	5/8	3 1/2	4 1/4	20	1.5	28	2.6	68	8.5	9
2 1/2	2.50	2.32	7.50	1.00	4.12	3.94	4.62	7.50	2.50	0.88	1.15	2.50	8	0.88	5.88	4.62	3.94	1.00	3/4	4	4 1/2	25	2.1	38	3.6	89	11	9
	3	3.00	2.90	8.25	1.12	5.00	4.62	5.38	2.63	0.81	1.24	2.63	8	0.88	6.62	5.38	4.62	1.00	3/4	4 1/4	5	35	2.7	49	4.6	106	13	9
3 1/2	3.50	3.36	9.00	1.19	5.50	5.25	6.00	9.00	2.75	0.88	1.32	2.75	8	0.88	7.25	6.00	5.25	1.00	3/4	4 1/4	5	42	3.4	59	5.5	122	15	9
4	4.00	3.83	10.00	1.25	6.19	5.75	6.62	10.00	3.00	0.88	1.40	3.00	8	0.88	7.88	6.62	5.75	1.00	3/4	4 1/2	5 1/4	62	3.8	91	6.5	207	19	12
5	5.00	4.81	11.00	1.38	7.31	7.00	8.00	11.00	3.00	0.88	1.60	3.00	8	0.88	9.25	8.00	7.00	1.00	3/4	4 3/4	5 1/4	84	5.3	124	9.1	241	21	12
6	6.00	5.76	12.50	1.44	8.50	8.12	9.38	12.50	3.25	1.06	1.81	3.25	12	0.88	10.62	9.38	8.12	1.00	3/4	4 3/4	5 3/4	105	6.7	165	12.0	303	27	12
8	8.00	7.62	15.00	1.62	10.62	10.25	11.56	15.00	3.50	1.13	1.97	3.50	12	1.00	13.00	11.56	10.25	1.12	7/8	5 1/2	6 1/4	148	9.1	228	17	405	36	12
10	10.00	9.56	17.50	1.88	12.75	12.62	13.62	17.50	3.75	1.31	2.03	3.75	16	1.12	15.25	13.62	12.62	1.25	1	6 1/4	7 1/4	210	13.0	291	21	499	46	12
12	12.00	11.38	20.50	2.00	15.00	14.75	15.94	20.50	4.25	1.38	2.28	4.25	16	1.25	17.75	15.94	14.75	1.38	1 1/8	6 3/4	7 1/2	275	16	392	28	651	61	12
14	14.00	14.00	23.00	2.12	16.25	16.75	18.44	23.00	4.50	1.38	2.22	4.50	20	1.25	20.25	18.44	16.75	1.38	1 1/8	7	7 3/4	324	19	456	32	785	74	12
16	16.00	16.00	25.50	2.25	18.50	19.00	20.50	25.50	4.75	1.50	2.25	4.75	20	1.38	22.50	20.50	19.00	1.50	1 1/4	7 1/2	8 1/2	404	23	529	37	914	88	12
18	18.00	18.00	28.00	2.38	21.00	21.00	22.75	28.00	5.00	1.50	2.38	5.00	24	1.38	24.75	22.75	21.00	1.50	1 1/4	7 3/4	8 1/4	465	26	630	43	1066	102	12
20	20.00	20.00	30.50	2.50	23.00	23.12	25.00	30.50	5.25	1.56	2.50	5.25	24	1.38	27.00	25.00	23.12	1.50	1 1/4	8 1/4	9 1/4	549	30	741	50	1228	118	12
24	24.00	24.00	36.00	2.75	27.25	27.62	29.62	36.00	6.00	1.81	2.81	6.00	24	1.62	32.00	29.62	27.62	1.75	1 1/2	9 1/4	10 1/4	778	42	1016	67	1627	160	12

NOTE

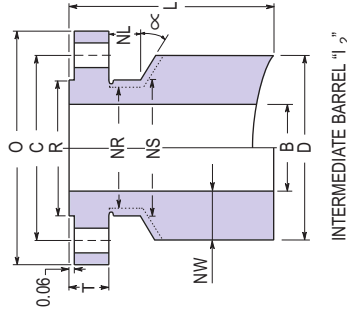
- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

class 300

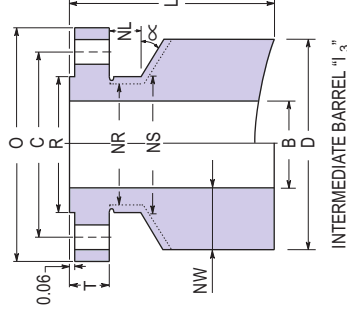
FCI INTERMEDIATE CONNECTIONS



INTERMEDIATE BARREL "1" 1"



INTERMEDIATE BARREL "1" 2"



INTERMEDIATE BARREL "1" 3"



Custom barrel connections and other forged products available upon request

Size		Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights					Length				
Nom	Bore	OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	Base	Per 1"	I ₁	I ₂	Base	Per 1"	I ₃	Base	Per 1"	
	B	O	T	R	D	D	D	NW	NW	NW			C	NS	NR	NL													L
1	0.96	4.88	0.69	2.00	2.75	3.75	4.00	0.90	1.40	1.62	4	0.75	3.50	2.44	2.12	0.88	5/8	3 1/4	3 1/2	20	1.5	34	2.9	39	3.4	12			
1 1/2	1.50	6.12	0.81	2.88	4.00	4.62	5.00	1.25	1.56	2.00	4	0.88	4.50	3.25	2.75	1.00	3/4	3 1/2	4	39	3.1	51	4.3	70	6.2	12			
2	1.94	6.50	0.88	3.62	4.62	5.50	6.00	1.34	1.78	2.03	8	0.75	5.00	3.94	3.31	0.88	5/8	3 1/2	4 1/4	49	3.9	69	5.9	81	7.2	12			
2 1/2	2.32	7.50	1.00	4.12	5.75	6.00	6.38	1.72	1.84	2.03	8	0.88	5.88	4.62	3.94	1.00	3/4	4	4 1/2	72	6.2	80	6.8	90	7.8	12			
3	2.90	8.25	1.12	5.00	6.00	6.38	7.00	1.55	1.74	2.05	8	0.88	6.62	5.38	4.62	1.00	3/4	4 1/4	5	78	6.1	88	7.2	106	9	12			
3 1/2	3.36	9.00	1.19	5.50	7.00	7.75	8.25	1.82	2.20	2.45	8	0.88	7.25	6.00	5.25	1.00	3/4	4 1/4	5	104	8.4	127	11	144	13	12			
4	3.83	10.00	1.25	6.19	7.00	7.75	8.88	1.59	1.96	2.53	8	0.88	7.88	6.62	5.75	1.00	3/4	4 1/2	5 1/4	102	7.6	125	10	164	14	12			
5	4.81	11.00	1.38	7.31	8.25	8.88	9.88	1.72	2.04	2.54	8	0.88	9.25	8.00	7.00	1.00	3/4	4 3/4	5 1/4	133	10	155	12	194	17	12			
6	5.76	12.50	1.44	8.50	9.88	10.38	11.00	2.06	2.31	2.62	12	0.88	10.62	9.38	8.12	1.00	3/4	4 3/4	5 3/4	185	14	206	17	233	20	12			
8	7.62	15.00	1.62	10.62	12.12	13.50	14.25	2.25	2.94	3.32	12	1.00	13.00	11.56	10.25	1.12	7/8	5 1/2	6 1/4	255	20	324	28	364	32	12			
10	9.56	17.50	1.88	12.75	14.25	15.12	16.25	2.35	2.78	3.35	16	1.12	15.25	13.62	12.62	1.25	1	6 1/4	7 1/4	425	25	498	31	591	38	16			
12	11.38	20.50	2.00	15.00	16.25	17.38	18.25	2.44	3.00	3.44	16	1.25	17.75	15.94	14.75	1.38	1 1/8	6 3/4	7 1/2	532	30	636	38	720	45	16			
14	14.00	23.00	2.12	16.25	19.38	20.12	22.25	2.69	3.06	4.13	20	1.25	20.25	18.44	16.75	1.38	1 1/8	7	7 3/4	681	40	761	47	996	67	16			
16	16.00	25.50	2.25	18.50	22.25	23.25	24.12	3.13	3.63	4.06	20	1.38	22.50	20.50	19.00	1.50	1 1/4	7 1/2	8 1/2	877	53	988	63	1099	73	16			
18	18.00	28.00	2.38	21.00	24.12	25.12	26.75	3.06	3.56	4.38	24	1.38	24.75	22.75	21.00	1.50	1 1/4	7 3/4	8 1/4	982	57	1102	68	1314	87	16			
20	20.00	30.50	2.50	23.00	26.75	27.75	29.25	3.38	3.88	4.63	24	1.38	27.00	25.00	23.12	1.50	1 1/4	8 1/4	9 1/4	1176	70	1316	82	1525	101	16			
24	24.00	36.00	2.75	27.25	30.75	32.00	33.62	3.38	4.00	4.81	24	1.62	32.00	29.62	27.62	1.75	1 1/2	9 1/4	10 1/4	1455	82	1647	100	1899	123	16			

NOTE

- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

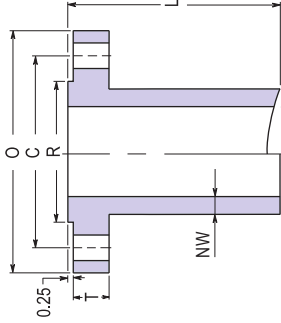


class 400

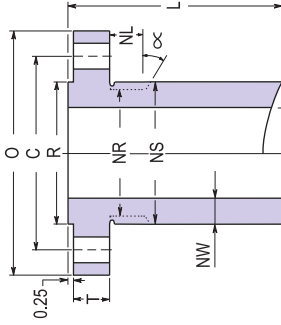
FCI STANDARD CONNECTIONS

FORGED

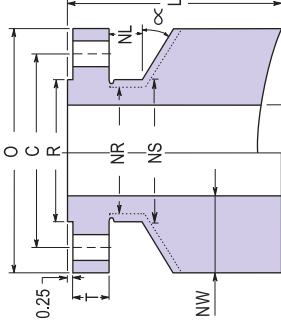
COMPONENTS, INC.



LONG WELD NECK "LWN"



HEAVY BARREL "HB"



EQUAL BARREL "E"

CROSS REFERENCE CHART				
Connection Description	FCI	Other Designations		
Long Weld Neck	LWN	LWN	LWN	LWN
Heavy Barrel	HB	HB	H	HB
Intermediate Barrel	- light - medium - heavy	I 1	*	V 1
		I 2	*	V 2
		I 3	*	V 3
Equal Barrel	E	S	S	F
Super Barrel	SB*	Super S*		*
Insert Lip	Q*	M*		Q*

*Denotes Custom Order

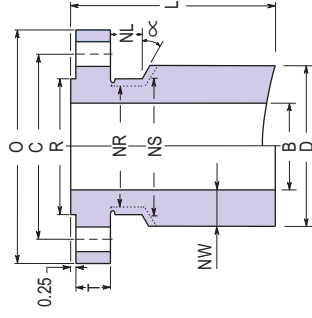
Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights						Length					
			Nom	Bore LWN & HB	B	OD	Thk	RF OD	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB	E	Base	Per 1"	Base		Per 1"	Base	Per 1"		
	1/2	0.50	0.55	3.75	0.56	1.38	D	D	D	D	D	D	NS	NR	NL	1/2	3	3	5	0.4	7	0.6	24	3.1	9	5	0.4	7	0.6	24	3.1	9
	3/4	0.75	0.74	4.62	0.62	1.69	1.88	2.19	4.62	0.57	0.73	----	2.19	1.88	0.88	5/8	3 1/2	3 1/2	8	0.7	11	0.9	37	4.6	9	8	0.7	11	0.9	37	4.6	9
	1	1.00	0.96	4.88	0.69	2.00	2.12	2.44	4.88	0.56	0.74	1.94	2.44	2.12	0.88	5/8	3 1/2	3 1/2	9	0.8	12	1.1	40	5.1	9	9	0.8	12	1.1	40	5.1	9
	1 1/4	1.25	1.28	5.25	0.81	2.50	2.50	2.81	5.25	0.63	0.77	----	2.81	2.50	0.88	5/8	3 3/4	3 3/4	13	1.0	15	1.4	45	5.8	9	13	1.0	15	1.4	45	5.8	9
	1 1/2	1.50	1.50	6.12	0.88	2.88	2.75	3.25	6.12	0.63	0.88	2.31	3.25	2.75	1.00	3/4	4 1/4	4 1/4	16	1.2	21	1.9	61	7.8	9	16	1.2	21	1.9	61	7.8	9
	2	2.00	1.94	6.50	1.00	3.62	3.31	3.94	6.50	0.66	1.00	2.25	3.94	3.31	0.88	5/8	4 1/4	4 1/4	20	1.5	29	2.6	68	8.5	9	20	1.5	29	2.6	68	8.5	9
	2 1/2	2.50	2.32	7.50	1.12	4.12	3.94	4.62	7.50	0.72	1.15	2.50	4.62	3.94	1.00	3/4	4 3/4	4 3/4	27	2.1	39	3.6	88	11	9	27	2.1	39	3.6	88	11	9
	3	3.00	2.90	8.25	1.25	5.00	4.62	5.38	8.25	0.81	1.24	2.63	5.38	4.62	1.00	3/4	5	5	36	2.7	50	4.6	104	13	9	36	2.7	50	4.6	104	13	9
	3 1/2	3.50	3.36	9.00	1.38	5.50	5.25	5.81	9.00	0.88	1.23	2.75	5.81	5.25	1.12	7/8	5 1/2	5 1/2	45	3.4	61	5.5	116	15	9	45	3.4	61	5.5	116	15	9
	4	4.00	3.83	10.00	1.38	6.19	5.75	6.44	10.00	0.88	1.31	3.00	6.44	5.75	1.12	7/8	5 1/2	5 1/2	65	3.8	93	6.5	197	19	12	65	3.8	93	6.5	197	19	12
	5	5.00	4.81	11.00	1.50	7.31	7.00	7.81	11.00	1.00	1.31	3.00	7.81	7.00	1.12	7/8	5 3/4	5 3/4	88	5.3	127	9.1	229	22	12	88	5.3	127	9.1	229	22	12
	6	6.00	5.76	12.50	1.62	8.50	8.12	9.19	12.50	1.06	1.72	3.25	9.19	8.12	1.12	7/8	6	6	110	6.7	169	12	286	27	12	110	6.7	169	12	286	27	12
	8	8.00	7.62	15.00	1.88	10.62	10.25	11.38	15.00	1.13	1.88	3.50	11.38	10.25	1.25	1	6 3/4	6 3/4	154	9.1	233	17	379	36	12	154	9.1	233	17	379	36	12
	10	10.00	9.56	17.50	2.12	12.75	12.62	13.44	17.50	1.31	1.94	3.75	13.44	12.62	1.38	1 1/8	7 1/2	7 1/2	218	13	298	21	475	46	12	218	13	298	21	475	46	12
	12	12.00	11.38	20.50	2.25	15.00	14.75	15.75	20.50	1.38	2.19	4.25	15.75	14.75	1.50	1 1/4	8	8	285	16	401	28	627	62	12	285	16	401	28	627	62	12
	14	14.00	14.00	23.00	2.38	16.25	16.75	18.25	23.00	1.38	2.13	4.50	18.25	16.75	1.50	1 1/4	8 1/4	8 1/4	336	19	467	32	758	74	12	336	19	467	32	758	74	12
	16	16.00	16.00	25.50	2.50	18.50	19.00	20.31	25.50	1.50	2.16	4.75	20.31	19.00	1.62	1 3/8	8 3/4	8 3/4	418	23	542	37	884	88	12	418	23	542	37	884	88	12
	18	18.00	18.00	28.00	2.62	21.00	21.00	22.56	28.00	1.50	2.28	5.00	22.56	21.00	1.62	1 3/8	9	9	482	26	645	43	1033	102	12	482	26	645	43	1033	102	12
	20	20.00	20.00	30.50	2.75	23.00	23.12	24.63	30.50	1.56	2.32	5.25	24.63	23.12	1.75	1 1/2	9 1/2	9 1/2	568	30	759	50	1165	118	12	568	30	759	50	1165	118	12
	24	24.00	24.00	36.00	3.00	27.25	27.62	29.25	36.00	1.81	2.63	6.00	29.25	27.62	2.00	1 3/4	10 1/2	11	804	42	1040	67	1540	160	12	804	42	1040	67	1540	160	12

NOTE

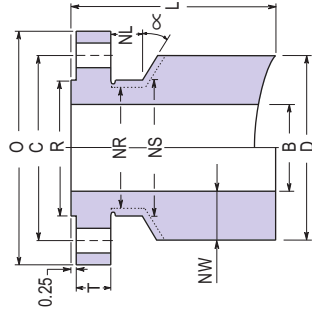
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- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

class 400

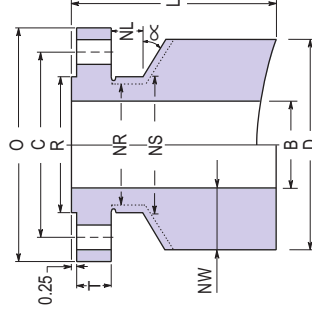
FCI INTERMEDIATE CONNECTIONS



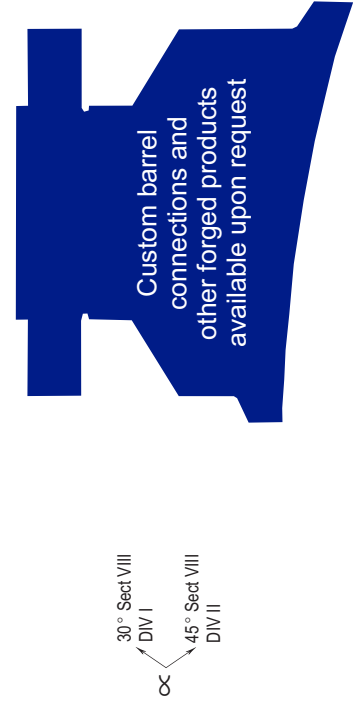
INTERMEDIATE BARREL "I" 1"



INTERMEDIATE BARREL "I" 2"



INTERMEDIATE BARREL "I" 3"

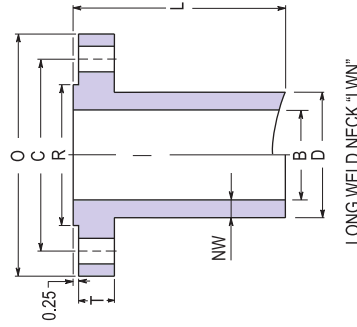


Size		Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights				Length						
Nom	Bore	OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	I ₁	I ₂	I ₃	Base	Per 1"	Base	Per 1"	Base	Per 1"	Base	
	B	O	T	R	D	D	D	NW	NW	NW			C	NS	NR	NL							L							
1	0.96	4.88	0.69	2.00	2.75	3.25	4.00	0.90	1.15	1.52	4	0.75	3.50	2.44	2.12	0.88	5/8	3 1/2	3 1/2	20	1.5	27	39	20	1.5	27	39	20	1.5	12
1 1/2	1.50	6.12	0.88	2.88	4.00	4.62	5.50	1.25	1.56	2.00	4	0.88	4.50	3.25	2.75	1.00	3/4	4 1/4	4 1/4	39	3.1	51	69	39	3.1	51	69	39	3.1	12
2	1.94	6.50	1.00	3.62	4.62	5.50	6.60	1.34	1.78	2.03	8	0.75	5.00	3.94	3.31	0.88	5/8	4 1/4	4 1/4	49	3.9	69	95	49	3.9	69	95	49	3.9	12
2 1/2	2.32	7.50	1.12	4.12	5.75	6.00	6.38	1.72	1.84	2.03	8	0.88	5.88	4.62	3.94	1.00	3/4	4 3/4	4 3/4	73	6.2	81	90	73	6.2	81	90	73	6.2	12
3	2.90	8.25	1.25	5.00	6.00	6.38	7.00	1.55	1.74	2.05	8	0.88	6.62	5.38	4.62	1.00	3/4	5	5	79	6.1	89	106	79	6.1	89	106	79	6.1	12
3 1/2	3.36	9.00	1.38	5.50	7.00	7.75	8.25	1.82	2.20	2.45	8	1.00	7.25	5.81	5.25	1.12	7/8	5 1/2	5 1/2	106	8.4	128	145	106	8.4	128	145	106	8.4	12
4	3.83	10.00	1.38	6.19	7.00	7.75	8.88	1.59	1.96	2.53	8	1.00	7.88	6.44	5.75	1.12	7/8	5 1/2	5 1/2	104	7.6	126	145	104	7.6	126	145	104	7.6	12
5	4.81	11.00	1.50	7.31	8.25	8.88	9.88	1.72	2.04	2.54	8	1.00	9.25	7.81	7.00	1.12	7/8	5 3/4	5 3/4	135	10	157	172	135	10	157	172	135	10	12
6	5.76	12.50	1.62	8.50	9.88	10.38	11.00	2.06	2.31	2.62	12	1.00	10.62	9.19	8.12	1.12	7/8	6	6	188	14	208	17	188	14	208	17	235	20	12
8	7.62	15.00	1.88	10.62	12.12	13.50	14.25	2.25	2.94	3.32	12	1.12	13.00	11.38	10.25	1.25	1	6 3/4	6 3/4	259	20	327	28	259	20	327	28	366	32	12
10	9.56	17.50	2.12	12.75	14.25	15.12	16.25	2.35	2.78	3.35	16	1.25	15.25	13.44	12.62	1.38	1 1/8	7 1/2	7 1/2	431	25	502	31	431	25	502	31	594	38	16
12	11.38	20.50	2.25	15.00	16.25	17.38	18.25	2.44	3.00	3.44	16	1.38	17.75	15.75	14.75	1.50	1 1/4	8	8	539	30	641	38	539	30	641	38	724	45	16
14	14.00	23.00	2.38	16.25	19.38	20.12	22.25	2.69	3.06	4.13	20	1.38	20.25	18.25	16.75	1.50	1 1/4	8 1/4	8 1/4	690	40	768	47	690	40	768	47	974	67	16
16	16.00	25.50	2.50	18.50	22.25	23.25	24.12	3.13	3.63	4.06	20	1.50	22.50	20.31	19.00	1.62	1 3/8	8 3/4	8 3/4	887	53	980	63	887	53	980	63	1078	73	16
18	18.00	28.00	2.62	21.00	24.12	25.12	26.75	3.06	3.56	4.38	24	1.50	24.75	22.56	21.00	1.62	1 3/8	9	9	982	57	1102	68	982	57	1102	68	1284	87	16
20	20.00	30.50	2.75	23.00	26.75	27.75	29.25	3.38	3.88	4.63	24	1.62	27.00	24.63	23.12	1.75	1 1/2	9 1/2	9 3/4	1176	70	1283	82	1176	70	1283	82	1476	101	16
24	24.00	36.00	3.00	27.25	30.75	32.00	33.62	3.38	4.00	4.81	24	1.88	32.00	29.25	27.62	2.00	1 3/4	10 1/2	11	1437	82	1614	100	1437	82	1614	100	1844	123	16

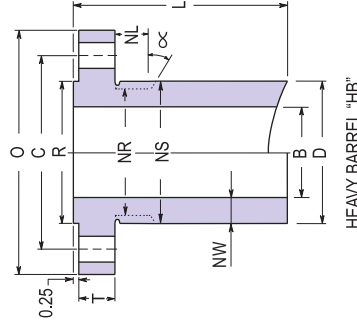
NOTE

- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.

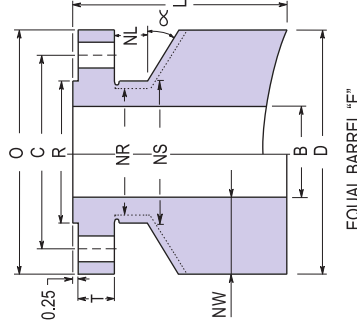
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.



LONG WEI D NECK "I WN"



HEAVY BARREL "HB"



FOILIA BARREI "E"

CROSS REFERENCE CHART

Connection Description	FCI	Other Designations
Long Weld Neck	LWN	LWN LWN
Heavy Barrel	HB	H HB
Intermediate Barrel	- light	* V ₁
	- medium	* V ₂
	- heavy	* V ₃
Equal Barrel	E	S F
Super Barrel	SB*	Super S* *
Insert Lip	Q*	M* Q*

*Denotes Custom Order



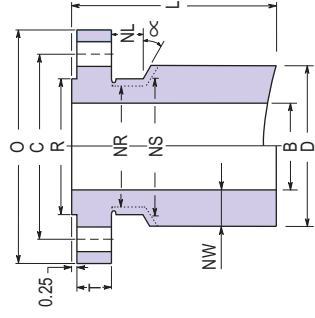
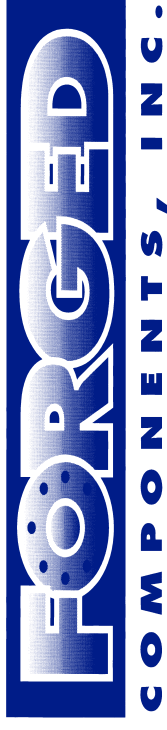
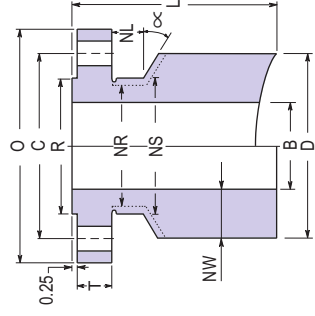
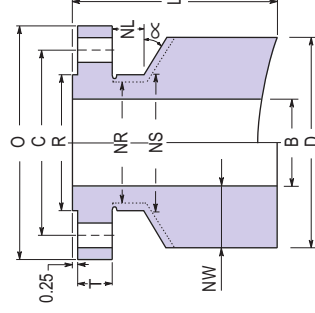
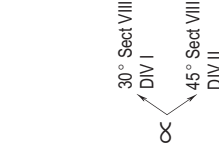
Size			Flange			Barrel OD			Wall Thickness				Bolting			Nut			Stud Bolt			Weights				Length	
Nom	Bore LWN & HB		OD	Thk	RF OD	LWN	HB	E	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB	E				
	B	B																					Base	Per 1"	Base		Per 1"
1/2	0.50	0.55	3.75	0.56	1.38	1.50	1.75	3.75	0.50	0.60	1.63	4	0.62	2.62	1.75	1.50	0.75	1/2	3	3	5	0.4	7	0.6	24	3.1	9
3/4	0.75	0.74	4.62	0.62	1.69	1.88	2.19	4.62	0.57	0.73	1.94	4	0.75	3.25	2.19	1.88	0.88	5/8	3 1/2	3 1/2	8	0.7	11	0.9	36	4.6	9
1	1.00	0.96	4.88	0.69	2.00	2.12	2.44	4.88	0.56	0.74	1.94	4	0.75	3.25	2.44	2.12	1.1	5/8	3 1/2	3 1/2	9	0.8	12	1.1	39	5.1	9
1 1/4	1.25	1.28	5.25	0.81	2.50	2.50	2.81	5.25	0.63	0.77	2.00	4	0.75	3.88	2.81	2.50	0.88	5/8	3 3/4	3 3/4	13	1.0	15	1.4	44	5.8	9
1 1/2	1.50	1.50	6.12	0.88	2.88	2.75	3.25	6.12	0.63	0.88	2.31	4	0.88	4.50	3.25	2.75	1.00	3/4	4 1/4	4 1/4	16	1.2	21	1.9	59	7.8	9
2	2.00	1.94	6.50	1.00	3.62	3.31	3.94	6.50	0.66	1.00	2.25	8	0.75	5.00	3.94	3.31	0.88	5/8	4 1/4	4 1/4	20	1.5	29	2.6	67	8.5	9
2 1/2	2.50	2.32	7.50	1.12	4.12	3.94	4.62	7.50	0.72	1.15	2.50	8	0.88	5.88	4.62	3.94	1.00	3/4	5	4 3/4	27	2.1	39	3.6	85	11	9
3	3.00	2.90	8.25	1.25	5.00	4.62	5.38	8.25	0.81	1.24	2.63	8	0.88	6.62	5.38	4.62	1.00	3/4	5	5 1/4	36	2.7	50	4.6	104	13	9
3 1/2	3.50	3.36	9.00	1.38	5.50	5.25	5.81	9.00	0.88	1.23	2.75	8	1.00	7.25	5.81	5.25	1.12	7/8	5 1/2	5 1/2	45	3.4	57	5.0	116	15	9
4	4.00	3.83	10.75	1.50	6.19	6.00	7.06	10.75	1.00	1.62	3.38	8	1.00	8.50	7.06	6.00	1.12	7/8	5 3/4	6	77	4.5	113	7.8	238	22	12
5	5.00	4.81	13.00	1.75	7.31	7.50	8.88	13.00	1.25	2.04	4.00	8	1.12	10.50	8.88	7.50	1.25	1	6 1/2	6 1/2	123	7	180	12	336	32	12
6	6.00	5.76	14.00	1.88	8.50	8.75	9.88	14.00	1.38	2.06	4.00	12	1.12	11.50	9.88	8.75	1.25	1	6 3/4	7	152	9	207	14	373	36	12
8	8.00	7.62	16.50	2.19	10.62	10.75	11.94	16.50	1.38	2.16	4.25	12	1.25	13.75	11.94	10.75	1.38	1 1/8	7 3/4	8	207	11	277	19	478	46	12
10	10.00	9.56	20.00	2.50	12.75	13.50	15.00	20.00	1.75	2.72	5.00	16	1.38	17.00	15.00	13.50	1.50	1 1/4	8 1/2	8 3/4	324	18	433	30	683	67	12
12	12.00	11.38	22.00	2.62	15.00	15.75	17.25	22.00	1.88	2.94	5.00	20	1.38	19.25	17.25	15.75	1.50	1 1/4	8 3/4	9	393	23	533	37	779	76	12
14	14.00	14.00	23.75	2.75	16.25	17.00	18.56	23.75	1.50	2.28	4.88	20	1.50	20.75	18.56	17.00	1.62	1 3/8	9 1/4	9 1/2	471	21	631	33	1149	82	16
16	16.00	16.00	27.00	3.00	18.50	19.00	21.38	27.00	1.75	2.69	5.50	20	1.62	23.75	21.38	19.50	1.75	1 1/2	10	10 1/4	638	28	856	45	1471	105	16
18	18.00	18.00	29.25	3.25	21.00	21.50	23.19	29.25	1.75	2.60	5.63	20	1.75	25.75	23.19	21.50	1.88	1 5/8	10 3/4	11	731	31	941	48	1628	118	16
20	20.00	20.00	32.00	3.50	23.00	24.00	25.94	32.00	2.00	2.97	6.00	24	1.75	28.00	25.94	24.00	1.88	1 7/8	11 1/2	11 3/4	916	39	1180	61	1920	139	16
24	24.00	24.00	37.00	4.00	27.25	28.25	30.06	37.00	2.13	3.03	6.50	24	2.00	33.00	30.06	28.25	2.12	1 7/8	13	13 1/2	1210	45	1486	73	2376	176	16

NOTE

1. **MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
2. **FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
3. **LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
4. **TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
5. **BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
6. **NUT RELIEF:** All connections except LVN's will be supplied to the Nut "Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
7. **CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
8. **PRESSURE-TEMPERATURE RATING:** See technical section.

class 600

FCI INTERMEDIATE CONNECTIONS

INTERMEDIATE BARREL "I₁"INTERMEDIATE BARREL "I₂"INTERMEDIATE BARREL "I₃"

Size			Flange				Barrel OD			Wall Thickness				Bolting			Nut			Stud Bolt			Weights						Length	
Nom	Bore		OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	Base	Per 1"	Base	Per 1"	Base	Per 1"	I ₃	Base	Per 1"	
1	0.96		4.88	0.69	2.00	3.25	4.00	4.62	1.15	1.52	1.84	4	0.75	3.50	2.44	2.12	0.88	5/8	3 1/2	3 1/2	26	2.2	38	3.4	50	4.6			L	12
1 1/2	1.50		6.12	0.88	2.88	4.00	4.62	5.50	1.25	1.56	2.00	4	0.88	4.50	3.25	2.75	1.00	3/4	4 1/4	4 1/4	39	3.1	50	4.3	69	6.2				12
2	1.94		6.50	1.00	3.62	4.62	5.50	6.00	1.34	1.78	2.03	8	0.75	5.00	3.94	3.31	0.88	5/8	4 1/4	4 1/2	50	3.9	69	5.9	81	7.2				12
2 1/2	2.32		7.50	1.12	4.12	5.75	6.38	7.00	1.72	2.03	2.34	8	0.88	5.88	4.62	3.94	1.00	3/4	5	4 3/4	83	6.2	98	7.9	105	9.7				12
3	2.90		8.25	1.25	5.00	6.38	7.00	7.75	1.74	2.05	2.43	8	0.88	6.62	5.38	4.62	1.00	3/4	5 1/4	5 1/4	88	7.2	105	9.0	127	11.5				12
3 1/2	3.36		9.00	1.38	5.50	7.00	7.75	8.25	1.82	2.20	2.45	8	1.00	7.50	5.81	5.25	1.12	7/8	5 1/2	5 1/2	103	8.4	124	10.9	140	12.6				12
4	3.83		10.75	1.50	6.19	7.75	8.88	9.88	1.96	2.53	3.03	8	1.00	8.50	7.06	6.00	1.12	7/8	5 3/4	6	132	10.1	169	14.2	205	18.4				12
5	4.81		13.00	1.75	7.31	9.88	11.00	12.12	2.54	3.10	3.68	8	1.12	10.50	8.88	7.50	1.25	1	6 1/2	6 1/2	216	16.5	259	21.8	305	27.5				12
6	5.76		14.00	1.88	8.50	11.00	12.12	13.25	2.62	3.18	3.75	12	1.12	11.50	9.88	8.75	1.25	1	6 3/4	7	235	20	300	25	350	32				12
8	7.62		16.50	2.19	10.62	13.25	15.12	16.00	2.82	3.75	4.19	12	1.25	13.75	11.94	10.75	1.38	1 1/8	7 3/4	8	335	26	427	38	478	44				12
10	9.56		20.00	2.50	12.75	16.25	17.38	18.25	3.35	3.91	4.35	16	1.38	17.00	15.00	13.50	1.50	1 1/4	8 1/2	8 3/4	650	38	747	47	824	54				16
12	11.38		22.00	2.62	15.00	18.25	19.38	20.12	3.44	4.00	4.37	20	1.38	19.25	17.25	15.75	1.50	1 1/4	8 3/4	9	771	45	877	55	949	61				16
14	14.00		23.75	2.75	16.25	19.38	20.12	22.25	2.69	3.06	4.13	20	1.50	20.75	18.56	17.00	1.62	1 3/8	9 1/4	9 1/2	708	40	781	47	994	67				16
16	16.00		27.00	3.00	18.50	23.25	24.12	25.00	3.63	4.06	4.50	20	1.62	23.75	21.38	19.50	1.75	1 1/2	10	10 1/4	1055	63	1151	73	1248	82				16
18	18.00		29.25	3.25	21.00	24.12	26.25	27.75	3.06	4.13	4.88	20	1.75	25.75	23.19	21.50	1.88	1 5/8	10 3/4	11	1044	57	1283	81	1456	89				16
20	20.00		32.00	3.50	23.00	27.75	29.25	30.75	3.88	4.63	5.38	24	1.75	28.50	25.94	24.00	1.88	1 5/8	11 1/2	11 3/4	1398	82	1582	101	1767	121				16
24	24.00		37.00	4.00	27.25	30.75	32.00	33.62	3.38	4.00	4.81	24	2.00	33.00	30.06	28.25	2.12	1 7/8	13	13 1/2	1574	82	1736	100	1946	123				16

NOTE

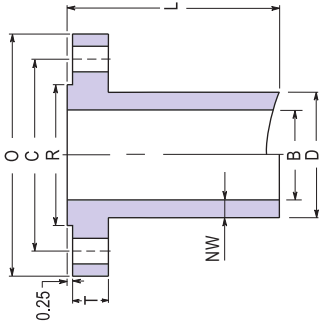
- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

Class 900

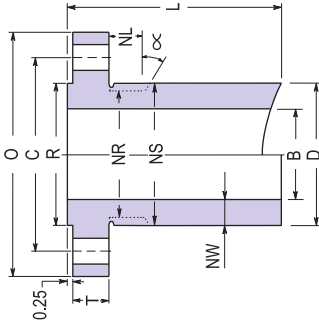
FCI STANDARD CONNECTIONS

FORGED

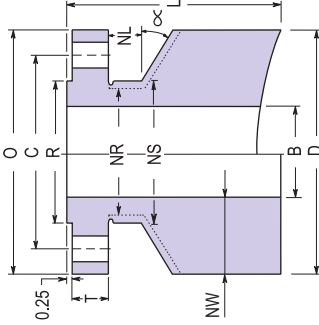
COMPONENTS, INC.



LONG WELD NECK "LWN"



HEAVY BARREL "HB"



EQUAL BARREL "E"



CROSS REFERENCE CHART

Connection Description	FCI	Other Designations
Long Weld Neck	LWN	LWN
Heavy Barrel	HB	H
Intermediate Barrel	- light - medium - heavy	I ₁ * I ₂ * I ₃ *
Equal Barrel	E	S
Super Barrel	SB*	Super S*
Insert Lip	Q*	M* Q*

*Denotes Custom Order

Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights				Length		
Nom	Bore LWN & HB		OD	Thk	RF OD	LWN	HB	E	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB	E	Base			
	B	Bore																							D	D	D
1/2	0.50	0.55	4.75	0.88	1.38	1.56	2.00	4.75	0.53	0.73	2.13	4	0.88	3.25	2.00	1.56	1.00	3/4	4 1/4	4 1/4	8	0.5	10	0.8	37	5.0	9
3/4	0.75	0.74	5.12	1.00	1.69	1.81	2.25	5.12	0.53	0.76	2.19	4	0.88	3.50	2.25	1.81	1.00	3/4	4 1/2	4 1/2	10	0.6	13	1.0	42	5.7	9
1	1.00	0.96	5.88	1.12	2.00	2.12	2.56	5.88	0.56	0.80	2.44	4	1.00	4.00	2.56	2.12	1.12	7/8	5	5	13	0.8	17	1.3	54	7.5	9
1 1/4	1.25	1.28	6.25	1.12	2.50	2.50	2.94	6.25	0.63	0.83	2.50	4	1.00	4.38	2.94	2.50	1.12	7/8	5	5	17	1.0	20	1.6	61	8.3	9
1 1/2	1.50	1.50	7.00	1.25	2.88	2.75	3.25	7.00	0.63	0.88	2.75	4	1.12	4.88	3.25	2.75	1.25	1	5 1/2	5 1/2	21	1.2	26	1.9	77	10	9
2	2.00	1.94	8.50	1.50	3.62	4.12	5.06	8.50	1.06	1.56	3.25	8	1.00	6.50	5.06	4.12	1.12	7/8	5 3/4	42	2.9	56	4.9	115	15	9	
2 1/2	2.50	2.32	9.62	1.62	4.12	4.88	5.88	9.62	1.19	1.78	3.56	8	1.12	7.50	5.88	4.88	1.25	1	6 1/4	6 1/4	56	3.9	75	6.5	144	19	9
3	3.00	2.90	11.50	1.50	5.00	5.00	6.06	9.50	1.00	1.58	3.25	8	1.00	7.50	6.06	5.00	1.12	7/8	5 3/4	5 3/4	51	3.6	71	6.3	139	18	9
4	4.00	3.83	11.50	1.75	6.19	6.25	7.44	11.50	1.13	1.81	3.75	8	1.25	9.25	7.44	6.25	1.38	1 1/8	6 3/4	6 3/4	93	5.1	133	9.1	270	26	12
5	5.00	4.81	13.75	2.00	7.31	7.50	9.00	13.75	1.25	2.10	4.38	8	1.38	11.00	9.00	7.50	1.50	1 1/4	7 1/2	7 1/2	135	7	194	13	376	37	12
6	6.00	5.76	15.00	2.19	8.50	9.25	10.69	15.00	1.63	2.47	4.50	12	1.25	12.50	10.69	9.25	1.38	1 1/8	7 1/2	7 3/4	191	11	259	18	436	42	12
8	8.00	7.62	18.50	2.50	10.62	11.75	13.31	18.50	1.88	2.85	5.25	12	1.50	15.50	13.31	11.75	1.62	1 3/8	8 3/4	8 3/4	297	16	389	27	626	62	12
10	10.00	9.56	21.50	2.75	12.75	14.50	16.31	21.50	2.25	3.38	5.75	16	1.50	18.50	16.31	14.50	1.62	1 3/8	9 1/4	9 1/4	422	25	558	39	824	81	12
12	12.00	11.38	24.00	3.12	15.00	16.50	18.81	24.00	2.25	3.72	6.00	20	1.50	21.00	18.81	16.50	1.62	1 3/8	10	10	518	29	715	50	984	96	12
14	14.00	14.00	25.25	3.38	16.25	17.75	19.62	25.25	1.88	2.81	5.63	20	1.62	22.00	19.62	17.75	1.75	1 1/2	10 3/4	11	624	26	817	42	1368	98	16
16	16.00	16.00	27.75	3.50	18.50	20.00	21.69	27.75	2.00	2.85	5.88	20	1.75	24.25	21.69	20.00	1.88	1 5/8	11 1/4	11 1/2	750	32	942	48	1573	114	16
18	18.00	18.00	31.00	4.00	21.00	22.25	24.06	31.00	2.13	3.03	6.50	20	2.00	27.00	24.06	22.25	2.12	1 7/8	12 3/4	13 1/4	950	38	1169	57	1898	142	16
20	20.00	20.00	33.75	4.25	23.00	24.50	26.38	33.75	2.25	3.19	6.88	20	2.12	29.50	26.38	24.50	2.25	2	13 3/4	14 1/4	1121	43	1378	66	2182	164	16
24	24.00	24.00	41.00	5.50	27.25	29.50	31.62	41.00	2.75	3.81	8.50	20	2.62	35.50	31.62	29.50	2.75	2 1/2	17 1/4	18	1865	65	2160	94	3084	246	16

NOTE

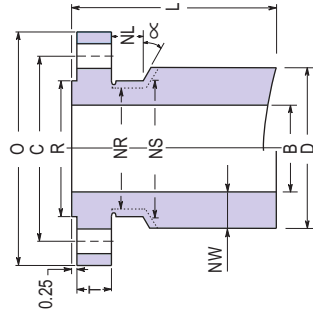
- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

class 900

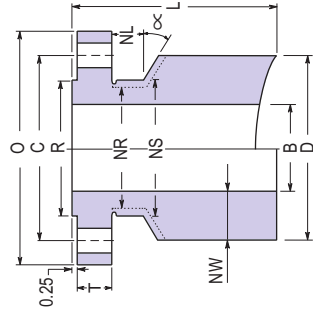
FCI INTERMEDIATE CONNECTIONS

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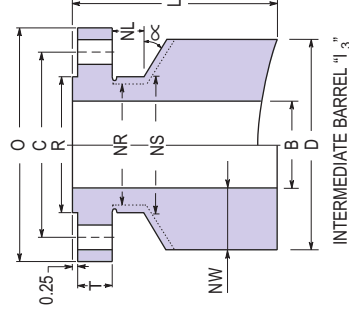
COMPONENTS, INC.



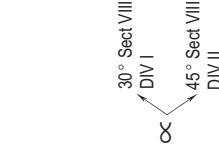
INTERMEDIATE BARREL "1"



INTERMEDIATE BARREL "1 1/2"



INTERMEDIATE BARREL "1 3/4"



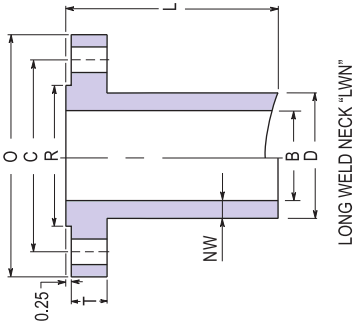
Size		Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights						Length						
Nom	Bore	OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	I ₁	I ₂	I ₃	Base	Per 1"	Base	Per 1"	Base	Per 1"	Base	Per 1"		
B		O	T	R	D	D	D	NW	NW	NW		C		NS	NR	NL																L
1	0.96	5.88	1.12	2.00	3.25	4.00	4.62	1.15	1.52	1.83	4	1.00	4.00	2.56	2.12	1.12	7/8	5	5	29	2.2	41	51	4.6								12
1 1/2	1.50	7.00	1.25	2.88	4.00	5.50	6.00	1.25	2.00	2.25	4	1.12	4.88	3.25	2.75	1.25	1	5 1/2	5 1/2	43	3.1	71	6.2	82	7.5							12
2	1.94	8.50	1.50	3.62	5.50	6.00	7.00	1.78	2.03	2.53	8	1.00	6.50	5.06	4.12	1.12	7/8	5 3/4	5 3/4	80	5.9	92	7.2	117	10.1							12
2 1/2	2.32	9.62	1.62	4.12	6.38	7.00	8.25	2.03	2.34	2.97	8	1.12	7.50	5.88	4.88	1.25	1	6 1/4	6 1/4	107	8.0	123	10	158	14							12
3	2.90	9.50	1.50	5.00	7.00	7.75	8.25	2.05	2.43	2.68	8	1.00	7.50	6.06	5.00	1.12	7/8	5 3/4	5 3/4	114	9.0	136	12	151	13							12
4	3.83	11.50	1.75	6.19	8.88	9.88	10.38	2.53	3.03	3.28	8	1.25	9.25	7.44	6.25	1.38	1 1/8	6 3/4	6 3/4	177	14	211	18	228	21							12
5	4.81	13.75	2.00	7.31	10.38	11.00	12.12	2.79	3.10	3.66	8	1.38	11.00	9.00	7.50	1.50	1 1/4	7 1/2	7 1/2	242	19	265	22	309	28							12
6	5.76	15.00	2.19	8.50	11.00	12.12	13.50	2.62	3.18	3.87	12	1.25	12.50	10.69	9.25	1.38	1 1/8	7 1/2	7 3/4	271	20	317	25	377	33							12
8	7.62	18.50	2.50	10.62	15.12	16.25	17.38	3.75	4.32	4.88	12	1.50	15.50	13.31	11.75	1.62	1 3/8	8 3/4	8 3/4	474	38	528	46	584	54							12
10	9.56	21.50	2.75	12.75	17.38	18.25	20.12	3.91	4.35	5.28	16	1.50	18.50	16.31	14.50	1.62	1 3/8	9 1/4	9 1/4	804	47	880	54	1049	70							16
12	11.38	24.00	3.12	15.00	20.12	22.25	23.25	4.37	5.44	5.94	20	1.50	21.00	18.81	16.50	1.62	1 3/8	10	10	1038	61	1245	81	1345	92							16
14	14.00	25.25	3.38	16.25	22.25	23.25	24.12	4.13	4.63	5.06	20	1.62	22.00	19.62	17.75	1.75	1 1/2	10 3/4	11	1068	67	1166	77	1254	86							16
16	16.00	27.75	3.50	18.50	23.25	25.00	26.50	3.63	4.50	5.25	20	1.75	24.25	21.69	20.00	1.88	1 5/8	11 1/4	11 1/2	1100	63	1282	82	1451	99							16
18	18.00	31.00	4.00	21.00	26.00	27.75	29.25	4.00	4.88	5.63	20	2.00	27.00	24.06	22.25	2.12	1 7/8	12 3/4	13 1/4	1365	78	1555	99	1715	118							16
20	20.00	33.75	4.25	23.00	27.75	30.75	32.00	3.88	5.38	6.00	20	2.12	29.50	26.38	24.50	2.25	2	13 3/4	14 1/4	1525	82	1857	121	1994	139							16
24	24.00	41.00	5.50	27.25	33.62	35.00	36.00	4.81	5.50	6.00	20	2.62	35.50	31.62	29.50	2.75	2 1/2	17 1/4	18	2360	123	2515	144	2625	160							16

NOTE

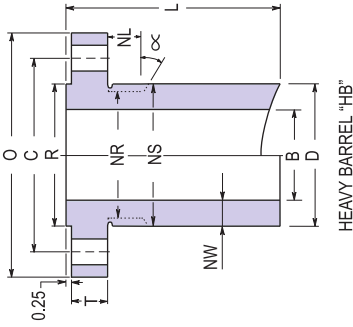
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- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
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- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

class 1500

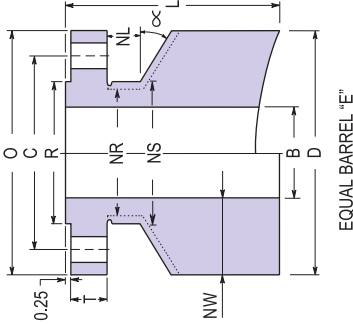
FCI STANDARD CONNECTIONS



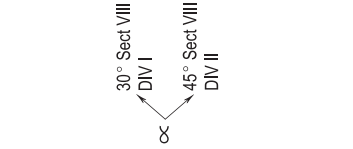
LONG WELD NECK "LWN"



HEAVY BARREL "HB"



EQUAL BARREL "E"



CROSS REFERENCE CHART

Connection Description	FCI	Other Designations
Long Weld Neck	LWN	LWN
Heavy Barrel	HB	H
Intermediate Barrel	- light - medium - heavy	I 1 I 2 I 3
Equal Barrel	E	S
Super Barrel	SB*	Super S*
Insert Lip	Q*	M*
		Q*

*Denotes Custom Order

Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights			Length					
Nom	Bore LWN & HB		OD	Thk	RF OD	LWN	HB	E	LWN	HB	E	NW	NW	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN		HB		E		
	B	B																					D	D	D	D	Per 1"	Base	Per 1"
1/2	0.50	0.55	4.75	0.88	1.38	1.56	2.00	4.75	0.53	0.73	2.13	0.88	3.25	4	0.88	3.25	2.00	1.56	1.00	3/4	4 1/4	4 1/4	8	0.5	10	0.8	37	5.0	9
3/4	0.75	0.74	5.12	1.00	1.69	1.81	2.25	5.12	0.53	0.76	2.19	0.88	3.50	4	0.88	3.50	2.25	1.81	1.00	3/4	4 1/2	4 1/2	10	0.6	13	1.0	42	5.7	9
1	1.00	0.96	5.88	1.12	2.00	2.12	2.56	5.88	0.56	0.80	2.44	1.00	4.00	4	1.00	4.00	2.56	2.12	1.12	7/8	5	5	13	0.8	17	1.3	54	7.5	9
1 1/4	1.25	1.28	6.25	1.12	2.50	2.50	2.94	6.25	0.63	0.83	2.50	1.00	4.38	4	1.00	4.38	2.94	2.50	1.12	7/8	5	5	17	1.0	20	1.6	61	8.3	9
1 1/2	1.50	1.50	7.00	1.25	2.88	2.75	3.25	7.00	0.63	0.88	2.75	1.12	4.88	4	1.12	4.88	3.25	2.75	1.25	1	5 1/2	5 1/2	21	1.2	26	1.9	77	10	9
2	2.00	1.94	8.50	1.50	3.62	4.12	5.06	8.50	1.06	1.56	3.25	1.00	6.50	8	1.00	6.50	5.06	4.12	1.12	7/8	5 3/4	5 3/4	42	2.9	56	4.9	115	15	9
2 1/2	2.50	2.32	9.62	1.62	4.12	4.88	5.88	9.62	1.19	1.78	3.56	1.12	7.50	8	1.12	7.50	5.88	4.88	1.25	1	6 1/4	6 1/4	56	3.9	75	6.5	144	19	9
3	3.00	2.90	10.50	1.88	5.00	5.25	6.19	10.50	1.13	1.85	3.75	1.25	8.00	8	1.25	8.00	6.19	5.25	1.38	1 1/8	7	7	67	4.1	84	6.7	161	23	9
4	4.00	3.83	12.25	2.12	6.19	6.38	7.50	12.25	1.19	1.84	4.13	1.38	9.50	8	1.38	9.50	7.50	6.38	1.50	1 1/4	7 3/4	7 3/4	110	5.5	147	9.3	302	30	12
5	5.00	4.81	14.75	2.88	7.31	7.75	9.12	14.75	1.38	2.16	4.88	1.62	11.50	8	1.62	11.50	9.12	7.75	1.75	1 1/2	9 3/4	9 3/4	181	7.8	233	13	414	43	12
6	6.00	5.76	15.50	3.25	8.50	9.00	10.31	15.50	1.50	2.28	4.75	1.75	12.50	12	1.50	12.50	10.31	9.00	1.62	1 3/8	10 1/4	10 1/2	215	10	272	16	445	46	12
8	8.00	7.62	19.00	3.62	10.62	11.50	12.94	19.00	1.75	2.66	5.50	1.75	15.50	12	1.75	15.50	12.94	11.50	1.88	1 5/8	11 1/2	12 3/4	337	15	417	24	629	67	12
10	10.00	9.56	23.00	4.25	12.75	14.50	16.06	23.00	2.25	3.25	6.50	2.00	19.00	12	2.00	19.00	16.06	14.50	2.12	1 7/8	13 1/4	13 1/2	546	25	651	37	888	97	12
12	12.00	11.38	26.50	4.88	15.00	17.75	19.38	26.50	2.88	4.00	7.25	2.12	22.50	16	2.12	22.50	19.38	17.75	2.25	2	14 3/4	15 1/4	946	38	1148	55	1683	127	16
14	14.00	14.00	29.50	5.25	16.25	19.50	21.50	29.50	2.75	3.75	7.75	2.38	25.00	16	2.38	25.00	21.50	19.50	2.50	2 1/4	16	16 3/4	1116	41	1308	59	1929	150	16
16	16.00	16.00	32.50	5.75	18.50	21.75	23.88	32.50	2.88	3.94	8.25	2.62	27.75	16	2.62	27.75	23.88	21.75	2.75	2 1/2	17 1/2	18 1/2	1371	48	1588	70	2238	178	16
18	18.00	18.00	36.00	6.38	21.00	23.50	26.25	36.00	2.75	4.13	9.00	2.88	30.50	16	2.88	30.50	26.25	23.50	3.00	2 3/4	19 1/2	20 3/4	1674	51	1959	81	2629	216	16
20	20.00	20.00	38.75	7.00	23.00	25.25	28.12	38.75	2.63	4.06	9.38	3.12	32.75	16	3.12	32.75	28.12	25.25	3.25	3	21 1/4	22 1/4	1943	53	2241	87	2868	245	16
24	24.00	24.00	46.00	8.00	27.25	30.00	33.62	46.00	3.00	4.81	11.00	3.62	39.00	16	3.62	39.00	33.62	30.00	3.75	3 1/2	24 1/4	25 1/2	2936	72	3334	123	3819	343	16

NOTE

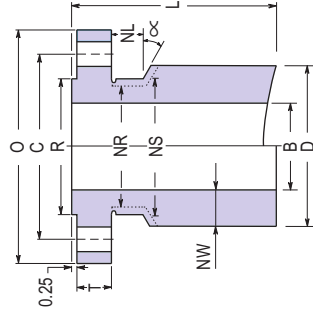
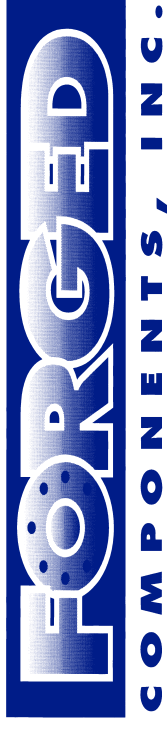
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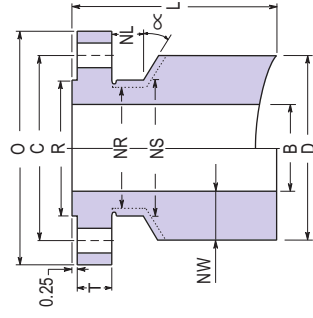
COMPONENTS, INC.

class 1500

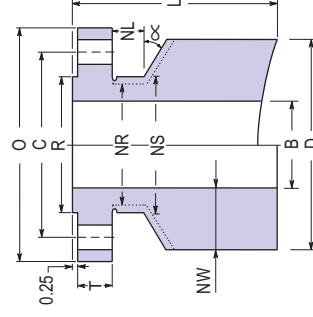
FCI INTERMEDIATE CONNECTIONS



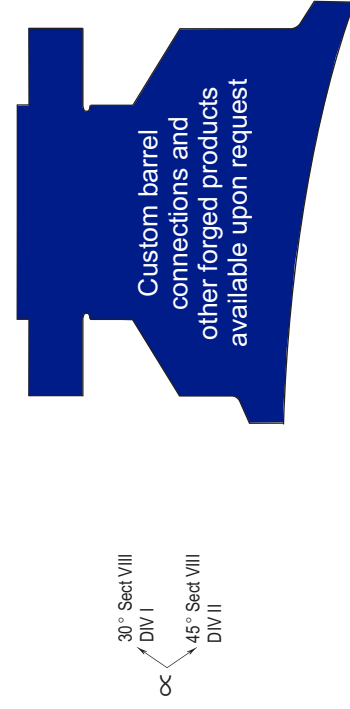
INTERMEDIATE BARREL "I" 1



INTERMEDIATE BARREL "I" 2



INTERMEDIATE BARREL "I" 3

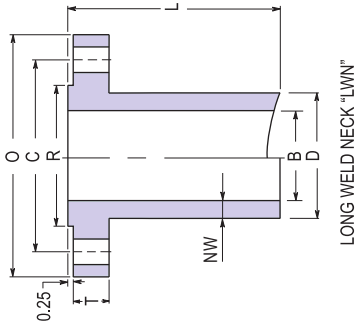


Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights						Length
Nom	Bore		OD	Thk	RF OD	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	I ₁	I ₂	I ₃	Base	Per 1"	Base	Per 1"	Base	Per 1"	Base
	B		O	T	R	D	D	D			C	NS	NR	NL													L
1	0.96		5.88	1.12	2.00	3.25	4.00	4.62	4	1.00	4.00	2.56	2.12	1.12	7/8	5	5	29	2.2	41	3.4	51	4.6				12
1 1/2	1.50		7.00	1.25	2.88	4.62	5.50	6.00	4	1.12	4.88	3.25	2.75	1.25	1	5 1/2	5 1/2	54	4.3	71	6.2	82	7.5				12
2	1.94		8.50	1.50	3.62	5.50	6.00	7.00	8	1.00	6.50	5.06	4.12	1.12	7/8	5 3/4	5 3/4	80	5.9	92	7.2	117	10.1				12
2 1/2	2.32		9.62	1.62	4.12	6.38	7.00	8.25	8	1.12	7.50	5.88	4.88	1.25	1	6 1/4	6 1/4	107	8	123	10	158	14				12
3	2.90		10.50	1.88	5.00	7.00	7.75	8.88	8	1.25	8.00	6.19	5.25	1.38	1 1/8	7	7	124	9	144	12	177	16				12
4	3.83		12.25	2.12	6.19	8.88	9.88	11.00	8	1.38	9.50	7.50	6.38	1.50	1 1/4	7 3/4	7 3/4	187	14	218	18	257	24				12
5	4.81		14.75	2.88	7.31	10.38	12.12	13.50	8	1.62	11.50	9.12	7.75	1.75	1 1/2	9 3/4	9 3/4	271	19	328	28	376	35				12
6	5.76		15.50	3.25	8.50	12.12	13.50	14.25	12	1.50	12.50	10.31	9.00	1.62	1 3/8	10 1/4	10 1/2	332	25	380	33	408	38				12
8	7.62		19.00	3.62	10.62	15.12	16.25	17.38	12	1.75	15.50	12.94	11.50	1.88	1 5/8	11 1/2	12 3/4	498	38	541	46	585	54				12
10	9.56		23.00	4.25	12.75	17.38	20.12	22.25	12	2.00	19.00	16.06	14.50	2.12	1 7/8	13 1/4	13 1/2	889	47	1088	70	1243	90				16
12	11.38		26.50	4.88	15.00	22.25	23.25	24.12	16	2.12	22.50	19.38	17.75	2.25	2	14 3/4	15 1/4	1348	81	1426	92	1495	101				16
14	14.00		29.50	5.25	16.25	23.25	25.00	27.75	16	2.38	25.00	21.50	19.50	2.50	2 1/4	16	16 3/4	1443	77	1579	95	1794	128				16
16	16.00		32.50	5.75	18.50	26.25	29.25	30.75	16	2.62	27.75	23.88	21.75	2.75	2 1/2	17 1/2	18 1/2	1771	96	1999	133	2111	153				16
18	18.00		36.00	6.38	21.00	27.75	30.75	33.62	16	2.88	30.50	26.25	23.50	3.00	2 3/4	19 1/2	20 3/4	2070	99	2285	138	2481	180				16
20	20.00		38.75	7.00	23.00	30.75	33.00	36.00	16	3.12	32.75	28.12	25.25	3.25	3	21 1/4	22 1/4	2417	121	2558	153	2727	200				16
24	24.00		46.00	8.00	27.25	36.00	37.50	40.50	16	3.62	39.00	33.62	30.00	3.75	3 1/2	24 1/4	25 1/2	3470	160	3545	185	3675	237				16

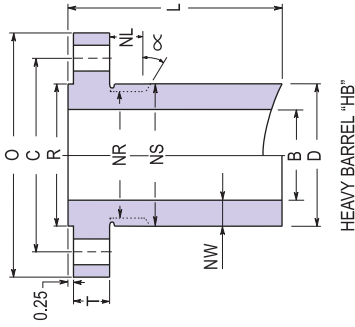
NOTE

- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, core, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

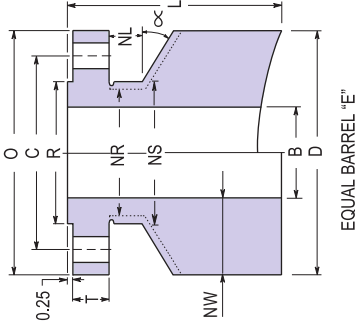
class 2500 FCI STANDARD CONNECTIONS



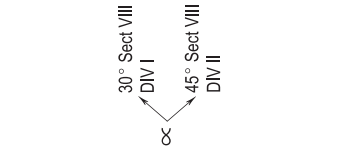
LONG WELD NECK "LWN"



HEAVY BARREL "HB"



EQUAL BARREL "E"



CROSS REFERENCE CHART

Connection Description	FCI	Other Designations
Long Weld Neck	LWN	LWN
Heavy Barrel	HB	H
Intermediate Barrel	- light - medium - heavy	I 1 I 2 I 3
Equal Barrel	E	S
Super Barrel	SB*	Super S*
Insert Lip	Q*	M*

*Denotes Custom Order

Size			Flange			Barrel OD			Wall Thickness			Bolting			Nut			Stud Bolt			Weights				Length		
Nom	Bore LWN & HB		OD	Thk	RF OD	LWN	HB	E	LWN	HB	E	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	LWN	HB		E		Base	
	B	B																				Base	Per 1"	Base	Per 1"		
	1/2	0.50	0.55	5.25	1.19	1.38	1.81	2.25	5.25	0.66	0.85	2.38	1.81	1.00	3/4	4 3/4	4 3/4	11	0.7	14	1.1	45	6.1	9	9		
	3/4	0.75	0.74	5.50	1.25	1.69	2.06	2.50	5.50	0.66	0.88	2.38	2.50	2.06	1.00	3/4	5	5	13	0.8	17	1.3	49	6.6	9	9	
	1	1.00	0.96	6.25	1.38	2.00	2.25	2.81	6.25	0.63	0.93	2.63	2.81	2.25	1.12	7/8	5 1/2	5 1/2	18	0.9	22	1.6	62	8.5	9	9	
	1 1/4	1.25	1.28	7.25	1.50	2.50	2.88	3.50	7.25	0.82	1.11	3.00	3.50	2.88	1.25	1	6	6	27	1.5	32	2.4	84	11	9	9	
	1 1/2	1.50	1.50	8.00	1.75	2.88	3.12	3.94	8.00	0.81	1.22	3.25	3.94	3.12	1.38	1 1/8	6 3/4	6 3/4	33	1.7	42	3.0	94	14	9	9	
	2	2.00	1.94	9.25	2.00	3.62	3.75	5.12	9.25	0.88	1.59	3.63	5.12	3.75	1.25	1	7	7	48	2.2	66	5.0	131	18	9	9	
	2 1/2	2.50	2.32	10.50	2.25	4.12	4.50	5.94	10.50	1.00	1.81	4.00	5.94	4.50	1.38	1 1/8	7 3/4	8	66	3.1	90	6.7	165	23	9	9	
	3	3.00	2.90	12.00	2.62	5.00	5.25	7.00	12.00	1.13	2.05	4.50	7.00	5.25	1.50	1 1/4	8 3/4	9	97	4.1	127	9	210	30	9	9	
	4	4.00	3.83	14.00	3.00	6.19	6.50	8.38	14.00	1.25	2.28	5.00	8.38	6.50	1.75	1 1/2	10	10 1/4	159	5.8	218	12	391	40	12	12	
	5	5.00	4.81	16.50	3.62	7.31	8.00	10.00	16.50	1.50	2.60	5.75	10.00	8.00	2.00	1 3/4	11 3/4	12 1/4	248	8.7	319	17	518	55	12	12	
	6	6.00	5.76	19.00	4.25	8.50	9.25	11.38	19.00	1.63	2.81	6.50	11.38	9.25	2.25	2	13 1/2	14	358	11	441	21	641	73	12	12	
	8	8.00	7.62	21.75	5.00	10.62	12.00	14.12	21.75	2.00	3.25	6.88	14.12	12.00	2.25	2	15	15 1/2	589	18	743	31	1167	92	16	16	
	10	10.00	9.56	26.50	6.50	12.75	14.75	17.38	26.50	2.38	3.91	8.25	17.38	14.75	2.75	2 1/2	19 1/4	20	997	26	1202	47	1625	134	16	16	
	12	12.00	11.38	30.00	7.25	15.00	17.38	20.12	30.00	2.69	4.37	9.00	20.12	21.38	3.00	2 3/4	21 1/4	22	1363	35	1609	61	1995	168	16	16	

NOTE

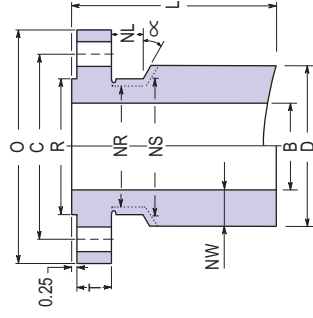
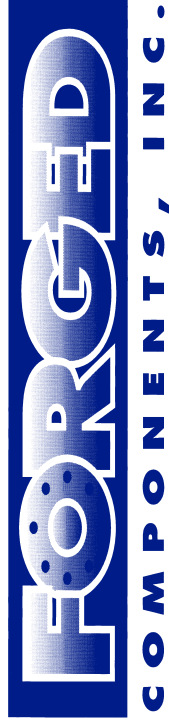
- MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- PRESSURE-TEMPERATURE RATING:** See technical section.

FORGED

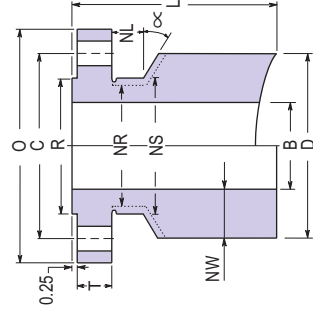
COMPONENTS, INC.

class 2500

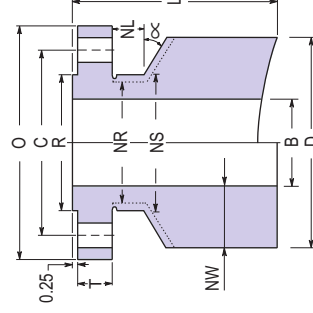
FCI INTERMEDIATE CONNECTIONS



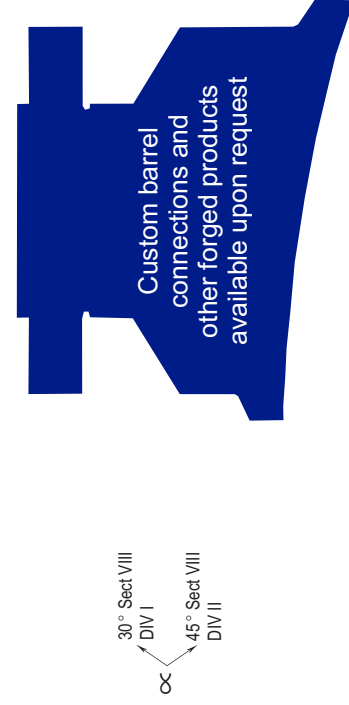
INTERMEDIATE BARREL "I" 1"



INTERMEDIATE BARREL "I" 2"



INTERMEDIATE BARREL "I" 3"



Size		Flange			Barrel OD			Wall Thickness			Bolting		Nut			Stud Bolt			Weights				Length			
Nom	Bore	OD	Thk	RF OD	I ₁	I ₂	I ₃	I ₁	I ₂	I ₃	No Of Holes	Hole Size	Bolt Circle	Stop Dia	Relief Dia	Relief Length	Size	RF Length	RTJ Length	I ₁		I ₂		I ₃		Base
	B	O	T	R	D	D	D	NW	NW	NW	4	C	C	NS	NR	NL				Base	Per 1"	Base	Per 1"	Base	Per 1"	L
1	0.96	6.25	1.38	2.00	4.00	4.62	5.50	1.52	1.83	2.27	4	1.00	4.25	2.81	2.25	1.12	7/8	5 1/2	5 1/2	43	3.4	54	4.6	71	6.5	12
1 1/2	1.50	8.00	1.75	2.88	5.50	6.00	7.00	2.00	2.25	2.75	4	1.25	5.75	3.94	3.12	1.38	1 1/8	6 3/4	6 3/4	79	6.2	89	7.5	112	10.4	12
2	1.94	9.25	2.00	3.62	6.00	7.00	8.00	2.03	2.53	3.03	8	1.12	6.75	5.12	3.75	1.25	1	7	7	99	7.2	123	10	149	13.4	12
2 1/2	2.32	10.50	2.25	4.12	7.00	7.75	8.88	2.34	2.72	3.28	8	1.25	7.75	5.94	4.50	1.38	1 1/8	7 3/4	8	135	10	153	12	184	16	12
3	2.90	12.00	2.62	5.00	8.25	9.88	11.00	2.68	3.49	4.05	8	1.38	9.00	7.00	5.25	1.50	1 1/4	8 3/4	9	186	13	232	20	267	25	12
4	3.83	14.00	3.00	6.19	9.88	11.00	12.12	3.03	3.59	4.15	8	1.62	10.75	8.38	6.50	1.75	1 1/2	10	10 1/4	259	18	293	24	328	29	12
5	4.81	16.50	3.62	7.31	11.00	13.50	15.25	3.10	4.35	5.22	8	1.88	12.75	10.00	8.00	2.00	1 3/4	11 3/4	12 1/4	347	22	422	35	477	47	12
6	5.76	19.00	4.25	8.50	13.50	15.12	17.38	3.87	4.68	5.81	8	2.12	14.50	11.38	9.25	2.25	2	13 1/2	14	499	33	545	44	609	60	12
8	7.62	21.75	5.00	10.62	15.12	18.25	20.12	3.75	5.32	6.25	12	2.12	17.25	14.12	12.00	2.25	2	15	15 1/2	647	38	735	61	785	77	12
10	9.56	26.50	6.50	12.75	20.12	22.25	24.12	5.28	6.35	7.28	12	2.62	21.25	17.38	14.75	2.75	2 1/2	19 1/4	20	1342	70	1451	90	1545	109	16
12	11.38	30.00	7.25	15.00	22.25	25.00	27.75	5.44	6.81	8.19	12	2.88	24.38	20.12	17.38	3.00	2 3/4	21 1/4	22	1713	81	1844	110	1966	143	16

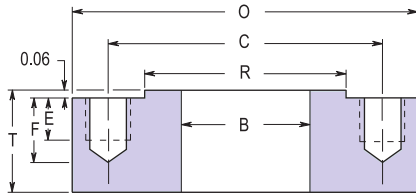
NOTE

- 1. MATERIAL:** SA 105 in accordance with ASME Section II. Other material grades and compositions available upon request. See technical section.
- 2. FACING:** Classes 150# and 300# include 1/16" raised face in thickness "T" and length "L". Classes 400# to 2500# do not include 1/4" raised face per ASME B16.5 in thickness "T" but is included in length "L". Other standard and special facings available upon request with height or depth added to thickness "T".
- 3. LENGTH:** Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
- 4. TOLERANCE:** Flanges are furnished to tolerances of ASME B16.5 unless otherwise specified.
- 5. BORE:** Bore sizes listed are standard, smaller or larger bores available upon request.
- 6. NUT RELIEF:** All connections except LWNs will be supplied to the Nut Stop "NS" diameter listed unless the Nut Relief "NR" diameter is requested.
- 7. CONTOURING:** All connections will be supplied square cut. Connection can be contoured to fit shell, head, cone, or other shape upon request.
- 8. PRESSURE-TEMPERATURE RATING:** See technical section.

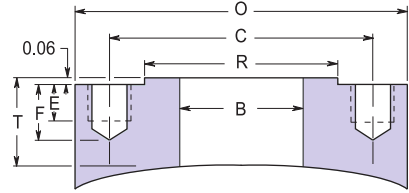
GENERAL NOTES FOR FCI STANDARD AND INTERMEDIATE BARREL CONNECTIONS

CODES:	FCI connections are manufactured in compliance with ASME Section II, Section VIII, Div. 1, and ASME B16.5. Products may be ordered to special requirements or other standard codes such as ASME Section I, III and Section VIII, Div. 2, ASME B31.1 and B16.47 Series A&B, API and ASTM.
MATERIALS:	All materials comply with the applicable ASME and ASTM specifications. Full traceability is mandated by our quality system. Standard forged material is carbon steel SA105. Connections can also be furnished in other carbon steels, alloy steels, stainless, high nickel and non-ferrous alloys upon request.
BORES:	Heavy Barrel "HB" and Intermediate Barrel "I" connections 12" and smaller are provided with standard bores to match Sch. 80 pipe, thus eliminating turbulence and accelerated corrosion resulting from the orifice effect of a sharp constriction common to Long Weld Necks "LWN". In sizes 14" and greater, standard bores are equal to the nominal flange/pipe size. Special bores are available upon request for all products.
FACING:	Standard facing is raised face to ASME B16.5. The 0.06" raised face is included in thickness "T" and length "L" dimensions for Class 150 and 300 flange connections. The 0.25" raised face is not included in thickness "T" but is included in length "L" dimensions for Class 400, 600, 900, 1500 and class 2500 flange connections. Other standard and special facings are available – see technical section.
LENGTHS:	Listed lengths are standards used for base weight calculations. Other lengths are available upon request.
FLANGES:	Flange dimensions and drilling are in accordance with ASME B16.5. Bolt holes will straddle natural centerlines, unless specified otherwise. Studs, bolts, nuts, and gaskets are not furnished, but can be supplied upon request.
NUT RELIEF:	Standard on Long Weld Neck "LWN" connections only, optional on all other connections.
NUT STOPS:	Standard on all Heavy Barrel "HB", Intermediate Barrel "I ₁ ", "I ₂ ", "I ₃ ", Equal Barrel "E", and Super Barrel "SB" connections. Not available on Long Weld Neck "LWN" connections. The connection flange hub area outside diameter acts as the nut stop, preventing the nut from turning thereby only requiring one wrench to loosen or tighten the bolting on the mating side. Nut relief can be furnished on special order.
CONTOURED BOTTOMS:	Connections will be furnished with flat bottoms unless specified otherwise. All connections are available with "contoured" bottoms for installation in shells, heads and cones. In these cases, the centerline length "CL" will be measured on the connection axis from the flange face or butt weld connection end to the bottom contour of the connection.
INSERT LIPS:	All connections can be ordered with insert lips- "Q" type attachment.
HEAT TREATMENT:	All standard connections over Class 300 rating are supplied in the normalized condition in accordance with the requirements of ASME Section II. Other heat treatment requirements can be provided upon request.
TOLERANCE:	Manufacturing tolerances, as a minimum, will meet the requirements of ASME B16.5 where applicable.

FCI STUDDING OUTLETS



FLAT BOTTOM

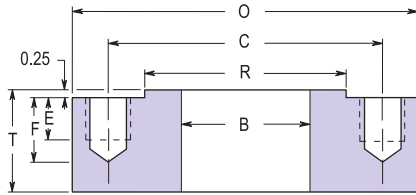


OPTIONAL CURVED BOTTOM

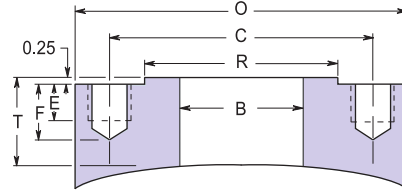
Size	Flange			Bolting				Stud Bolt			Weight	
Bore	OD	Thk	RF OD	No Of Holes	Hole Size	Hole Depth	Bolt Circle	Tap Size	T.P.I.	Tap Depth	Flat Bottom	
B	O	T	R			F	C			E	Base	Per 1"
class 150 STUDDING OUTLETS												
1/2	3.50	1.25	1.38	4	27/64	0.88	2.38	1/2	13	0.56	3	2.7
3/4	3.88	1.25	1.69	4	27/64	0.88	2.75	1/2	13	0.56	3.7	3.2
1	4.25	1.25	2.00	4	27/64	0.88	3.12	1/2	13	0.56	4.3	3.8
1 1/4	4.62	1.25	2.50	4	27/64	0.88	3.50	1/2	13	0.56	5.1	4.4
1 1/2	5.00	1.25	2.88	4	27/64	0.88	3.88	1/2	13	0.56	5.9	5.1
2	6.00	1.50	3.62	4	17/32	1.12	4.75	5/8	11	0.75	10.2	7.1
2 1/2	7.00	1.50	4.12	4	17/32	1.12	5.50	5/8	11	0.75	14	9.5
3	7.50	1.50	5.00	4	17/32	1.12	6.00	5/8	11	0.75	15	11
3 1/2	8.50	1.50	5.50	8	17/32	1.12	7.00	5/8	11	0.75	19	13
4	9.00	1.50	6.19	8	17/32	1.12	7.50	5/8	11	0.75	20	14
5	10.00	1.75	7.31	8	21/32	1.31	8.50	3/4	10	0.88	28	17
6	11.00	1.75	8.50	8	21/32	1.31	9.50	3/4	10	0.88	31	19
8	13.50	1.75	10.62	8	21/32	1.31	11.75	3/4	10	0.88	46	26
10	16.00	1.81	12.75	12	49/64	1.44	14.25	7/8	9	1.00	58	35
12	19.00	1.81	15.00	12	49/64	1.44	17.00	7/8	9	1.00	83	48
14	21.00	2.00	16.25	12	7/8	1.56	18.75	1	8	1.12	102	55
16	23.50	2.00	18.50	16	7/8	1.56	21.25	1	8	1.12	123	66
18	25.00	2.25	21.00	16	1	1.81	22.75	1 1/8	8	1.25	140	67
20	27.50	2.25	23.00	20	1	1.81	25.00	1 1/8	8	1.25	166	79
24	32.00	2.50	27.25	20	1 1/8	2.12	29.50	1 1/4	8	1.44	231	100
class 300 STUDDING OUTLETS												
1/2	3.75	1.25	1.38	4	27/64	0.88	2.62	1/2	13	0.56	3.5	3.1
3/4	4.62	1.50	1.69	4	17/32	1.12	3.25	5/8	11	0.75	6.4	4.6
1	4.88	1.50	2.00	4	17/32	1.12	3.50	5/8	11	0.75	7	5.1
1 1/4	5.25	1.50	2.50	4	17/32	1.12	3.88	5/8	11	0.75	8	5.8
1 1/2	6.12	1.75	2.88	4	21/32	1.31	4.50	3/4	10	0.88	13	7.8
2	6.50	1.50	3.62	8	17/32	1.12	5.00	5/8	11	0.75	12	8.5
2 1/2	7.50	1.75	4.12	8	21/32	1.31	5.88	3/4	10	0.88	18	11
3	8.25	1.75	5.00	8	21/32	1.31	6.62	3/4	10	0.88	22	14
3 1/2	9.00	1.75	5.50	8	21/32	1.31	7.25	3/4	10	0.88	25	15
4	10.00	1.75	6.19	8	21/32	1.31	7.88	3/4	10	0.88	30	19
5	11.00	1.75	7.31	8	21/32	1.31	9.25	3/4	10	0.88	36	21
6	12.50	1.75	8.50	12	21/32	1.31	10.62	3/4	10	0.88	44	27
8	15.00	1.88	10.62	12	49/64	1.44	13.00	7/8	9	1.00	63	36
10	17.50	2.12	12.75	16	7/8	1.56	15.25	1	8	1.12	90	46
12	20.50	2.25	15.00	16	1	1.81	17.75	1 1/8	8	1.25	127	61
14	23.00	2.25	16.25	20	1	1.81	20.25	1 1/8	8	1.25	153	74
16	25.50	2.50	18.50	20	1 1/8	2.12	22.50	1 1/4	8	1.44	201	88
18	28.00	2.50	21.00	24	1 1/8	2.12	24.75	1 1/4	8	1.44	235	102
20	30.50	2.50	23.00	24	1 1/8	2.12	27.00	1 1/4	8	1.44	273	118
24	36.00	2.88	27.25	24	1 3/8	2.38	32.00	1 1/2	8	1.69	425	160

See Notes on Pages 23-24

FCI STUDDING OUTLETS



FLAT BOTTOM

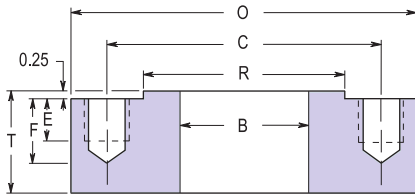


OPTIONAL CURVED BOTTOM

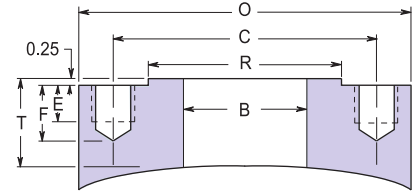
Size	Flange			Bolting				Stud Bolt			Weight	
Bore	OD	Thk	RF OD	No Of Holes	Hole Size	Hole Depth	Bolt Circle	Tap Size	T.P.I.	Tap Depth	Flat Bottom	
B	O	T	R			F	C			E	Base	Per 1"
class 600 STUDDING OUTLETS												
1/2	3.75	1.50	1.38	4	27/64	0.88	2.62	1/2	13	0.56	3.8	3.1
3/4	4.62	1.75	1.69	4	17/32	1.12	3.25	5/8	11	0.75	6.7	4.6
1	4.88	1.75	2.00	4	17/32	1.12	3.50	5/8	11	0.75	7.4	5.1
1 1/4	5.25	1.75	2.50	4	17/32	1.12	3.88	5/8	11	0.75	8.6	5.8
1 1/2	6.12	1.94	2.88	4	21/32	1.31	4.50	3/4	10	0.88	13	7.8
2	6.50	1.75	3.62	8	17/32	1.12	5.00	5/8	11	0.75	12	8.5
2 1/2	7.50	2.00	4.12	8	21/32	1.31	5.88	3/4	10	0.88	19	11
3	8.25	2.00	5.00	8	21/32	1.31	6.62	3/4	10	0.88	23	13
3 1/2	9.00	2.12	5.50	8	49/64	1.44	7.25	7/8	9	1.00	28	15
4	10.75	2.12	6.19	8	49/64	1.44	8.50	7/8	9	1.00	41	22
5	13.00	2.25	7.31	8	7/8	1.56	10.50	1	8	1.12	63	32
6	14.00	2.25	8.50	12	7/8	1.56	11.50	1	8	1.12	68	36
8	16.50	2.50	10.62	12	1	1.81	13.75	1 1/8	8	1.25	101	46
10	20.00	2.75	12.75	16	1 1/8	2.12	17.00	1 1/4	8	1.44	160	67
12	22.00	2.75	15.00	20	1 1/8	2.12	19.25	1 1/4	8	1.44	180	76
14	23.75	2.88	16.25	20	1 1/4	2.25	20.75	1 3/8	8	1.56	201	82
16	27.00	3.00	18.50	20	1 3/8	2.38	23.75	1 1/2	8	1.69	271	105
18	29.25	3.25	21.00	20	1 1/2	2.56	25.75	1 5/8	8	1.88	331	118
20	32.00	3.25	23.00	24	1 1/2	2.56	28.50	1 5/8	8	1.88	387	139
24	37.00	3.75	27.25	24	1 3/4	3.00	33.00	1 7/8	8	2.12	571	176
class 900 STUDDING OUTLETS												
1/2	4.75	2.00	1.38	4	21/32	1.31	3.25	3/4	10	0.88	8.2	5
3/4	5.12	2.00	1.69	4	21/32	1.31	3.50	3/4	10	0.88	10	5.7
1	5.88	2.12	2.00	4	49/64	1.44	4.00	7/8	9	1.00	14	7.5
1 1/4	6.25	2.12	2.50	4	49/64	1.44	4.38	7/8	9	1.00	15	8.3
1 1/2	7.00	2.25	2.88	4	7/8	1.56	4.88	1	8	1.12	20	10
2	8.50	2.12	3.62	8	49/64	1.44	6.50	7/8	9	1.00	27	15
2 1/2	9.62	2.25	4.12	8	7/8	1.56	7.50	1	8	1.12	37	19
3	9.50	2.12	5.00	8	49/64	1.44	7.50	7/8	9	1.00	33	18
4	11.50	2.50	6.19	8	1	1.81	9.25	1 1/8	8	1.25	56	26
5	13.75	2.75	7.31	8	1 1/8	2.12	11.00	1 1/4	8	1.44	87	37
6	15.00	2.50	8.50	12	1	1.81	12.50	1 1/8	8	1.25	91	42
8	18.50	3.00	10.62	12	1 1/4	2.25	15.50	1 3/8	8	1.56	162	62
10	21.50	3.00	12.75	16	1 1/4	2.25	18.50	1 3/8	8	1.56	210	81
12	24.00	3.00	15.00	20	1 1/4	2.25	21.00	1 3/8	8	1.56	251	96
14	25.25	3.25	16.25	20	1 3/8	2.38	22.00	1 1/2	8	1.69	275	98
16	27.25	3.50	18.50	20	1 1/2	2.56	24.25	1 5/8	8	1.88	348	114
18	31.00	3.88	21.00	20	1 3/4	3.00	27.00	1 7/8	8	2.12	473	142
20	33.75	4.25	23.00	20	1 7/8	3.31	29.50	2	8	2.25	608	164
24	41.00	5.12	27.25	20	2 3/8	4.00	35.50	2 1/2	8	2.81	1096	246

See Notes on Pages 23-24

FCI STUDDING OUTLETS



FLAT BOTTOM



OPTIONAL CURVED BOTTOM

Size	Flange			Bolting				Stud Bolt			Weight	
Bore	OD	Thk	RF OD	No Of Holes	Hole Size	Hole Depth	Bolt Circle	Tap Size	T.P.I.	Tap Depth	Flat Bottom	
B	O	T	R			F	C			E	Base	Per 1"
class 1500 STUDDING OUTLETS												
1/2	4.75	2.00	1.38	4	21/32	1.31	3.25	3/4	10	0.88	8.2	5
3/4	5.12	2.00	1.69	4	21/32	1.31	3.50	3/4	10	0.88	10	5.7
1	5.88	2.12	2.00	4	49/64	1.44	4.00	7/8	9	1.00	14	7.5
1 1/4	6.25	2.12	2.50	4	49/64	1.44	4.38	7/8	9	1.00	15	8.3
1 1/2	7.00	2.25	2.88	4	7/8	1.56	4.88	1	8	1.12	20	10
2	8.50	2.12	3.62	8	49/64	1.44	6.50	7/8	9	1.00	27	15
2 1/2	9.62	2.25	4.12	8	7/8	1.56	7.50	1	8	1.12	37	19
3	10.50	2.50	5.00	8	1	1.81	8.00	1 1/8	8	1.25	48	23
4	12.25	2.75	6.19	8	1 1/8	2.12	9.50	1 1/4	8	1.44	70	30
5	14.75	3.12	7.31	8	1 3/8	2.38	11.50	1 1/2	8	1.69	114	43
6	15.50	3.00	8.50	12	1 1/4	2.25	12.50	1 3/8	8	1.56	116	45
8	19.00	3.50	10.62	12	1 1/2	2.56	15.50	1 5/8	8	1.88	224	66
10	23.00	3.88	12.75	12	1 3/4	3.00	19.00	1 7/8	8	2.12	345	95
12	26.50	4.12	15.00	16	1 7/8	3.31	22.50	2	8	2.25	456	124
14	29.50	4.25	16.25	16	2 1/8	3.56	25.00	2 1/4	8	2.56	540	150
16	32.50	5.00	18.50	16	2 3/8	4.00	27.75	2 1/2	8	2.81	762	178
18	36.00	5.50	21.00	16	2 5/8	4.38	30.50	2 3/4	8	3.12	1024	216
20	38.75	5.88	23.00	16	2 7/8	4.62	32.75	3	8	3.44	1234	245
24	46.00	6.75	27.25	16	3 3/8	5.38	39.00	3 1/2	8	4.00	1992	343
class 2500 STUDDING OUTLETS												
1/2	5.25	2.00	1.38	4	21/32	1.31	3.50	3/4	10	0.88	10	6.1
3/4	5.50	2.00	1.69	4	21/32	1.31	3.75	3/4	10	0.88	11	6.6
1	6.25	2.12	2.00	4	49/64	1.44	4.25	7/8	9	1.00	15	8.5
1 1/4	7.25	2.25	2.50	4	7/8	1.56	5.12	1	8	1.12	22	11
1 1/2	8.00	2.50	2.88	4	1	1.81	5.75	1 1/8	8	1.25	29	14
2	9.25	2.25	3.62	8	7/8	1.56	6.75	1	8	1.12	34	18
2 1/2	10.50	2.50	4.12	8	1	1.81	7.75	1 1/8	8	1.25	49	23
3	12.00	2.75	5.00	8	1 1/8	2.12	9.00	1 1/4	8	1.44	71	30
4	14.00	3.25	6.19	8	1 3/8	2.38	10.75	1 1/2	8	1.69	112	40
5	16.50	3.75	7.31	8	1 5/8	2.81	12.75	1 3/4	8	2.00	179	55
6	19.00	4.12	8.50	8	1 7/8	3.31	14.50	2	8	2.25	259	72
8	21.75	4.38	10.62	12	1 7/8	3.31	17.25	2	8	2.25	345	91
10	26.50	5.12	12.75	12	2 3/8	4.00	21.25	2 1/2	8	2.81	590	134
12	30.00	5.50	15.00	12	2 5/8	4.38	24.38	2 3/4	8	3.12	799	168

See Notes on Pages 23-24

GENERAL NOTES FOR FCI STANDARD STUDDING OUTLETS

- CODES:** FCI Studding Outlets are manufactured in compliance with ASME Section II, Section VIII, Div. 1, and ASME B16.5. Products may be ordered to special requirements or other standard codes such as ASME Section I, III and Section VIII, Div. 2, ASME B31.1 or B31.7.
- MATERIALS:** All materials comply with the applicable ASME and ASTM specifications. Full traceability is mandated by our quality system. Standard forged material is carbon steel SA105. Connections can also be furnished in other carbon steels, alloy steels, stainless, high nickel and non-ferrous alloys upon request.
- BORES:** Standard studding outlet bores are equal to their nominal flange/pipe size. Special bores are available upon request.
- FACING:** Standard facing is raised face to ASME B16.5. The 0.06" raised face is included in thickness "T" for Class 150 and 300 studding outlet connections. The 0.25" raised face is included in thickness "T" for Class 600, 900, 1500 and Class 2500 studding outlet connections. Other standard and special facings are available.
- THICKNESS:** Listed thickness "T" dimensions in FCI charts are the minimums required per ASME Section VIII Div. 1 for thread engagement and thickness required for installing studding outlets to the inside diameter of vessel shells, heads, cones, pipes, etc. as shown in Figures A, B, C, and D of typical attachment styles for studding outlet connections.
- For "through-type" installations as per Fig. B and per Fig. C, thickness "T" must generally be increased in accordance with the requirements of the ASME Code, Section VIII, Div. 1, paragraph UG-43(d), to provide additional material under the drilled and tapped holes of the studding outlet.
- Surface mounted "set-on" studding outlets, as shown in Figures E, F and G, generally require a thickness less than that listed in accordance with ASME Code design.
- Studding outlets will be priced and produced to other than the FCI listed thickness "T" at Purchaser's request. See following page of other studding outlet mounting configurations to determine thickness "T".
- In all cases, Purchaser shall design and advise FCI of the required thickness "T" dimension.
- BODY:** Studding outlet body outside diameters are equal to the outside diameters of flanges, as specified in ASME B16.5 for the size and class of connection ordered. Upon request, studding outlet outside diameters may be increased to satisfy reinforcing requirements. Standard FCI studding outlet mating connection ends will be manufactured in accordance with ASME B16.5 flange and drilling dimensions. Drilled holes will be tapped in accordance with ASME Section VIII, Div. 1, paragraph UG-43(g). Bolt holes will straddle natural centerlines, unless specified otherwise. Studs, bolts, nuts, and gaskets are not furnished.
- CONTOURED BOTTOMS:** Studding outlet connections will be furnished with flat bottoms unless specified otherwise. All connections are available with optional "contoured" bottoms for installation in shells, heads and cones. In these cases, the minimum thickness "T" will be measured from the studding outlet face to the bottom contour of the connection. See preceding thickness note and typical attachment style as shown on following page.
- Tolerance for bottom contouring will be in accordance with ASME Section VIII, Div. 1, paragraph UG-80 out-of-roundness tolerance. Purchaser to specify when connections are to be surface mounted for special contouring requirements, such as Fig. F and Fig. G.
- Wrap around" connections exceeding the outside diameter of the shell to which they are mounted will have the transverse pendant points square cut.
- Tangential/hillside, inclined, and other special contoured bottoms are available upon request.

GENERAL NOTES FOR FCI STANDARD STUDDING OUTLETS

INSERT LIPS: All studding outlet connections can be ordered with insert lips- "Q" type attachment.

TEST HOLES: Studding outlets may be ordered with test holes. Unless specified otherwise, test holes will be provided in accordance with Fig. E, 1/4" diameter drilling and tapped with a 1/8" N.P.T.

HEAT TREATMENT: All standard connections over Class 300 rating are supplied in the normalized condition in accordance with the requirements of ASME Section II. Other heat treatment requirements can be provided upon request.

TOLERANCE: Manufacturing tolerances, as a minimum, will meet the requirements of ASME B16.5 where applicable.

REINFORCEMENT:

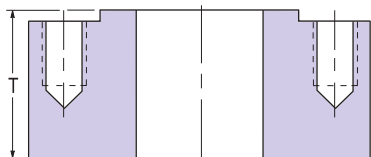
Reinforcement must be provided to satisfy area requirements for all planes through the center of the opening normal to the vessel surface especially the voids created by the drilled and tapped holes of studding outlets. The area requirements, planes of reinforcement and the "F" factor are to be addressed by Purchaser's designer in accordance with the ASME Code, Section VIII, Div. 1, paragraph UG-37. Increasing the thickness "T" and/or the outside diameter of the studding outlet connection may replace the area lost from the drilled and tapped holes. See following table for area loss of FCI standard studding outlet drilled and tapped holes:

<u>TAP SIZE</u> <u>(inches)</u>	<u>DEPTH OF HOLE</u> <u>(inches)</u>	<u>AREA</u> <u>(sq. inches)</u>
1/2	0.88	0.81
5/8	1.12	1.28
3/4	1.31	1.80
7/8	1.44	2.29
1	1.56	2.82
1 1/8	1.81	3.69
1 1/4	2.12	4.83
1 3/8	2.25	5.62
1 1/2	2.38	6.47
1 5/8	2.56	7.53
1 3/4	2.81	8.92
1 7/8	3.00	10.19
2	3.31	12.04
2 1/4	3.56	14.50
2 1/2	4.00	16.13
2 3/4	4.38	21.82
3	4.62	25.02
3 1/2	5.38	33.99

FCI STUDDING OUTLETS

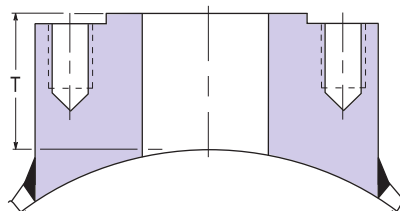
TYPICAL ATTACHMENT STYLES AND RELATED THICKNESS “T” DIMENSIONS

FIG. A



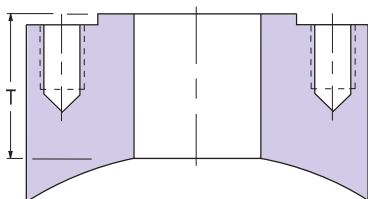
Standard Flat Bottom Attachment

FIG. B



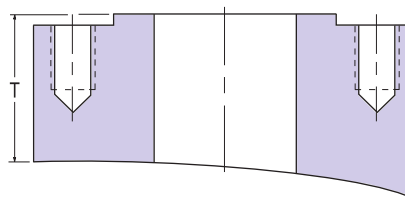
Optional Contoured “Through-Type” Shell Attachment

FIG. C



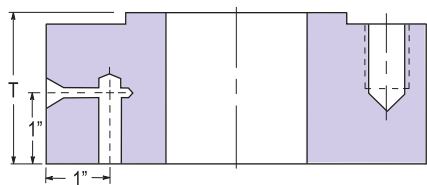
Optional Contoured For Spherical Head Attachment

FIG. D



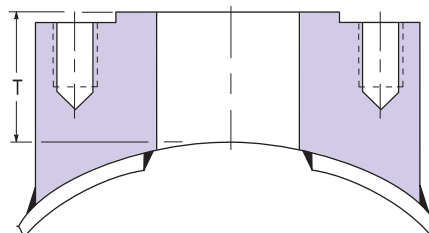
Optional Contoured Tangential Attachment

FIG. E



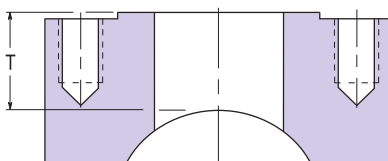
Optional “Pipe Tap Test Hole” Connection

FIG. F



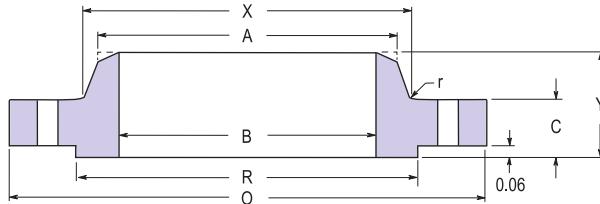
Optional Contoured Set-On Type Attachment

FIG. G

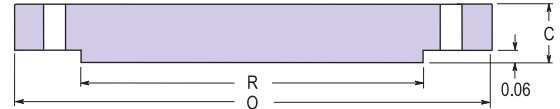


Optional “Wrap Around” Connection

LARGE DIAMETER FLANGES



WELDING NECK



BLIND

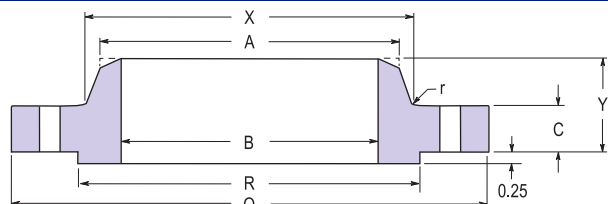
Nominal Pipe Size	Flange								Bolting				Weights	
	OD	Thickness		Raised Face OD	Fillet Radius Min.	Hub			No. of Holes	Hole Size	Bolt Circle Dia.	Stud Bolt Diameter	Weld Neck Flange	Blind
		WN Flg	Blind			Length	Bottom OD	Top OD						
	O	C	C	R	r	Y	X	A						
class 150 LARGE DIAMETER FLANGES ASME B16.47 Series A or MSS SP- 44														
26	34.25	2.69	2.69	29.50	0.38	4.75	26.62	26.00	24	1.38	31.75	1 1/4	300	670
28	36.50	2.81	2.81	31.50	0.44	4.94	28.62	28.00	28	1.38	34.00	1 1/4	345	795
30	38.75	2.94	2.94	33.75	0.44	5.38	30.75	30.00	28	1.38	36.00	1 1/4	400	940
32	41.75	3.19	3.19	36.00	0.44	5.69	32.75	32.00	28	1.62	38.50	1 1/2	505	1175
34	43.75	3.25	3.25	38.00	0.50	5.88	34.75	34.00	32	1.62	40.50	1 1/2	540	1315
36	46.00	3.56	3.56	40.25	0.50	6.19	36.75	36.00	32	1.62	42.75	1 1/2	640	1590
38	48.75	3.44	3.44	42.25	0.50	6.19	39.00	38.00	32	1.62	45.25	1 1/2	720	1740
40	50.75	3.56	3.56	44.25	0.50	6.44	41.00	40.00	36	1.62	47.25	1 1/2	775	1955
42	53.00	3.81	3.81	47.00	0.50	6.75	43.00	42.00	36	1.62	49.50	1 1/2	890	2290
44	55.25	4.00	4.00	49.00	0.50	7.00	45.00	44.00	40	1.62	51.75	1 1/2	990	2790
46	57.25	4.06	4.06	51.00	0.50	7.31	47.12	46.00	40	1.62	53.75	1 1/2	1060	3050
48	59.50	4.25	4.25	53.50	0.50	7.56	49.12	48.00	44	1.62	56.00	1 1/2	1185	3220
50	61.75	4.38	4.38	55.50	0.50	8.00	51.25	50.00	44	1.88	58.25	1 3/4	1270	3545
52	64.00	4.56	4.56	57.50	0.50	8.25	53.25	52.00	44	1.88	60.50	1 3/4	1410	3990
54	66.25	4.75	4.75	59.50	0.50	8.50	55.25	54.00	44	1.88	62.75	1 3/4	1585	4455
56	68.75	4.88	4.88	62.00	0.50	9.00	57.38	56.00	48	1.88	65.00	1 3/4	1760	4920
58	71.00	5.06	5.06	64.00	0.50	9.25	59.38	58.00	48	1.88	67.25	1 3/4	1915	5465
60	73.00	5.19	5.19	66.00	0.50	9.44	61.38	60.00	52	1.88	69.25	1 3/4	2045	5800
class 300 LARGE DIAMETER FLANGES ASME B16.47 Series A or MSS SP- 44														
26	38.25	3.12	3.31	29.50	0.38	7.25	28.38	26.00	28	1.75	34.50	1 5/8	605	1010
28	40.75	3.38	3.56	31.50	0.44	7.75	30.50	28.00	28	1.75	37.00	1 5/8	745	1240
30	43.00	3.62	3.75	33.75	0.44	8.25	32.56	30.00	28	1.88	39.25	1 3/4	870	1450
32	45.25	3.88	3.94	36.00	0.44	8.75	34.69	32.00	28	2.00	41.50	1 7/8	1005	1685
34	47.50	4.00	4.12	38.00	0.50	9.12	36.88	34.00	28	2.00	43.50	1 7/8	1145	1915
36	50.00	4.12	4.38	40.25	0.50	9.50	39.00	36.00	32	2.12	46.00	2	1275	2280
38	46.00	4.25	4.25	40.50	0.50	7.12	39.12	38.00	32	1.62	43.00	1 1/2	695	1910
40	48.75	4.50	4.50	42.75	0.50	7.62	41.25	40.00	32	1.75	45.50	1 5/8	840	2270
42	50.75	4.69	4.69	44.75	0.50	7.88	43.25	42.00	32	1.75	47.50	1 5/8	950	2570
44	53.25	4.88	4.88	47.00	0.50	8.12	45.25	44.00	32	1.88	49.75	1 3/4	1055	2940
46	55.75	5.06	5.06	49.00	0.50	8.50	47.38	46.00	28	2.00	52.00	1 7/8	1235	3370
48	57.75	5.25	5.25	51.25	0.50	8.81	49.38	48.00	32	2.00	54.00	1 7/8	1380	3740
50	60.25	5.50	5.50	53.50	0.50	9.12	51.38	50.00	32	2.12	56.25	2	1530	4270
52	62.25	5.69	5.69	55.50	0.50	9.38	53.38	52.00	32	2.12	58.25	2	1660	4715
54	65.25	6.00	6.00	57.75	0.50	9.94	55.50	54.00	28	2.38	61.00	2 1/4	2050	5460
56	67.25	6.06	6.06	59.75	0.50	10.25	57.62	56.00	28	2.38	63.00	2 1/4	2155	5870
58	69.25	6.25	6.25	62.00	0.50	10.50	59.62	58.00	32	2.38	65.00	2 1/4	2270	6400
60	71.25	6.44	6.44	64.00	0.50	10.75	61.62	60.00	32	2.38	67.00	2 1/4	2470	7000

NOTE

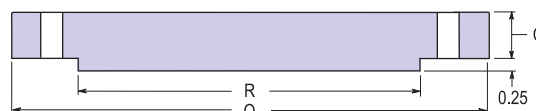
Class 400 large diameter flanges and blinds are available upon request.

See Notes on Page 30

LARGE DIAMETER FLANGES



WELDING NECK



BLIND

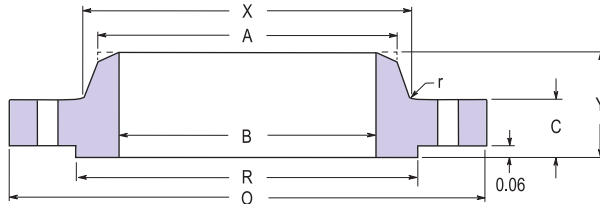
Nominal Pipe Size	Flange								Bolting				Weights	
	OD	Thickness		Raised Face OD	Fillet Radius Min.	Hub			No. of Holes	Hole Size	Bolt Circle Dia.	Stud Bolt Diameter	Weld Neck Flange	Blind
		△ WN Flg	△ Blind			△ Length	Bottom OD	Top OD						
	O	C	C	R	r	Y	X	A						
class 600 LARGE DIAMETER FLANGES ASME B16.47 Series A or MSS SP-44														
26	40.00	4.25	4.94	29.50	0.50	8.75	29.44	26.00	28	2.00	36.00	1 7/8	940	1680
28	42.25	4.38	5.19	31.50	0.50	9.25	31.62	28.00	28	2.12	38.00	2	1060	1970
30	44.50	4.50	5.50	33.75	0.50	9.75	33.94	30.00	28	2.12	40.25	2	1210	1330
32	47.00	4.62	5.81	36.00	0.50	10.25	36.12	32.00	28	2.38	42.50	2 1/4	1375	2575
34	49.00	4.75	6.06	38.00	0.56	10.62	38.31	34.00	28	2.38	44.50	2 1/4	1540	3100
36	51.75	4.88	6.38	40.25	0.56	11.12	40.62	36.00	28	2.62	47.00	2 1/2	1705	3610
38	50.00	6.00	6.12	41.50	0.56	10.00	40.25	38.00	28	2.38	45.75	2 1/4	1470	3280
40	52.00	6.25	6.38	43.75	0.56	10.38	42.25	40.00	32	2.38	47.75	2 1/4	1630	3680
42	55.25	6.62	6.75	46.00	0.56	11.00	44.38	42.00	28	2.62	50.50	2 1/2	2030	4400
44	57.25	6.81	7.00	48.25	0.56	11.38	46.50	44.00	32	2.62	52.50	2 1/2	2160	4885
46	59.50	7.06	7.31	50.25	0.56	11.81	48.62	46.00	32	2.62	54.75	2 1/2	2410	5530
48	62.75	7.44	7.69	52.50	0.56	12.44	50.75	48.00	32	2.88	57.50	2 3/4	2855	6425
50	65.75	7.75	8.00	54.50	0.56	12.94	52.88	50.00	28	3.12	60.00	3	3330	7360
52	67.75	8.00	8.25	56.50	0.56	13.25	54.88	52.00	32	3.12	62.00	3	3560	8015
54	70.00	8.25	8.56	58.75	0.56	13.75	57.00	54.00	32	3.12	64.25	3	3920	8915
56	73.00	8.56	8.88	60.75	0.62	14.25	59.12	56.00	32	3.38	66.75	3 1/4	4280	10000
58	75.00	8.75	9.12	63.00	0.62	14.56	61.12	58.00	32	3.38	68.75	3 1/4	4640	10880
60	78.50	9.19	9.56	65.25	0.69	15.31	63.38	60.00	28	3.62	71.75	3 1/2	5000	12030
class 900 LARGE DIAMETER FLANGES ASME B16.47 Series A or MSS SP-44														
26	42.75	5.50	6.31	29.50	0.44	11.25	30.50	26.00	20	2.88	37.50	2 3/4	1525	2400
28	46.00	5.62	6.75	31.50	0.50	11.75	32.75	28.00	20	3.12	40.25	3	1810	2945
30	48.50	5.88	7.18	33.75	0.50	12.25	35.00	30.00	20	3.12	42.75	3	2120	3500
32	51.75	6.25	7.62	36.00	0.50	13.00	37.25	32.00	20	3.38	45.50	3 1/4	2545	4230
34	55.00	6.50	8.06	38.00	0.56	13.75	39.62	34.00	20	3.62	48.25	3 1/2	2970	5030
36	57.50	6.75	8.44	40.25	0.56	14.25	41.88	36.00	20	3.62	50.75	3 1/2	3395	5800
38	57.50	7.50	8.50	43.25	0.75	13.88	42.25	38.00	20	3.62	50.75	3 1/2	3385	5825
40	59.50	7.75	8.81	45.75	0.81	14.31	44.38	40.00	24	3.62	52.75	3 1/2	3620	6390
42	61.50	8.12	9.12	47.75	0.81	14.62	46.31	42.00	24	3.62	54.75	3 1/2	3960	7110
44	64.88	8.44	9.56	50.00	0.88	15.38	48.62	44.00	24	3.88	57.62	3 3/4	4300	8265
46	68.25	8.88	10.06	52.50	0.88	16.18	50.88	46.00	24	4.12	60.50	4	4640	10345
48	70.25	9.19	10.38	54.50	0.94	16.50	52.88	48.00	24	4.12	62.50	4	4980	10600
50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
52	--	--	--	--	--	--	--	--	--	--	--	--	--	--
54	--	--	--	--	--	--	--	--	--	--	--	--	--	--
56	--	--	--	--	--	--	--	--	--	--	--	--	--	--
58	--	--	--	--	--	--	--	--	--	--	--	--	--	--
60	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTE

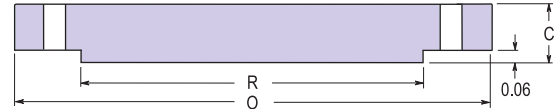
△ The 1/4" raised face is not included in Thickness C, Length Y.

See Notes on Page 30

LARGE DIAMETER FLANGES



WELDING NECK



BLIND

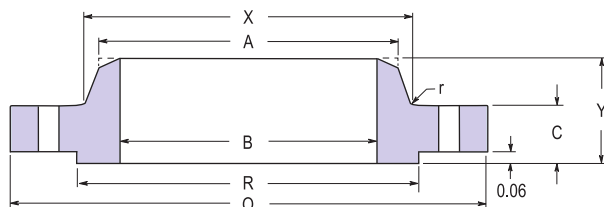
Nominal Pipe Size	Flange								Bolting				Weights	
	OD	Thickness		Raised Face OD	Fillet Radius Min.	Hub			No. of Holes	Hole Size	Bolt Circle Dia.	Stud Bolt Diameter	Weld Neck Flange	Blind
		WN Flg	Blind*			Length	Bottom OD	Top OD						
	O	C	C	R	r	Y	X	A						
class 75 LARGE DIAMETER FLANGES ASME B16.47 Series B or API 605*														
26	30.00	1.31	1.31	27.75	0.31	2.31	26.62	26.06	36	0.75	28.50	5/8	80	255
28	32.00	1.31	1.31	29.75	0.31	2.44	28.62	28.06	40	0.75	30.50	5/8	85	290
30	34.00	1.31	1.31	31.75	0.31	2.56	30.62	30.06	44	0.75	32.50	5/8	90	330
32	36.00	1.38	1.44	33.75	0.31	2.75	32.62	32.06	48	0.75	34.50	5/8	105	390
34	38.00	1.38	1.50	35.75	0.31	2.88	34.62	34.06	52	0.75	36.50	5/8	110	430
36	40.69	1.44	1.67	38.00	0.38	3.38	36.81	36.06	40	0.88	39.06	3/4	145	518
38	42.69	1.50	1.75	40.00	0.38	3.50	38.81	38.06	40	0.88	41.06	3/4	160	595
40	44.69	1.50	1.75	42.00	0.38	3.62	40.81	40.06	44	0.88	43.06	3/4	170	760
42	46.69	1.56	1.88	44.00	0.38	3.75	42.81	42.06	48	0.88	45.06	3/4	185	895
44	49.25	1.69	1.94	46.25	0.38	4.12	44.88	44.06	36	1.00	47.38	7/8	230	1065
46	51.25	1.75	2.00	48.25	0.38	4.25	46.88	46.06	40	1.00	49.38	7/8	245	1185
48	53.25	1.81	2.12	50.25	0.38	4.38	48.88	48.06	44	1.00	51.38	7/8	270	1315
50	55.25	1.88	2.18	52.25	0.38	4.56	50.94	50.06	44	1.00	53.38	7/8	290	1505
52	57.38	1.88	2.25	54.25	0.38	4.75	52.94	52.06	48	1.00	55.50	7/8	310	1665
54	59.38	1.94	2.38	56.25	0.38	4.94	55.00	54.06	48	1.00	57.50	7/8	340	1840
56	62.00	2.00	2.44	58.25	0.44	5.31	57.12	56.06	40	1.12	59.88	1	400	2110
58	64.00	2.06	2.50	60.50	0.44	5.44	59.12	58.06	44	1.12	61.88	1	430	2300
60	66.00	2.19	2.62	62.50	0.44	5.69	61.12	60.06	44	1.12	63.88	1	475	2500
class 150 LARGE DIAMETER FLANGES ASME B16.47 Series B or API 605*														
26	30.94	1.62	1.75	28.00	0.38	3.50	26.94	26.06	36	0.88	29.31	3/4	120	363
28	32.94	1.75	1.88	30.00	0.38	3.75	28.94	28.06	40	0.88	31.31	3/4	140	443
30	34.94	1.75	2.00	32.00	0.38	3.94	31.00	30.06	44	0.88	33.31	3/4	150	530
32	37.06	1.81	2.12	34.00	0.38	4.25	33.06	32.06	48	0.88	35.44	3/4	170	598
34	39.56	1.94	2.25	36.25	0.38	4.34	35.12	34.06	40	1.00	37.69	7/8	210	781
36	41.62	2.06	2.31	38.25	0.38	4.62	37.19	36.06	44	1.00	39.75	7/8	240	883
38	44.25	2.12	2.50	40.25	0.38	4.88	39.25	38.12	40	1.12	42.12	1	290	1050
40	46.25	2.19	2.62	42.50	0.38	5.06	41.31	40.12	44	1.12	44.12	1	310	1205
42	48.25	2.31	2.69	44.50	0.44	5.25	43.38	42.12	48	1.12	46.12	1	345	1350
44	50.25	2.38	2.81	46.50	0.44	5.38	45.38	44.12	52	1.12	48.12	1	370	1520
46	52.81	2.44	2.94	48.62	0.44	5.69	47.44	46.12	40	1.25	50.56	1 1/8	435	1796
48	54.81	2.56	3.06	50.75	0.44	5.88	49.50	48.12	44	1.25	52.56	1 1/8	480	2015
50	56.81	2.69	3.18	52.75	0.44	6.06	51.50	50.12	48	1.25	54.56	1 1/8	520	2245
52	58.81	2.75	3.31	54.75	0.44	6.19	53.56	52.12	52	1.25	56.56	1 1/8	550	2502
54	61.00	2.81	3.44	56.75	0.44	6.38	55.62	54.12	56	1.25	58.75	1 1/8	620	2780
56	63.00	2.88	3.56	58.75	0.56	6.56	57.69	56.12	60	1.25	60.75	1 1/8	650	3070
58	65.94	2.94	3.68	60.75	0.56	6.88	59.69	58.12	48	1.38	63.44	1 1/4	780	3492
60	67.94	3.00	3.81	63.00	0.56	7.06	61.81	60.12	52	1.38	65.44	1 1/4	850	3835

NOTE

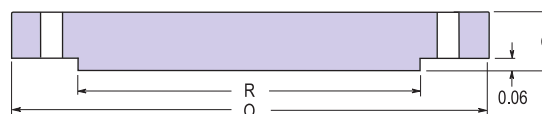
*Blinds are not included in API 605.

See Notes on Page 30

LARGE DIAMETER FLANGES



WELDING NECK



BLIND

Nominal Pipe Size	Flange								Bolting				Weights	
	OD	Thickness		Raised Face OD	Fillet Radius Min.	Hub			No. of Holes	Hole Size	Bolt Circle Dia.	Stud Bolt Diameter	Weld Neck Flange	Blind
		ΔWN Flg	Δ Blind*			Δ Length	Bottom OD	Top OD						
	O	C	C	R	r	Y	X	A						
class 300 LARGE DIAMETER FLANGES ASME B16.47 Series B or API 605*														
26	34.12	3.50	3.50	29.00	0.56	5.69	27.62	26.19	32	1.38	31.62	1 1/4	400	853
28	36.25	3.50	3.50	31.00	0.56	5.88	29.75	28.19	36	1.38	33.75	1 1/4	450	960
30	39.00	3.69	3.69	33.25	0.56	6.22	32.00	30.25	36	1.50	36.25	1 3/8	550	1182
32	41.50	4.06	4.06	35.50	0.62	6.62	34.00	32.25	32	1.62	38.50	1 1/2	685	1515
34	43.62	4.06	4.06	37.50	0.62	6.81	36.12	34.25	36	1.62	40.62	1 1/2	750	1660
36	46.12	4.06	4.06	39.75	0.62	7.12	38.00	36.25	32	1.75	42.88	1 5/8	840	1824
38	48.12	4.38	4.38	41.75	0.62	7.56	40.00	38.25	36	1.75	44.88	1 5/8	915	2140
40	50.12	4.56	4.56	43.88	0.62	7.81	42.00	40.25	40	1.75	46.88	1 5/8	990	2415
42	52.50	4.69	4.69	46.00	0.62	8.06	44.00	42.31	36	1.88	49.00	1 3/4	1135	2790
44	54.50	5.00	5.00	48.00	0.62	8.44	46.19	44.31	40	1.88	51.00	1 3/4	1235	3210
46	57.50	5.06	5.12	50.00	0.62	8.75	48.38	46.31	36	2.00	53.75	1 7/8	1470	3665
48	59.50	5.06	5.31	52.25	0.62	8.81	50.31	48.31	40	2.00	55.75	1 7/8	1575	4050
50	61.50	5.44	5.50	54.25	0.62	9.25	52.38	50.31	44	2.00	57.75	1 7/8	1710	4450
52	63.50	5.62	5.68	56.25	0.62	9.56	54.44	52.31	48	2.00	59.75	1 7/8	1840	4925
54	65.88	5.38	5.88	58.25	0.62	9.44	56.50	54.31	48	2.00	62.12	1 7/8	1980	5446
56	69.50	6.06	6.18	60.50	0.69	10.56	58.81	56.31	36	2.38	65.00	2 1/4	2595	6480
58	71.94	6.06	6.38	62.75	0.69	10.81	60.94	58.31	40	2.38	67.44	2 1/4	2770	7069
60	73.94	5.94	6.56	65.00	0.69	10.69	62.94	60.31	40	2.38	69.44	2 1/4	2870	7695
Δ class 600 LARGE DIAMETER FLANGES ASME B16.47 Series B or API 605*														
26	35.00	4.38	4.38	28.62	0.50	7.12	27.50	26.00	28	1.75	31.75	1 5/8	550	1109
28	37.50	4.56	4.56	30.88	0.50	7.50	29.62	28.00	28	1.88	34.00	1 3/4	650	1363
30	40.25	4.94	5.00	33.12	0.50	8.06	31.75	30.00	28	2.00	36.50	1 7/8	810	1655
32	42.75	5.12	5.31	35.25	0.50	8.50	33.88	32.00	28	2.12	38.75	2	950	2028
34	45.75	5.56	5.68	37.50	0.56	9.19	36.00	34.00	24	2.38	41.50	2 1/4	1205	2516
36	47.75	5.75	5.94	39.75	0.56	9.56	38.12	36.00	28	2.38	43.50	2 1/4	1340	2854
38	50.00	6.00	6.12	41.50	0.56	10.00	40.25	38.00	28	2.38	45.75	2 1/4	1470	3280
40	52.00	6.25	6.38	43.75	0.56	10.38	42.25	40.00	32	2.38	47.75	2 1/4	1630	3680
42	55.25	6.62	6.75	46.00	0.56	11.00	44.38	42.00	28	2.62	50.50	2 1/2	2030	4400
44	57.25	6.81	7.00	48.25	0.56	11.38	46.50	44.00	32	2.62	52.50	2 1/2	2160	4885
46	59.50	7.06	7.31	50.25	0.56	11.81	48.62	46.00	32	2.62	54.75	2 1/2	2410	5530
48	62.75	7.44	7.69	52.50	0.56	12.44	50.75	48.00	32	2.88	57.50	2 3/4	2855	6425
50	65.75	7.75	8.00	54.50	0.56	12.94	52.88	50.00	28	3.12	60.00	3	3330	7360
52	67.75	8.00	8.25	56.50	0.56	13.25	54.88	52.00	32	3.12	62.00	3	3560	8015
54	70.00	8.25	8.56	58.75	0.56	13.75	57.00	54.00	32	3.12	64.25	3	3920	8915
56	73.00	8.56	8.88	60.75	0.62	14.25	59.12	56.00	32	3.38	66.75	3 1/4	4280	10000
58	75.00	8.75	9.12	63.00	0.62	14.56	61.12	58.00	32	3.38	68.75	3 1/4	4640	10880
60	78.50	9.19	9.56	65.25	0.69	15.31	63.38	60.00	28	3.62	71.75	3 1/2	5000	12030

NOTE

Dimensions for Class 400 NPS 38 & Larger Series B Flanges are the same as for the Series A Flanges.

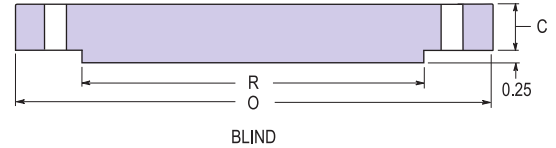
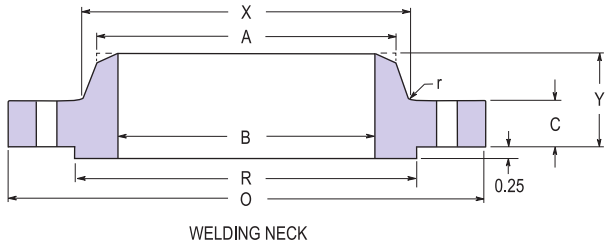
* Blinds are not included in API 605.

Δ The 1/4" raised face is not included in Thickness C, Length Y. See drawing on page 30 for details.

Class 400 large diameter flanges and blinds are available upon request.

See Notes on Page 30

LARGE DIAMETER FLANGES



Nominal Pipe Size	Flange								Bolting				Weights	
	OD	Thickness		Raised Face OD	Fillet Radius Min.	Hub			No. of Holes	Hole Size	Bolt Circle Dia.	Stud Bolt Diameter	Weld Neck Flange	Blind
		Δ WN Flg	Δ Blind*			Δ Length	Bottom OD	Top OD						
	O	C	C	R	r	Y	X	A						
class 900 LARGE DIAMETER FLANGES ASME B16.47 Series B or API 605*														
26	40.25	5.31	6.06	30.00	0.44	10.19	29.25	26.00	20	2.62	35.50	2 1/2	1050	1996
28	43.50	5.81	6.56	32.25	0.50	10.88	31.38	28.00	20	2.88	38.25	2 3/4	1520	2580
30	46.50	6.12	6.93	34.50	0.50	11.38	33.50	30.00	20	3.12	40.75	3	1820	3095
32	48.75	6.31	7.31	36.50	0.50	11.94	35.75	32.00	20	3.12	43.00	3	2065	3583
34	51.75	6.75	7.68	39.00	0.56	12.56	37.88	34.00	20	3.38	45.50	3 1/4	2450	4210
36	53.00	6.81	7.94	40.50	0.56	12.81	40.00	36.00	24	3.12	47.25	3	2520	4550
38	57.50	7.50	8.50	43.25	0.75	13.88	42.25	38.00	20	3.62	50.75	3 1/2	3385	5825
40	59.50	7.75	8.81	45.75	0.81	14.31	44.38	40.00	24	3.62	52.75	3 1/2	3620	6390
42	61.50	8.12	9.12	47.75	0.81	14.62	46.31	42.00	24	3.62	54.75	3 1/2	3960	7110
44	64.88	8.44	9.56	50.00	0.88	15.38	48.62	44.00	24	3.88	57.62	3 1/4	4300	8265
46	68.25	8.88	10.06	52.50	0.88	16.18	50.88	46.00	24	4.12	60.50	4	4640	10345
48	70.25	9.19	10.38	54.50	0.94	16.50	52.88	48.00	24	4.12	62.50	4	4980	10600
50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
52	--	--	--	--	--	--	--	--	--	--	--	--	--	--
54	--	--	--	--	--	--	--	--	--	--	--	--	--	--
56	--	--	--	--	--	--	--	--	--	--	--	--	--	--
58	--	--	--	--	--	--	--	--	--	--	--	--	--	--
60	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Dimensions for Classes 600 & 900 NPS 38 & Larger Series B Flanges are the same as for the Series A Flanges.

* Blinds are not included in API 605.

Δ The 1/4" raised face is not included in Thickness C, Length Y.

GENERAL NOTES FOR FCI STANDARD LARGE DIAMETER FLANGES

CODES: FCI large diameter flanges are manufactured in compliance with ASME Section II, Section VIII, Div. 1, and ASME B16.47 Series A and B.

MATERIALS: All materials comply with the applicable ASME and ASTM specifications. Full traceability is mandated by our quality system. Standard forged material is carbon steel SA105. Large diameter flanges can also be furnished in other carbon steels, alloy steels, stainless, high nickel and non-ferrous alloys upon request.

BORES: Large diameter flange bores are to be specified by Purchaser.

FACING: Standard facing is raised face to ASME B16.47 Series A or B as applicable. The 0.06" raised face is included in thickness "C" and length "Y" dimensions for Class 75, 150 and 300 large diameter flange connections. The 0.25" raised face is not included in thickness "C" and "Y" dimensions for Class 400, 600, and Class 900 large diameter flange connections. Other standard and special facings are available upon request.

LENGTHS: Listed lengths are standard. Other lengths are available on special order.

FLANGES: Flange dimensions and drilling are in accordance with ASME B16.47 Series A or B as applicable. Studs, bolts, nuts, and gaskets are not furnished.

HEAT TREATMENT: All standard connections over Class 300 rating are supplied in the normalized condition in accordance with the requirements of ASME Section II. Other heat treatment requirements can be provided upon request.

TOLERANCE: Manufacturing tolerances as a minimum, will meet the requirements of ASME B16.47 unless otherwise specified.

CUSTOM PRODUCTS



2 1/2" to 34" Bar and Ingot Inventory



Carbon and Alloy Large Ingot and Billet Inventory



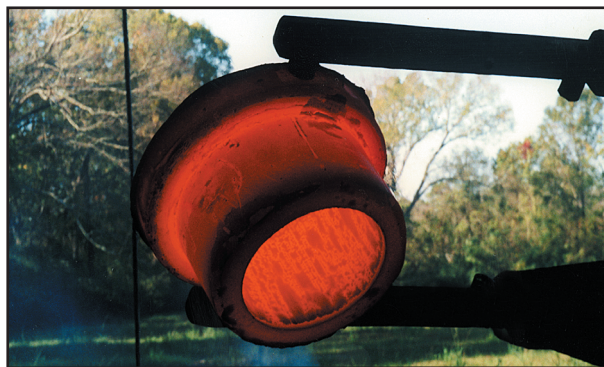
Carbon And Alloy Billet and Bar Inventory



Stainless Steel Billet and Bar Inventory



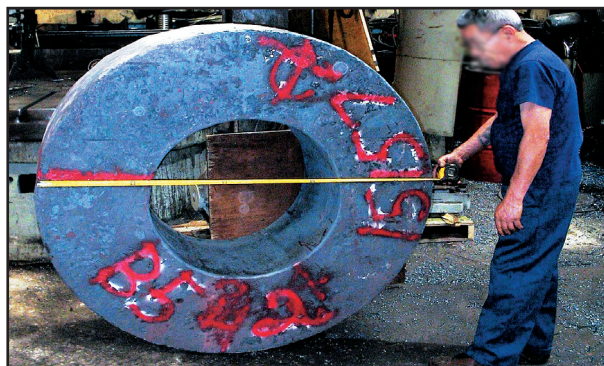
Forged Cylinders Being Air Cooled After Heat Treatment



Large Bore Long Weld Neck "LWN" Connection



California Style Ring Mill



Large Forged Ring

CUSTOM PRODUCTS



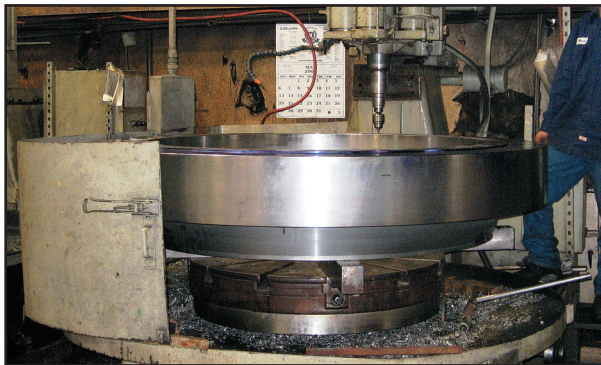
As Forged Inventory



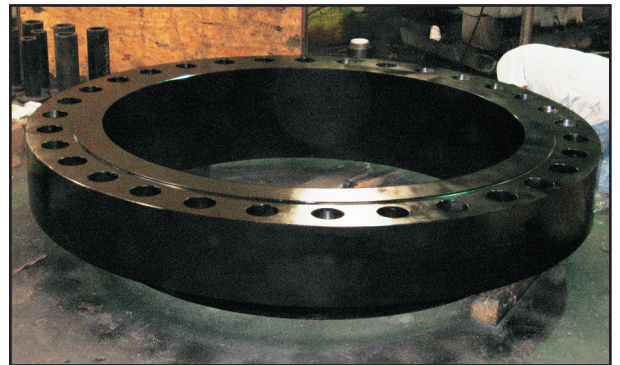
Large Diameter Forged Cylinder



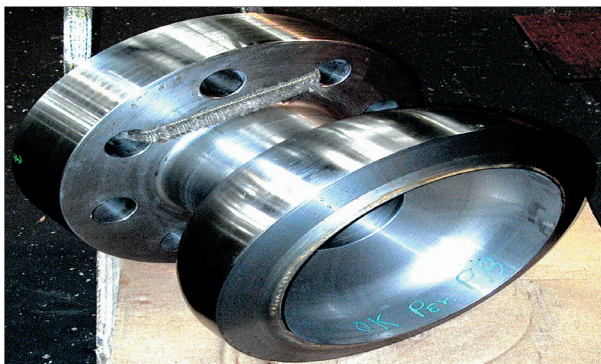
2500 Ton Press Forging Large Cyclinder



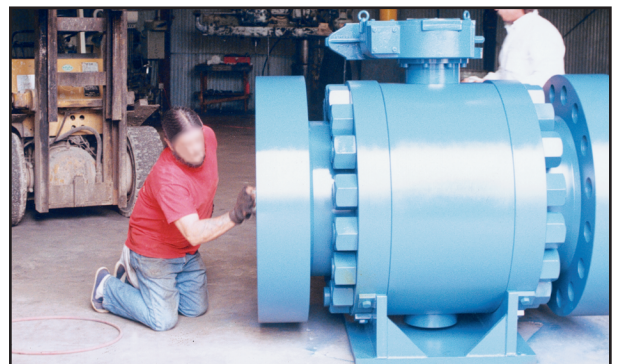
Large Diameter Flange



Large Diameter Flange



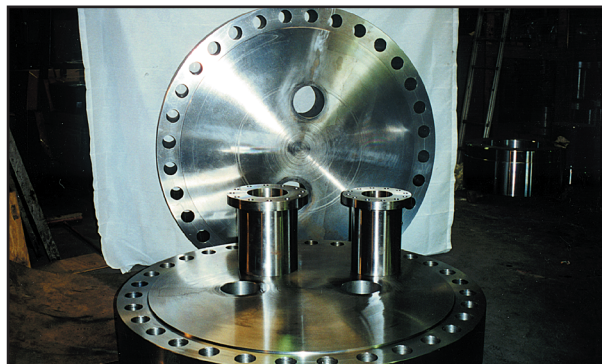
Integral Nozzle and Elliptical Head



2 Valve End Adaptors, Bonnets, Bodies, Special Balls, Trunnions



Vessel Insert Double Butt Weld Hubs



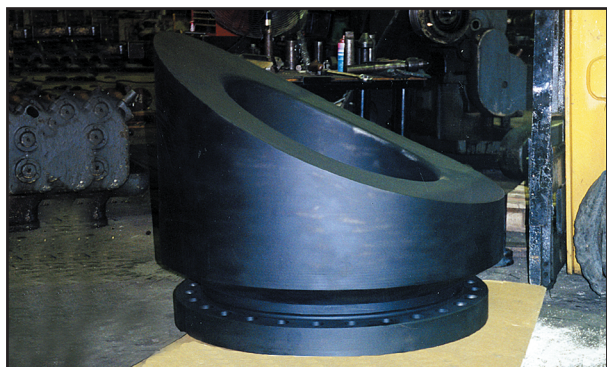
Blind Flanges and "LWN" Connections



Mandrel Connector



Oval Transition Nozzles – Nickel Alloy



Tangential Super Barrel "SB" Connection



66" ID Contoured Butt Weld Stub



Forged Conical Reducer

CUSTOM PRODUCTS



HB Necks Q-Lip Style for Radial Attachments and Cylindrical Hillside Complete with Bevels



36" F11 Hillside Q-Lip Stubs for Coker Vessels



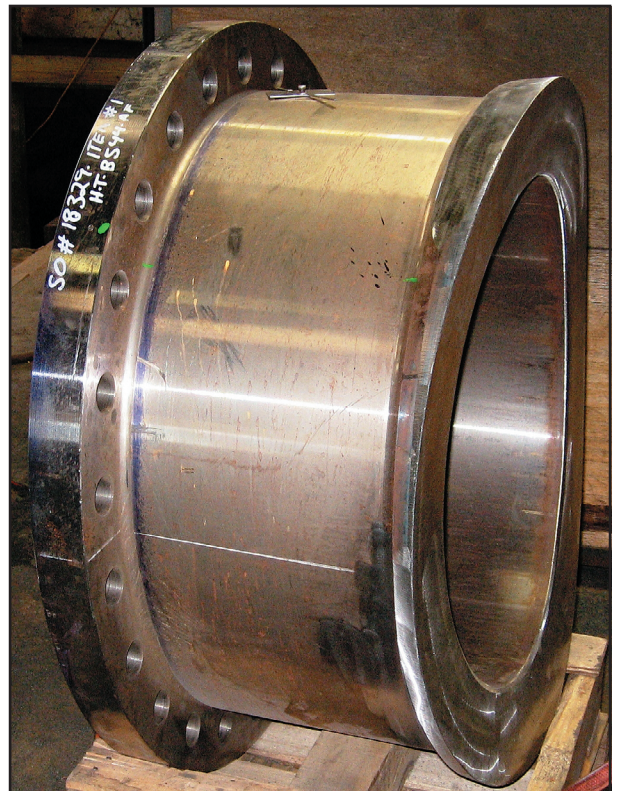
F11 Heavy Wall Q-Lip Stub



Hillside Q-Lip Stubs for Coker Vessels



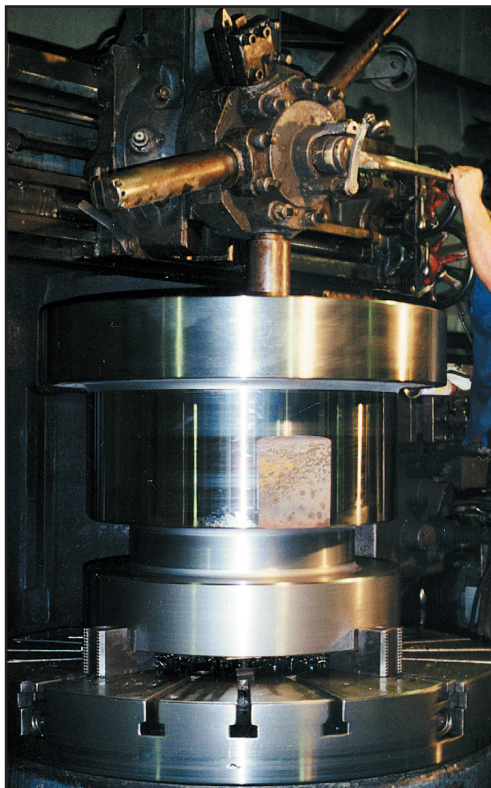
Elliptical Q-Lip Coker Nozzle



24" 300# Contoured Q-Lip Nozzle



19,000 Lb Pigable Y Block Forging



11" x 15M 7" x 20M Tubing Head



38" Double Flanged Spool



6" 600# H Neck 71" Long

CUSTOM PRODUCTS



Tubing Head 13 5/8" 5M x 11" 10M with 1 13/16" 10M Outlets



11" 10M Lower Slip Loc Housing with FPO's



Running Tool



15M and 10M Spool with Studded Outlets



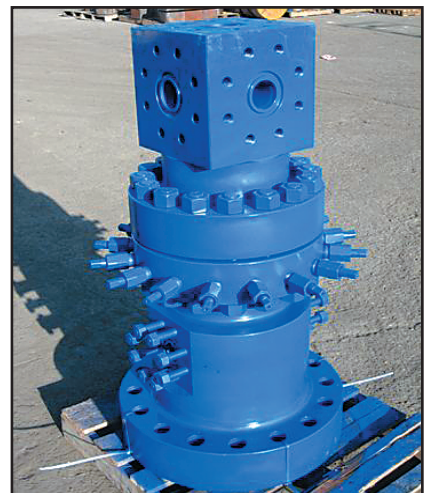
11" 10M Lower Connector



Combination Test Plug, Running and Retrieving Tool 11" x 4 1/2" IF

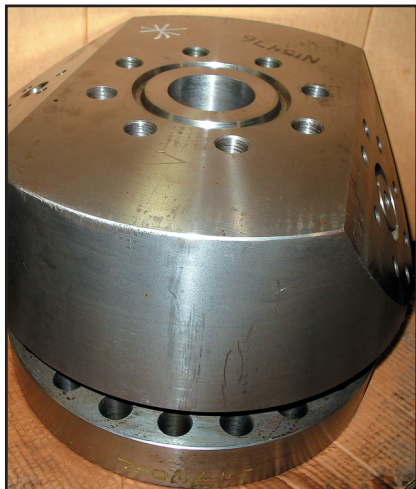


11" 10M x 11" 10M Upper Mult-Bowl



3 1/16" 15M Five Way Cross and 11" 10M x 7 1/16" 15M TCM Tubing Head

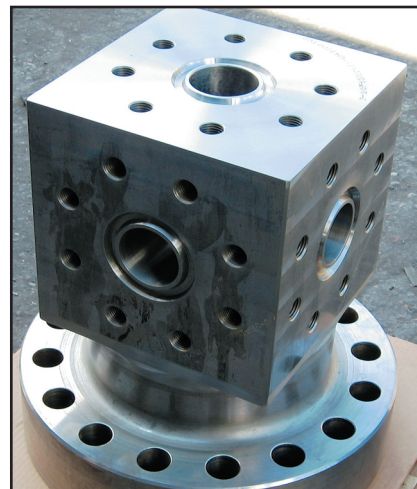
CUSTOM PRODUCTS



**Tubing Bonnet 11" 5M x 4" 5M with
2" 5M Outlet and Control Line**



7 1/16" 5M Studded Tee



**7 1/16" 15M Studded Flange Bottom
x 3 1/16" 15M Five Way Cross Top**



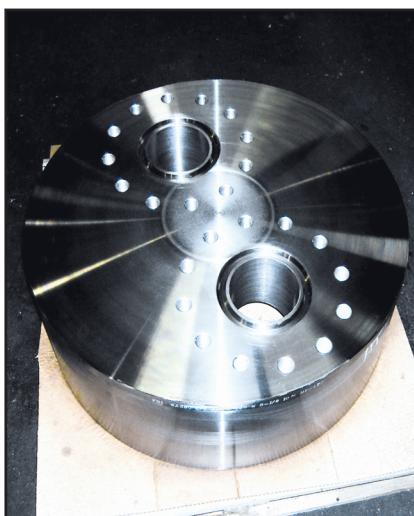
API Weld Neck Flange



Multi-Bowl 13 5/8" 5M x 13 5/8" 5M With Control Line



**7 1/16" 15M Spool with 4 1/16" 15M
Studded Outlets API PSL-3**



Dual Adapter 7 1/16" 10M x 7 1/16" 10M

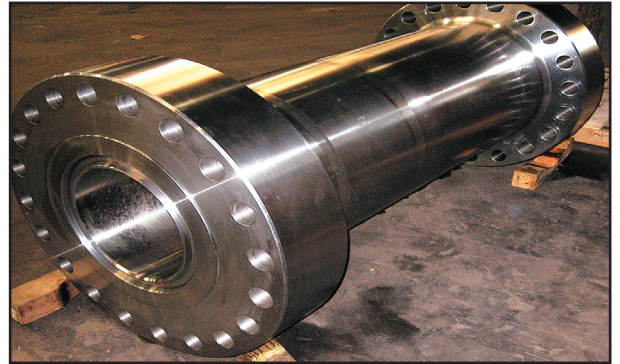


**12" 4130 High Pressure Water
Injection Tee**

CUSTOM PRODUCTS



Casing Heads



13 5/8" 15M x 13 5/8 15M Riser Spool 72" Long



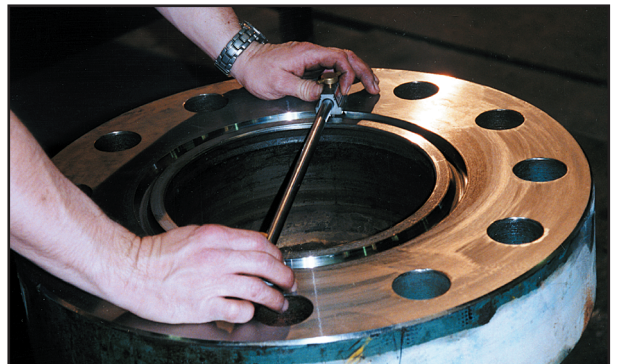
4 1/16" 10M Tree Cap Components



20 3/4" 3M x 16 3/4" 5M Spool with 9" 5M EFO's



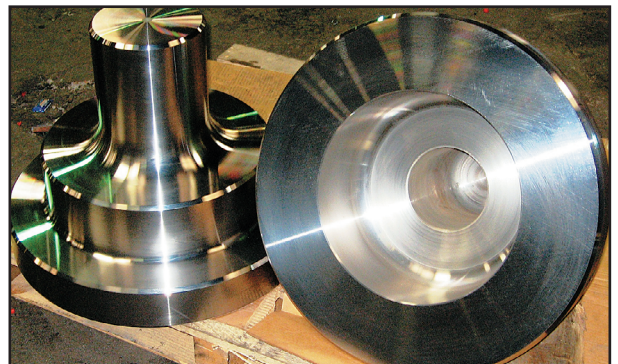
High Pressure Tapered Plug Flange



Wellhead Remanufacture/Contract Machine Work



Double Hubbed Flanged Bonnet Forgings



Completed Double Hubbed Flanged Bonnet

TECHNICAL SECTION

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NOTE:

Technical data contained in this section governed by ASME or other Codes/Specifications are subject to change and are therefore provided for information purposes only and are not to be used for design purposes. Refer to latest edition of applicable Code / Specification and addendums thereto for required design data.

COMMON FORGING MATERIALS FOR FCI PRODUCTS *

SA 105	Carbon Steels	
SA 182	Low Alloy Steels	F1, F5, F5a, F9, F91, F11, F12, F22
	Martensitic Stainless Steels	F6a, F6NM
	Ferritic-Austenitic Stainless Steels	F51, F60
	Austenitic Stainless Steels	F304, F304H, F304L, F310, F316, F316H, F316L, F317, F317L, F321, F321H, F347, F347H, F348, F348H
SA 266	Carbon Steels	Gr.1, Gr.2, Gr.3, Gr.4
SA 350	Carbon and Low Alloy Steels	LF1, LF2, LF3, LF6 Class 1, LF6 Class 2, LF9
SA 541	Q & T Carbon and Alloy Steels	Gr.2 Class 2, Gr.22 Class 3
SA 765	Carbon and Low Alloy, Low Temp. Steels	Gr.1, Gr.2, Gr.3, Gr.4
API	Carbon, Low Alloy and Stainless Steels	36K, 45K, 60K, 75K, 110K
AISI	Carbon Steels	1018M, 1020M, 1022M, 1030's, 1040's
	Carbon Alloy Steels	4130, 4140, 4340, 8630, 8630M
A 694	High Yield Steels	F42, F46, F48, F50, F52, F56, F60, F65, F70
A 705	Age Hardening Stainless Steels	17-4PH
A 707	Carbon and Alloy Steels	Gr.L3 Class 1, Gr.L3 Class 2, Gr.L3 Class 3
B 564	Nickel Alloy Steels	Series 400, 600 and 800

NOTE

Purchaser to specify material class where applicable.

Materials listed are normally available in raw form from FCI inventories or stocks made available to FCI.

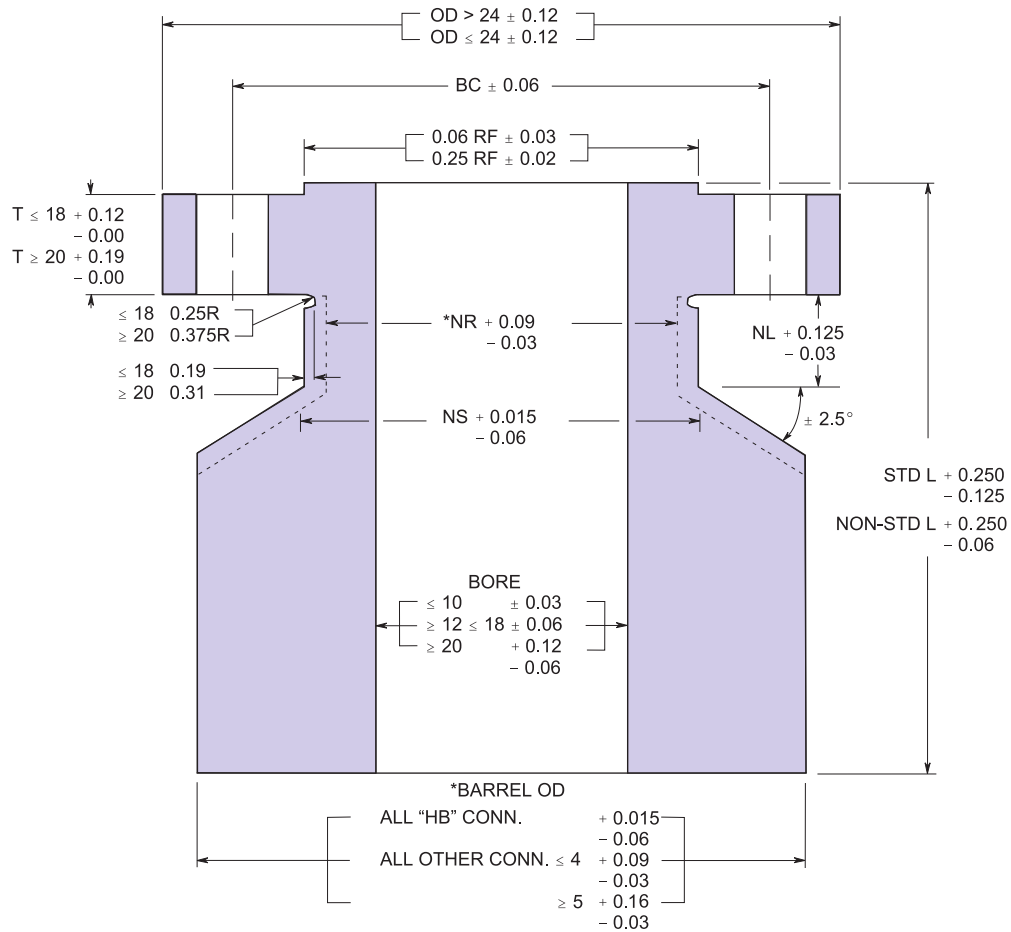
All materials comply with the applicable ASME, ASTM, API and AISI Codes and/or Specifications.

Materials can be selected to comply with "NACE" requirements upon request.

* Products can also be furnished in other carbon steels, alloy steels, stainless, high nickel and non-ferrous alloys upon request.

* Materials exhibiting other than standard Code chemical and/or physical properties or materials requiring specialized steel making practices can be furnished upon special order.

FCI CONNECTION TOLERANCES

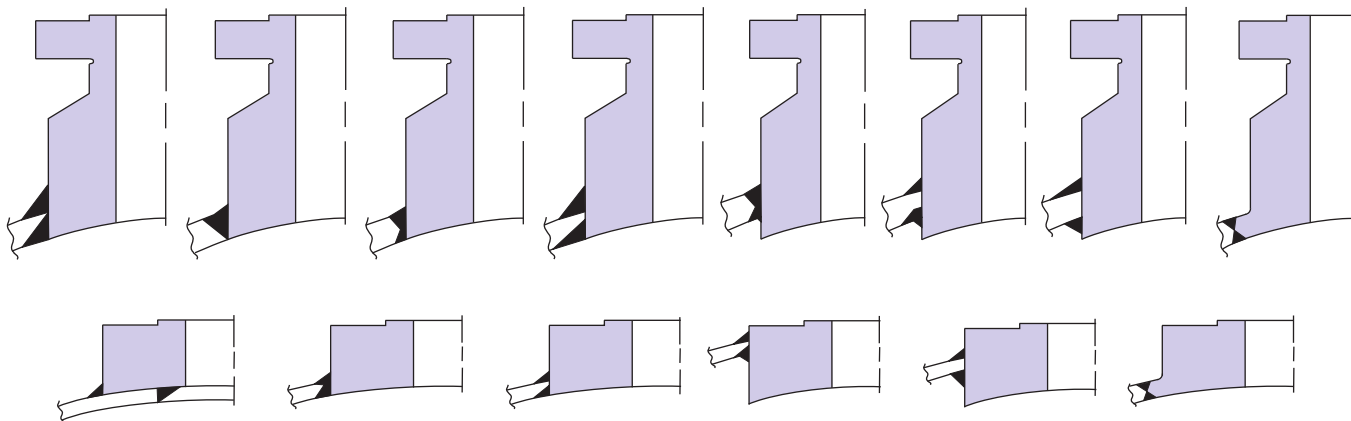


NOTE

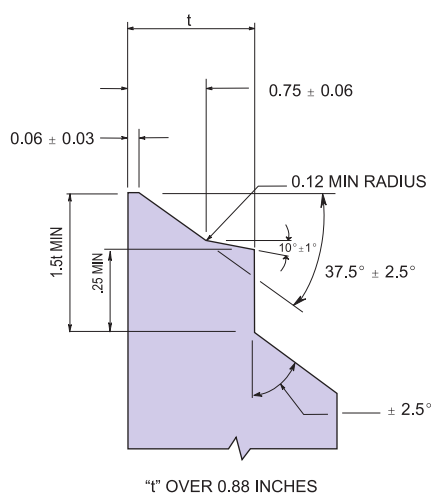
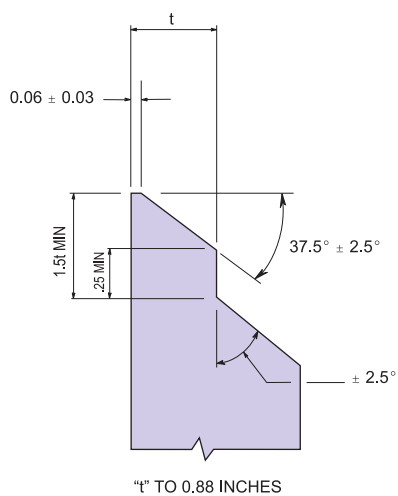
1. All dimensions are in inches.
2. Tolerances and undercut dimensions are in accordance with ASME B16.5 and ASME Section VIII, Div. 1, App. 2, Fig. 2-4.
3. Tolerances for FCI products will be modified as necessary to maintain compliance with latest Code updates.
4. Tolerances may be modified to meet other more stringent requirements upon Purchaser's request.

* Specific tolerance may deviate but minimum wall thickness will be maintained.

COMMON METHODS OF CONNECTION ATTACHMENTS



STANDARD WELD END PREPARATIONS



NOTE

1. All dimensions are in inches.
2. Bevel dimensions and tolerances are in accordance with ASME B16.5.
3. Butt weld end connections can be beveled to other special configurations upon Purchaser's request.

GENERAL NOTES FOR FCI FLANGE FACINGS

FCI connections are available with numerous standard and special facings. The more popular standard facings are described below. Special facing details if required are to be furnished by Purchaser.

RAISED FACE: Furnished as a standard facing on all FCI connections unless otherwise specified. The facing height and outside diameter are specified in the standard product tables. Gasket surface serrations are spiral and are in full compliance with the requirements of the latest issue of ASME B16.5, ASME B16.47 Series A & B, and ASME B46.1.

FLAT FACE: All connections may be ordered flat faced. Class 75, 150 and 300 connections and flanges ordered flat faced, will have the normally furnished raised face removed by machining. The resulting minimum flange thickness will be 0.06 inches less than that specified in the standard product tables. On connections and flanges rated Class 400 and greater, the raised face normally furnished will also be removed by machining, however, the resulting flange thickness will not be less than the flange thickness dimension specified in the product table.

Alternately, all connections and flanges may be ordered as "full-flat-face". When so ordered, Class 75, 150 and 300 connections and flanges will be furnished with a minimum flange thickness as specified in the product table. Class 400, 600, 900, 1500 and 2500 connections and flanges will be furnished with a minimum flange thickness as specified in the product table thickness plus 0.25 inches.

In all cases, the entire connection/flange mating surface will be finished to a surface roughness not exceeding 250 AARH unless otherwise specified by Purchaser.

Options mentioned above are in accordance with ASME B16.5 and ASME B16.47 Code requirements.

ROUGH FORGING: Except as otherwise specified, no finish machining or drilling of holes will be performed on rough forgings. A minimum of 0.12 inches will be provided on all surfaces for Purchaser machining. Facing heights exceeding those of a standard raised face must be indicated.

RING TYPE JOINT: The following table lists the dimensions and tolerances applicable to ring type joint facings for ASME B16.5 flanges. The side walls of the gasket groove are finished to a maximum surface roughness of 63 AARH. Ring joint facings can be furnished for large diameter flanges in accordance with ASME B16.47 upon request.

OTHER STANDARD FACINGS: The dimensional details of other standard facings for ASME B16.5 flanged connections are presented in the table following "Facing Dimensions For Ring Joint Connections". Other standard facings can be furnished for large diameter flanges in accordance with ASME B16.47 upon request.

"SWEEP LOSS" CHART

SHELL OR HEAD CROWN RADIUS	CONNECTION RADIUS																				
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
5.375	0.39	0.92	1.78	3.40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.375	0.32	0.75	1.41	2.42	4.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7	0.29	0.68	1.26	2.10	3.39	7.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8	0.25	0.58	1.07	1.76	2.71	4.13	8.00	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	0.23	0.51	0.94	1.52	2.29	3.34	4.88	9.00	-	-	-	-	-	-	-	-	-	-	-	-	
10	0.20	0.46	0.83	1.34	2.00	2.86	4.00	5.64	10.00	-	-	-	-	-	-	-	-	-	-	-	
12	0.17	0.38	0.69	1.09	1.61	2.25	3.06	4.06	5.37	7.20	12.00	-	-	-	-	-	-	-	-	-	
15	0.13	0.30	0.54	0.86	1.25	1.73	2.31	3.00	3.82	4.80	6.00	7.52	9.61	15.00	-	-	-	-	-	-	
18	0.11	0.25	0.45	0.71	1.03	1.42	1.88	2.41	3.03	3.75	4.58	5.55	6.69	8.05	9.75	12.08	18.00	-	-	-	
21	0.10	0.22	0.38	0.60	0.88	1.20	1.58	2.03	2.53	3.11	3.77	4.51	5.35	6.30	7.40	8.67	10.18	12.06	14.60	21.00	
24	0.08	0.19	0.34	0.53	0.76	1.04	1.37	1.75	2.18	2.67	3.22	3.83	4.51	5.27	6.11	7.06	8.13	9.34	10.73	12.38	
27	0.07	0.17	0.30	0.47	0.68	0.92	1.21	1.54	1.92	2.34	2.81	3.34	3.91	4.55	5.25	6.02	6.88	7.82	8.86	10.03	
30	0.07	0.15	0.27	0.42	0.61	0.83	1.09	1.38	1.72	2.09	2.50	2.96	3.47	4.02	4.62	5.28	6.00	6.78	7.64	8.58	
33	0.06	0.14	0.24	0.38	0.55	0.75	0.98	1.25	1.55	1.89	2.26	2.67	3.12	3.61	4.14	4.72	5.34	6.02	6.75	7.54	
36	0.06	0.13	0.22	0.35	0.50	0.69	0.90	1.14	1.42	1.72	2.06	2.43	2.83	3.27	3.75	4.27	4.82	5.42	6.07	6.76	
39	0.05	0.12	0.21	0.32	0.46	0.63	0.83	1.05	1.30	1.58	1.89	2.23	2.60	3.00	3.43	3.90	4.40	4.94	5.52	6.14	
42	0.05	0.11	0.19	0.30	0.43	0.59	0.77	0.98	1.21	1.47	1.75	2.06	2.40	2.77	3.17	3.59	4.05	4.54	5.07	5.63	
45	0.04	0.10	0.18	0.28	0.40	0.55	0.72	0.91	1.13	1.37	1.63	1.92	2.23	2.57	2.94	3.33	3.76	4.21	4.69	5.20	
48	0.04	0.09	0.17	0.26	0.38	0.51	0.67	0.85	1.05	1.28	1.52	1.79	2.09	2.40	2.75	3.11	3.50	3.92	4.37	4.84	
54	0.04	0.08	0.15	0.23	0.33	0.46	0.60	0.76	0.93	1.13	1.35	1.59	1.85	2.13	2.42	2.75	3.09	3.45	3.84	4.25	
60	0.03	0.08	0.13	0.21	0.30	0.41	0.54	0.68	0.84	1.02	1.21	1.43	1.66	1.91	2.17	2.46	2.76	3.09	3.43	3.80	
66	0.03	0.07	0.12	0.19	0.27	0.37	0.49	0.62	0.76	0.92	1.10	1.29	1.50	1.73	1.97	2.23	2.50	2.79	3.10	3.43	
72	0.03	0.06	0.11	0.17	0.25	0.34	0.45	0.56	0.70	0.85	1.01	1.18	1.37	1.58	1.80	2.04	2.29	2.55	2.83	3.13	
78	0.03	0.06	0.10	0.16	0.23	0.31	0.41	0.52	0.64	0.78	0.93	1.09	1.27	1.46	1.66	1.88	2.11	2.35	2.61	2.88	
84	0.02	0.05	0.10	0.15	0.21	0.29	0.38	0.48	0.60	0.72	0.86	1.01	1.17	1.35	1.54	1.74	1.95	2.18	2.42	2.67	
90	0.02	0.05	0.09	0.14	0.20	0.27	0.36	0.45	0.56	0.67	0.80	0.94	1.10	1.26	1.43	1.62	1.82	2.03	2.25	2.48	
96	0.02	0.05	0.08	0.13	0.19	0.26	0.33	0.42	0.52	0.63	0.75	0.88	1.03	1.18	1.34	1.52	1.70	1.90	2.11	2.33	
102	0.02	0.04	0.08	0.12	0.18	0.24	0.31	0.40	0.49	0.59	0.71	0.83	0.97	1.11	1.26	1.43	1.60	1.79	1.98	2.19	
108	0.02	0.04	0.07	0.12	0.17	0.23	0.30	0.38	0.46	0.56	0.67	0.79	0.91	1.05	1.19	1.35	1.51	1.68	1.87	2.06	
114	0.02	0.04	0.07	0.11	0.16	0.22	0.28	0.36	0.44	0.53	0.63	0.74	0.86	0.99	1.13	1.27	1.43	1.59	1.77	1.95	
120	0.02	0.04	0.07	0.10	0.15	0.20	0.27	0.34	0.42	0.51	0.60	0.71	0.82	0.94	1.07	1.21	1.36	1.51	1.68	1.85	
126	0.02	0.04	0.06	0.10	0.14	0.19	0.25	0.32	0.40	0.48	0.57	0.67	0.78	0.90	1.02	1.15	1.29	1.44	1.60	1.76	
132	0.02	0.03	0.06	0.09	0.14	0.19	0.24	0.31	0.38	0.46	0.55	0.64	0.74	0.86	0.97	1.10	1.23	1.37	1.52	1.68	
138	0.01	0.03	0.06	0.09	0.13	0.18	0.23	0.29	0.36	0.44	0.52	0.61	0.71	0.82	0.93	1.05	1.18	1.31	1.46	1.61	
144	0.01	0.03	0.06	0.09	0.13	0.17	0.22	0.28	0.35	0.42	0.50	0.59	0.68	0.78	0.89	1.01	1.13	1.26	1.40	1.54	
150	0.01	0.03	0.05	0.08	0.12	0.16	0.21	0.27	0.33	0.40	0.48	0.56	0.65	0.75	0.86	0.97	1.08	1.21	1.34	1.48	
156	0.01	0.03	0.05	0.08	0.12	0.16	0.21	0.26	0.32	0.39	0.46	0.54	0.63	0.72	0.82	0.93	1.04	1.16	1.29	1.42	
162	0.01	0.03	0.05	0.08	0.11	0.15	0.20	0.25	0.31	0.37	0.45	0.52	0.61	0.70	0.79	0.89	1.00	1.12	1.24	1.37	

CALCULATION OF CONNECTION “SWEEP LOSS”

Formula for “Sweep Loss” Calculation of Integrally Reinforced Forged Connections:

$$\text{Sweep Loss} = R - \sqrt{R^2 - r^2}$$

NOTATION

- SL = Sweep loss, inches
- R = Inside radius of shell or head crown radius, inches
- r = Outside barrel radius of connection, inches
- L = Required overall connection length, inches
- P = Projection of connection from centerline of equipment, inches
- IP = Inside projection of connection, inches

Example:

See Fig.1

Determine the required overall connection length of a 16" - 300 #RFLWN set through a 60" ID Shell.

DESIGN DATA

- L = Required overall connection length, inches
- P = 40 inches projection of connection
- IP = 0.00 inches inside projection of connection
- R = 30 inches inside radius of shell
- r = 9.5 inches outside barrel radius of connection

From the “Sweep Loss” chart or by using the above formula determine the connection sweep loss.

$$SL = R - \sqrt{R^2 - r^2} = 30 - \sqrt{30^2 - 9.5^2} = 1.54 \text{ in.}$$

Determine the required overall connection length “L”.

$$L = P - R + SL + IP = 40 - 30 + 1.54 + 0.0 = 11.54 \text{ in.}$$

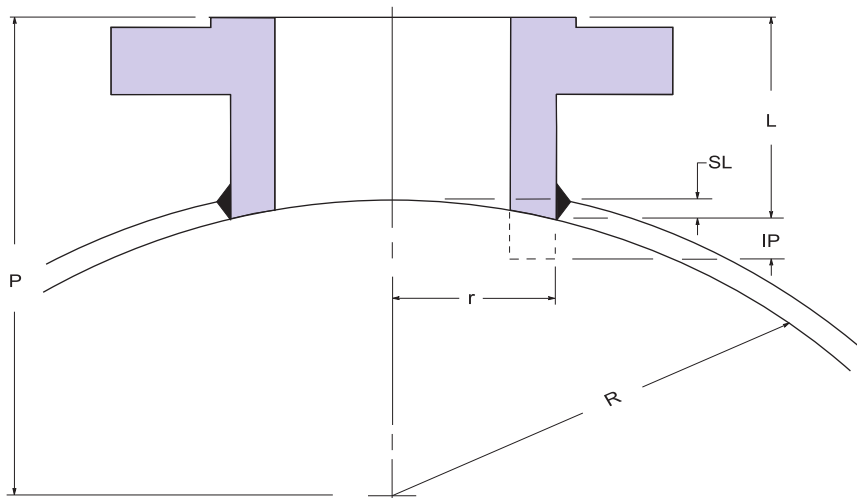


Fig. 1 Radially Installed Connection In Shell

CALCULATION OF CONNECTION “SWEEP LOSS”

Formula for “Sweep Loss” Calculation of Studding Outlet Connections:

$$\text{Sweep Loss \#1} = R - \sqrt{R^2 - r_i^2}$$

$$\text{Sweep Loss \#2} = R - \sqrt{R^2 - r_o^2}$$

NOTATION

SL1	= Sweep loss to inside radius of connection, inches
SL2	= Sweep loss to outside radius of connection, inches
R	= Inside radius of shell or head crown radius, inches
r_o	= Outside barrel radius of connection, inches
r_i	= Inside barrel radius of connection, inches
T	= Minimum required studding outlet thickness, inches
L	= Required overall studding outlet length, inches
P	= Projection of connection from centerline of equipment, inches
IP	= Inside projection of connection, inches
D	= Inside depth of head, inches

Example 1: Minimum Connection Length Per Fig. 2

Determine the required overall connection length of a 20” – 600# RF Studding Outlet set through a 48” OD ASME F&D head with a 42” inside dish radius.

DESIGN DATA

L = Required overall connection length, inches
 R = 42 inches inside head crown radius
 r_i = 10” inside barrel radius of connection
 r_o = 16” outside barrel radius of connection
 IP = 0.0” inside projection of connection
 T = 3.88” minimum required studding outlet thickness

From the “Sweep Loss” chart or by using the above formula determine connection sweep loss #1 and #2.

$$SL1 = R - \sqrt{R^2 - r_i^2} = 42 - \sqrt{42^2 - 10^2} = 1.21 \text{ in.}$$

$$SL2 = R - \sqrt{R^2 - r_o^2} = 42 - \sqrt{42^2 - 16^2} = 3.17 \text{ in.}$$

Determine the required overall connection length “L”.

$$L = T + SL2 - SL1 + IP = 3.88 + 3.17 - 1.21 + 0.0 = 5.84”$$

Example 2: Maintain Connection Projection Per Fig. 2

Determine the required overall connection length of a 20” – 600# RF Studding Outlet with internal projection set through a 48” OD ASME F&D head with a 42” inside dish radius.

DESIGN DATA

L = Required overall connection length, inches
 R = 42 inches inside head crown radius
 r_i = 10” inside barrel radius of connection
 r_o = 16” outside barrel radius of connection
 P = 12” inches projection of connection
 IP = 1.50” inside projection of connection
 T = 3.88” minimum required studding outlet thickness
 D = 8” inside depth of head

From the “Sweep Loss” chart or by using the above formula determine connection sweep loss #2.

$$SL2 = R - \sqrt{R^2 - r_o^2} = 42 - \sqrt{42^2 - 16^2} = 3.17 \text{ in.}$$

Determine the required overall connection length “L”.

$$L + P - D + SL2 + IP = 12 - 8 + 3.17 + 1.50 = 8.67”$$

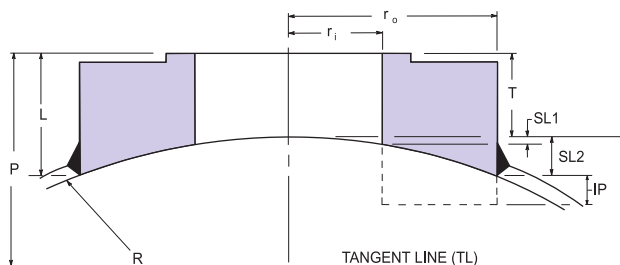
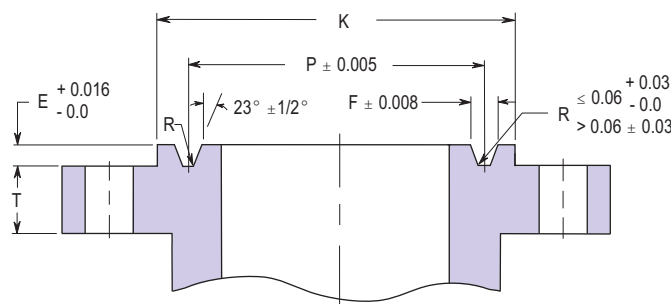


Fig. 2 Radially Installed Connection In Sphere

NOTE: In no case shall the required overall thickness “L” be less than the required minimum thickness “T”.

FACING DIMENSIONS FOR RING JOINT FLANGES



Nominal Pipe Size	Class	Ring & Groove Number	Pitch Diameter Ring & Groove	Groove Dimensions			Diameter Raised Face	Ring Gasket Dimensions			
				Depth	Width	Radius		Width	Height		Width of Flat
									Oval	Octagonal	
			P	E	F	R	K	A	B	H	C
1/2	300-600	R 11	1.344	0.219	0.281	0.03	2.00	0.250	0.4375	0.375	0.170
	900-1500	R 12	1.562	0.250	0.344	0.03	2.38	0.3125	0.5625	0.500	0.206
	2500	R 13	1.688	0.250	0.344	0.03	2.56	0.3125	0.5625	0.500	0.206
3/4	300-600	R 13	1.688	0.250	0.344	0.03	2.50	0.3125	0.5625	0.500	0.206
	900-1500	R 14	1.750	0.250	0.344	0.03	2.62	0.3125	0.5625	0.500	0.206
	2500	R 16	2.000	0.250	0.344	0.03	2.88	0.3125	0.5625	0.500	0.206
1	150	R 15	1.875	0.250	0.344	0.03	2.50	0.3125	0.5625	0.500	0.206
	300-600	R 16	2.000	0.250	0.344	0.03	2.75	0.3125	0.5625	0.500	0.206
	900-1500	R 16	2.000	0.250	0.344	0.03	2.81	0.3125	0.5625	0.500	0.206
	2500	R 18	2.375	0.250	0.344	0.03	3.25	0.3125	0.5625	0.500	0.206
1 1/4	150	R 17	2.250	0.250	0.344	0.03	2.88	0.3125	0.5625	0.500	0.206
	300-600	R 18	2.375	0.250	0.344	0.03	3.12	0.3125	0.5625	0.500	0.206
	900-1500	R 18	2.375	0.250	0.344	0.03	3.19	0.3125	0.5625	0.500	0.206
	2500	R 21	2.844	0.312	0.469	0.03	4.00	0.3125	0.5625	0.625	0.305
1 1/2	150	R 19	2.562	0.250	0.344	0.03	3.25	0.3125	0.5625	0.500	0.206
	300-600	R 20	2.688	0.250	0.344	0.03	3.56	0.3125	0.5625	0.500	0.206
	900-1500	R 20	2.688	0.250	0.344	0.03	3.62	0.3125	0.5625	0.500	0.206
	2500	R 23	3.250	0.312	0.469	0.03	4.50	0.3125	0.5625	0.625	0.305
2	150	R 22	3.250	0.250	0.344	0.03	4.00	0.3125	0.5625	0.500	0.206
	300-600	R 23	3.250	0.312	0.469	0.03	4.25	0.4375	0.6875	0.625	0.305
	900-1500	R 24	3.750	0.312	0.469	0.03	4.88	0.4375	0.6875	0.625	0.305
	2500	R 26	4.000	0.312	0.469	0.03	5.25	0.4375	0.6875	0.625	0.305
2 1/2	150	R 25	4.000	0.250	0.344	0.03	4.75	0.3125	0.5625	0.500	0.206
	300-600	R 26	4.000	0.312	0.469	0.03	5.00	0.4375	0.6875	0.625	0.305
	900-1500	R 27	4.250	0.312	0.469	0.03	5.38	0.4375	0.6875	0.625	0.305
	2500	R 28	4.375	0.375	0.531	0.06	5.88	0.5000	0.7500	0.688	0.341
3	150	R 29	4.500	0.250	0.344	0.03	5.25	0.3125	0.5625	0.500	0.206
	300-600	R 31	4.875	0.312	0.469	0.03	5.75	0.4375	0.6875	0.625	0.305
	900	R 31	4.875	0.312	0.469	0.03	6.12	0.4375	0.6875	0.625	0.305
	1500	R 35	5.375	0.312	0.469	0.03	6.62	0.4375	0.6875	0.625	0.305
	2500	R 32	5.000	0.375	0.531	0.06	6.62	0.500	0.750	0.6875	0.341
3 1/2	150	R 33	5.188	0.250	0.344	0.03	6.06	0.3125	0.5625	0.500	0.206
	300-600	R 34	5.188	0.312	0.469	0.03	6.25	0.4375	0.6875	0.625	0.305

NOTE:

- All dimensions are in inches.
- Dimension 'K' is minimum.
- Height of raised portion is equal to the depth of groove dimension 'E', is not subjected to the tolerances for 'E'. Groove depth 'E' is not included in flange thickness 'T' but is included in the connection overall length 'L'.
- Dimensions and tolerances are in accordance with ASME B16.5 and B16.20.
- A plus tolerance of 3/64 in. for heights B and H is permitted providing the variation in the height of any ring does not exceed 1/64 in. throughout its entire circumference.

FACING DIMENSIONS FOR RING JOINT FLANGES

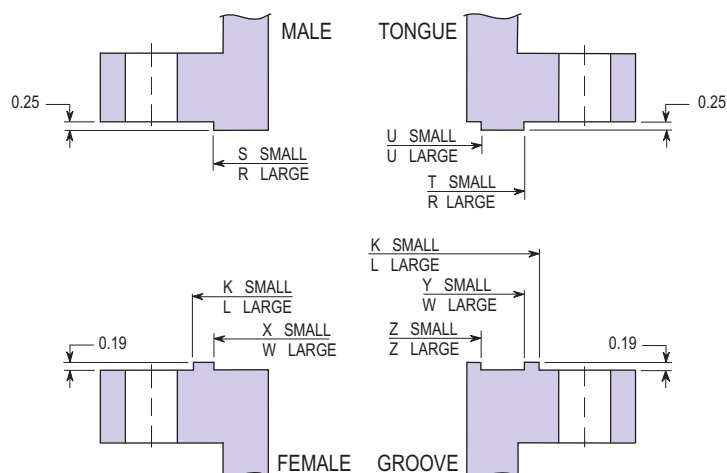
Nominal Pipe Size	Class	Ring & Groove Number	Pitch Diameter Ring & Groove	Groove Dimensions			Diameter Raised Face	Ring Gasket Dimensions			
				Depth	Width	Radius		Width	Height		Width of Flat
									Oval	Octagonal	
4	150	R 36	5.875	0.250	0.344	0.03	6.75	0.3125	0.5625	0.500	0.206
	300-600	R 37	5.875	0.312	0.469	0.03	6.88	0.4375	0.6875	0.625	0.305
	900	R 37	5.875	0.312	0.469	0.03	7.12	0.4375	0.6875	0.625	0.305
	1500	R 39	6.375	0.312	0.469	0.03	7.62	0.4375	0.6875	0.625	0.305
	2500	R 38	6.188	0.438	0.656	0.06	8.00	0.6250	0.8750	0.813	0.413
5	150	R 40	6.750	0.250	0.344	0.03	7.62	0.3125	0.5625	0.500	0.206
	300-600	R 41	7.125	0.312	0.469	0.03	8.25	0.4375	0.6875	0.625	0.305
	900	R 41	7.125	0.312	0.469	0.03	8.50	0.4375	0.6875	0.625	0.305
	1500	R 44	7.625	0.312	0.469	0.03	9.00	0.4375	0.6875	0.625	0.305
	2500	R 42	7.500	0.500	0.781	0.06	9.50	0.7500	1.0000	0.938	0.485
6	150	R 43	7.625	0.250	0.344	0.03	8.62	0.3125	0.5625	0.500	0.206
	300-900	R 45	8.312	0.312	0.469	0.03	9.50	0.4375	0.6875	0.625	0.305
	1500	R 46	8.312	0.375	0.531	0.06	9.75	0.5000	0.7500	0.688	0.341
	2500	R 47	9.000	0.500	0.781	0.06	11.00	0.7500	1.0000	0.938	0.485
8	150	R 48	9.750	0.250	0.344	0.03	10.75	0.3125	0.5625	0.500	0.206
	300-600	R 49	10.625	0.312	0.469	0.03	11.88	0.4375	0.6875	0.625	0.305
	900	R 49	10.625	0.312	0.469	0.03	12.12	0.4375	0.6875	0.625	0.305
	1500	R 50	10.625	0.438	0.656	0.06	12.50	0.6250	0.8750	0.813	0.413
	2500	R 51	11.000	0.562	0.906	0.06	13.38	0.8750	1.1250	1.063	0.583
10	150	R 52	12.000	0.250	0.344	0.03	13.00	0.3125	0.5625	0.500	0.206
	300-600	R 53	12.750	0.312	0.469	0.03	14.00	0.4375	0.6875	0.625	0.305
	900	R 53	12.750	0.312	0.469	0.03	14.25	0.4375	0.6875	0.625	0.305
	1500	R 54	12.750	0.438	0.656	0.06	14.62	0.6250	0.8750	0.813	0.413
	2500	R 55	13.500	0.688	1.188	0.09	16.75	1.1250	1.4375	1.375	0.780
12	150	R 56	15.000	0.250	0.344	0.03	16.00	0.3125	0.5625	0.500	0.206
	300-600	R 57	15.000	0.312	0.469	0.03	16.25	0.4375	0.6875	0.625	0.305
	900	R 57	15.000	0.312	0.469	0.03	16.50	0.4375	0.6875	0.625	0.305
	1500	R 58	15.000	0.562	0.906	0.06	17.25	0.8750	1.1250	1.063	0.583
	2500	R 60	16.000	0.688	1.312	0.09	19.50	1.2500	1.5625	1.500	0.879
14	150	R 59	15.625	0.250	0.344	0.03	16.75	0.3125	0.5625	0.500	0.206
	300-600	R 61	16.500	0.312	0.469	0.03	18.00	0.4375	0.6875	0.625	0.305
	900	R 62	16.500	0.438	0.656	0.06	18.38	0.6250	0.8750	0.813	0.413
	1500	R 63	16.500	0.625	1.062	0.09	19.25	1.0000	1.3125	1.250	0.681
16	150	R 64	17.875	0.250	0.344	0.03	19.00	0.3125	0.5625	0.500	0.206
	300-600	R 65	18.500	0.312	0.469	0.03	20.00	0.4375	0.6875	0.625	0.305
	900	R 66	18.500	0.438	0.656	0.06	20.62	0.6250	0.8750	0.813	0.413
	1500	R 67	18.500	0.688	1.188	0.09	21.50	1.1250	1.4375	1.375	0.780
18	150	R 68	20.375	0.250	0.344	0.03	21.50	0.3125	0.5625	0.500	0.206
	300-600	R 69	21.000	0.312	0.469	0.03	22.62	0.4375	0.6875	0.625	0.305
	900	R 70	21.000	0.500	0.781	0.06	23.38	0.7500	1.0000	0.938	0.485
	1500	R 71	21.000	0.688	1.188	0.09	24.12	1.1250	1.4375	1.375	0.780
20	150	R 72	22.000	0.250	0.344	0.03	23.50	0.3125	0.5625	0.500	0.206
	300-600	R 73	23.000	0.375	0.531	0.06	25.00	0.5000	0.7500	0.688	0.341
	900	R 74	23.000	0.500	0.781	0.06	25.50	0.7500	1.0000	0.938	0.485
	1500	R 75	23.000	0.688	1.312	0.09	26.50	1.2500	1.5625	1.500	0.879
24	150	R 76	26.500	0.250	0.344	0.03	28.00	0.3125	0.5625	0.500	0.206
	300-600	R 77	27.250	0.438	0.656	0.06	29.50	0.6250	0.8750	0.813	0.413
	900	R 78	27.250	0.625	1.062	0.09	30.38	1.0000	1.3125	1.250	0.681
	1500	R 79	27.250	0.812	1.438	0.09	31.25	1.3750	1.7500	1.625	0.977

NOTE:

- All dimensions are in inches.
- Dimension 'K' is minimum.
- Height of raised portion is equal to the depth of groove dimension 'E', is not subjected to the tolerances for 'E'. Groove depth 'E' is not included in flange thickness 'T' but is included in the connection overall length 'L'.
- Dimensions and tolerances are in accordance with ASME B16.5 and B16.20.
- A plus tolerance of 3/64 in. for heights B and H is permitted providing the variation in the height of any ring does not exceed 1/64 in. throughout its entire circumference.

OTHER STANDARD FACINGS

These standard male, female, tongue and groove facings are available on all FCI Connections



FLG SIZE	R	S	T	U	W	X	Y	Z	K	L
1/2	1.38	0.72	1.38	1.00	1.44	0.78	1.44	0.94	1.75	1.81
3/4	1.69	0.94	1.69	1.31	1.75	1.00	1.75	1.25	2.06	2.12
1	2.00	1.19	1.88	1.50	2.06	1.25	1.94	1.44	2.25	2.44
1 1/4	2.50	1.50	2.25	1.88	2.56	1.56	2.31	1.81	2.62	2.94
1 1/2	2.88	1.75	2.50	2.12	2.94	1.81	2.56	2.06	2.88	3.31
2	3.62	2.25	3.25	2.88	3.69	2.31	3.31	2.81	3.62	4.06
2 1/2	4.12	2.69	3.75	3.38	4.19	2.75	3.81	3.31	4.12	4.56
3	5.00	3.31	4.62	4.25	5.06	3.38	4.69	4.19	5.00	5.44
3 1/2	5.50	3.81	5.12	4.75	5.56	3.88	5.19	4.69	5.50	5.94
4	6.19	4.31	5.69	5.19	6.25	4.38	5.75	5.12	6.19	6.62
5	7.31	5.38	6.81	6.31	7.38	5.44	6.88	6.25	7.31	7.75
6	8.50	6.38	8.00	7.50	8.56	6.44	8.06	7.44	8.50	8.94
8	10.62	8.38	10.00	9.38	10.69	8.44	10.06	9.31	10.62	11.06
10	12.75	10.50	12.00	11.25	12.81	10.56	12.06	11.19	12.75	13.19
12	15.00	12.50	14.25	13.50	15.06	12.56	14.31	13.44	15.00	15.44
14	16.25	13.75	15.50	14.75	16.31	13.81	15.56	14.69	16.25	16.69
16	18.50	15.75	17.62	16.75	18.56	15.81	17.69	16.69	18.50	18.94
18	21.00	17.75	20.12	19.25	21.06	17.81	20.19	19.19	21.00	21.44
20	23.00	19.75	22.00	21.00	23.06	19.81	22.06	20.94	23.00	23.44
24	27.25	23.75	26.25	25.25	27.31	23.81	26.31	25.19	27.25	27.69

NOTE

1. All dimensions are in inches.
2. Dimensions and tolerances are in accordance with ASME B16.5.
3. The above dimensions are applicable to all ASME pressure Classes except that large male, female, tongue and groove facings are not available for Class 150 flanges because of potential dimension conflicts.
4. Face heights and groove depths are in addition to the basic flange thickness "T" dimensions and are to be included in overall length "L".

MATERIAL PRESSURE-TEMPERATURE RATINGS

Material Group	Material		See Notes
	Forgings	Plate	
1.1	A 105	A 515-70	1
	A 350 LF2		1
	A 350 LF6 CL1		4
		A 516-70	1,2
		A 537 CL 1	3
	A 350 LF3		
1.2	A 350 LF6 CL 2		4
		A 203 B	1
		A 203 E	1
1.4	A 350 LF1 CL 1	A 515-60	1
		A 516-60	1,2
1.5	A 182 F1		5
		A 204 A	5
		A 204 B	5
1.7	A 182 F2		6
1.9	A 182 F11 CL 2		7,8
		A 387-11 CL 2	8
1.10	A 182 F22 CL 3	A 387-22 CL 2	8
1.13	A 182 F5a		
1.14	A 182 F9		

Material Group	Material		See Notes
	Forgings	Plate	
1.15	A 182 F91	A 387-91 CL 2	
1.17	A 182 F12 CL 2		7,8
	A 182 F5		
2.1	A 182 F304	A 240-304	9
	A 182 F304H	A 240-304H	
2.2	A 182 F316	A 240-316	9
	A 182 F316H	A 240-316H	
	A 182 F317	A 240-317	9
2.3	A 182 F304L	A 240-304L	10
	A 182 F316L	A 240-316L	
2.4	A 182 F321	A 240-321	6
	A 182 F321H	A 240-321H	11
2.5	A 182 F347	A 240-347	6
	A 182F347H	A 240-347H	11
	A 182 F348	A 240-348	6
	A 182 F348H	A 240-348H	11
2.7	A 182 F310		9,13
		A 240-310H	

GENERAL NOTE

Plate materials are listed for reference where they are to be used for blind flanges.
For additional details see latest edition of ASME B16.5 2003.

NOTE

- Upon prolonged exposure to temperatures above 800°F, the carbide phase steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- Not to be used over 850°F.
- Not to be used over 700°F.
- Not to be used over 500°F.
- Upon prolonged exposure to temperatures above 875°F, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.
- Not to be used over 1000°F.
- Use normalized and tempered material only.
- Permissible, but not recommended for prolonged use above 1100°F.
- At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.
- Not to be used over 800°F.
- At temperatures over 1000°F, use only if the material is heat treated by heating to a minimum temperature of 2000°F.
- This material can be used for service temperatures 1050°F and above only when assurance is provided that grain size is not finer than ASTM 6.

Pressure-Temperature Ratings ASME B16.5
class 150

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	285	290	235	265	290	290	290	290	290	290	290	275	275	230	275	275	275	-20 to 100
200	260	260	215	260	260	260	260	260	260	260	260	230	235	195	250	255	245	200
300	230	230	210	230	230	230	230	230	230	230	230	205	215	175	230	230	225	300
400	200	200	200	200	200	200	200	200	200	200	200	190	195	160	200	200	200	400
500	170	170	170	170	170	170	170	170	170	170	170	170	170	150	170	170	170	500
600	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	600
650	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	650
700	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	700
750	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	750
800	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	800
850	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	850
900	50	50	50	50	50	50	50	50	50	50	50	50	50	-	50	50	50	900
950	35	35	35	35	35	35	35	35	35	35	35	35	35	-	35	35	35	950
1000	20	20	20	20	20	20	20	20	20	20	20	20	20	-	20	20	20	1000
1050	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	1050

Pressure-Temperature Ratings ASME B16.5
class 300

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	740	750	615	695	750	750	750	750	750	750	750	720	720	600	720	720	720	-20 to 100
200	680	750	565	695	750	750	750	750	750	750	735	600	620	510	650	660	635	200
300	655	730	545	685	730	720	730	730	730	730	700	540	560	455	595	615	580	300
400	635	705	525	660	705	695	705	705	705	705	670	495	515	420	550	575	540	400
500	605	665	500	640	665	665	665	665	665	665	645	465	480	395	515	540	515	500
600	570	605	475	605	605	605	605	605	605	605	605	440	450	370	485	515	495	600
650	550	590	455	590	590	590	590	590	590	590	590	430	440	365	475	505	485	650
700	530	555	440	570	570	570	570	570	570	570	570	420	435	360	465	495	480	700
750	505	505	430	530	530	530	530	530	530	530	530	415	425	355	460	490	470	750
800	410	410	370	510	510	510	510	510	510	510	510	405	420	345	450	485	465	800
850	320	320	300	485	485	485	485	485	485	485	485	395	420	340	445	485	460	850
900	230	225	170	450	450	450	450	375	450	450	375	390	415	-	440	450	450	900
950	135	135	135	280	315	320	385	275	375	385	275	380	385	-	385	385	385	950
1000	85	85	85	165	200	215	265	200	255	365	200	355	365	-	365	365	365	1000
1050	-	-	-	-	160	145	175	145	170	360	145	325	360	-	360	360	335	1050
1100	-	-	-	-	-	95	110	100	115	300	95	255	305	-	310	325	260	1100
1150	-	-	-	-	-	65	70	60	75	225	60	205	235	-	235	275	190	1150
1200	-	-	-	-	-	40	40	35	50	145	35	165	185	-	185	205	135	1200
1250	-	-	-	-	-	-	-	-	-	-	-	135	145	-	140	180	105	1250
1300	-	-	-	-	-	-	-	-	-	-	-	115	115	-	110	140	75	1300
1350	-	-	-	-	-	-	-	-	-	-	-	95	95	-	85	105	60	1350
1400	-	-	-	-	-	-	-	-	-	-	-	75	75	-	65	75	45	1400
1450	-	-	-	-	-	-	-	-	-	-	-	60	60	-	50	60	35	1450
1500	-	-	-	-	-	-	-	-	-	-	-	40	40	-	40	40	25	1500

NOTE

1. See temperature notes for all materials (page # 50)
2. Pressures are in pounds per square inch, gage (psig)

Pressure-Temperature Ratings ASME B16.5
class 400

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	985	1000	825	930	1000	1000	1000	1000	1000	1000	1000	960	960	800	960	960	960	-20 to 100
200	905	1000	755	930	1000	1000	1000	1000	1000	1000	980	800	825	680	865	885	850	200
300	870	970	725	915	970	965	970	970	970	970	935	715	745	610	795	820	775	300
400	845	940	700	885	940	925	940	940	940	940	890	660	685	560	735	770	725	400
500	805	885	670	855	885	885	885	885	885	885	860	620	635	525	690	725	685	500
600	755	805	630	805	805	805	805	805	805	805	805	590	600	495	650	690	660	600
650	730	785	610	785	785	785	785	785	785	785	785	575	590	485	635	675	645	650
700	710	740	590	755	755	755	755	755	755	755	755	565	580	480	620	660	635	700
750	675	675	570	710	710	710	710	710	710	710	710	550	570	470	610	655	625	750
800	550	550	495	675	675	675	675	675	675	675	675	540	565	460	600	650	620	800
850	425	425	400	650	650	650	650	650	650	650	650	530	555	450	595	645	610	850
900	305	295	230	600	600	600	600	600	500	600	500	520	555	-	590	600	600	900
950	185	185	185	375	420	425	515	365	505	515	365	510	515	-	515	515	515	950
1000	115	115	115	220	270	290	355	265	340	485	265	470	485	-	485	485	485	1000
1050	-	-	-	-	210	190	235	190	230	480	190	435	480	-	480	480	470	1050
1100	-	-	-	-	-	130	145	135	150	400	130	345	405	-	415	430	345	1100
1150	-	-	-	-	-	85	90	80	100	295	80	275	315	-	315	365	250	1150
1200	-	-	-	-	-	55	55	45	70	190	45	220	245	-	245	275	185	1200
1250	-	-	-	-	-	-	-	-	-	-	-	180	195	-	185	245	135	1250
1300	-	-	-	-	-	-	-	-	-	-	-	150	155	-	145	185	100	1300
1350	-	-	-	-	-	-	-	-	-	-	-	125	130	-	115	140	80	1350
1400	-	-	-	-	-	-	-	-	-	-	-	100	100	-	85	100	60	1400
1450	-	-	-	-	-	-	-	-	-	-	-	80	80	-	70	80	45	1450
1500	-	-	-	-	-	-	-	-	-	-	-	55	55	-	50	55	35	1500

Pressure-Temperature Ratings ASME B16.5
class 600

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	1480	1500	1235	1395	1500	1500	1500	1500	1500	1500	1500	1440	1440	1200	1440	1440	1440	-20 to 100
200	1360	1500	1130	1395	1500	1500	1500	1500	1500	1500	1470	1200	1240	1020	1295	1325	1270	200
300	1310	1455	1090	1375	1455	1445	1455	1455	1455	1455	1400	1075	1120	910	1190	1235	1160	300
400	1265	1405	1055	1325	1410	1385	1410	1410	1410	1410	1335	995	1025	840	1105	1150	1085	400
500	1205	1330	1005	1285	1330	1330	1330	1330	1330	1330	1290	930	955	785	1030	1085	1025	500
600	1135	1210	945	1210	1210	1210	1210	1210	1210	1210	1210	885	900	745	975	1030	990	600
650	1100	1175	915	1175	1175	1175	1175	1175	1175	1175	1175	865	885	730	950	1015	970	650
700	1060	1110	885	1135	1135	1135	1135	1135	1135	1135	1135	845	870	720	930	995	955	700
750	1015	1015	855	1065	1065	1065	1065	1065	1065	1065	1065	825	855	705	915	985	940	750
800	825	825	740	1015	1015	1015	1015	1015	1015	1015	1015	810	845	690	900	975	930	800
850	640	640	595	975	975	975	975	975	975	975	975	790	835	675	895	970	915	850
900	460	445	345	900	900	900	900	745	900	900	745	780	830	-	885	900	900	900
950	275	275	275	560	630	640	775	550	755	775	550	765	775	-	775	775	775	950
1000	170	170	170	330	405	430	535	400	505	725	400	710	725	-	725	725	725	1000
1050	-	-	-	-	315	290	350	290	345	720	290	650	720	-	720	720	705	1050
1100	-	-	-	-	-	190	220	200	225	605	190	515	610	-	625	645	520	1100
1150	-	-	-	-	-	130	135	125	150	445	125	410	475	-	475	550	375	1150
1200	-	-	-	-	-	80	80	70	105	290	70	330	370	-	370	410	275	1200
1250	-	-	-	-	-	-	-	-	-	-	-	265	295	-	280	365	205	1250
1300	-	-	-	-	-	-	-	-	-	-	-	225	235	-	220	275	150	1300
1350	-	-	-	-	-	-	-	-	-	-	-	185	190	-	170	205	115	1350
1400	-	-	-	-	-	-	-	-	-	-	-	150	150	-	130	150	90	1400
1450	-	-	-	-	-	-	-	-	-	-	-	115	115	-	105	115	65	1450
1500	-	-	-	-	-	-	-	-	-	-	-	85	85	-	75	85	50	1500

NOTE

1. See temperature notes for all materials (page # 50)
2. Pressures are in pounds per square inch, gage (psig)

Pressure-Temperature Ratings ASME B16.5
class 900

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	2220	2250	1850	2090	2250	2250	2250	2250	2250	2250	2250	2160	2160	1800	2160	2160	2160	-20 to 100
200	2035	2250	1695	2090	2250	2250	2250	2250	2250	2250	2210	1800	1860	1535	1945	1985	1910	200
300	1965	2185	1635	2060	2185	2165	2185	2185	2185	2185	2100	1615	1680	1370	1785	1850	1740	300
400	1900	2110	1580	1985	2115	2080	2115	2115	2115	2115	2005	1490	1540	1260	1655	1730	1625	400
500	1810	1995	1505	1925	1995	1995	1995	1995	1995	1995	1940	1395	1435	1180	1550	1625	1540	500
600	1705	1815	1420	1815	1815	1815	1815	1815	1815	1815	1815	1325	1355	1115	1460	1550	1485	600
650	1650	1765	1370	1765	1765	1765	1765	1765	1765	1765	1765	1295	1325	1095	1425	1520	1455	650
700	1590	1665	1325	1705	1705	1705	1705	1705	1705	1705	1705	1265	1305	1080	1395	1490	1435	700
750	1520	1520	1285	1595	1595	1595	1595	1595	1595	1595	1595	1240	1280	1060	1375	1475	1410	750
800	1235	1235	1110	1525	1525	1525	1525	1525	1525	1525	1525	1215	1265	1035	1355	1460	1395	800
850	955	955	895	1460	1460	1460	1460	1460	1460	1460	1460	1190	1255	1015	1340	1455	1375	850
900	690	670	515	1350	1350	1350	1350	1120	1350	1350	1120	1165	1245	-	1325	1350	1350	900
950	410	410	410	845	945	955	1160	825	1130	1160	825	1145	1160	-	1160	1160	1160	950
1000	255	255	255	495	605	650	800	595	760	1090	595	1065	1090	-	1090	1090	1090	1000
1050	-	-	-	-	475	430	525	430	515	1080	430	975	1080	-	1080	1080	1060	1050
1100	-	-	-	-	-	290	330	300	340	905	290	770	915	-	935	965	780	1100
1150	-	-	-	-	-	195	205	185	225	670	185	615	710	-	710	825	565	1150
1200	-	-	-	-	-	125	125	105	155	430	105	495	555	-	555	620	410	1200
1250	-	-	-	-	-	-	-	-	-	-	-	400	440	-	420	545	310	1250
1300	-	-	-	-	-	-	-	-	-	-	-	340	350	-	330	410	225	1300
1350	-	-	-	-	-	-	-	-	-	-	-	280	290	-	255	310	175	1350
1400	-	-	-	-	-	-	-	-	-	-	-	225	225	-	195	225	135	1400
1450	-	-	-	-	-	-	-	-	-	-	-	175	175	-	155	175	100	1450
1500	-	-	-	-	-	-	-	-	-	-	-	125	125	-	115	125	75	1500

Pressure-Temperature Ratings ASME B16.5
class 1500

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	3705	3750	3085	3480	3750	3750	3750	3750	3750	3750	3750	3600	3600	3000	3600	3600	3600	-20 to 100
200	3395	3750	2830	3480	3750	3750	3750	3750	3750	3750	3680	3000	3095	2555	3240	3310	3180	200
300	3270	3640	2725	3435	3640	3610	3640	3640	3640	3640	3495	2690	2795	2280	2975	3085	2905	300
400	3170	3520	2635	3310	3530	3465	3530	3530	3530	3530	3345	2485	2570	2100	2760	2880	2710	400
500	3015	3325	2510	3210	3325	3325	3325	3325	3325	3325	3230	2330	2390	1970	2580	2710	2570	500
600	2840	3025	2365	3025	3025	3025	3025	3025	3025	3025	3025	2210	2255	1860	2435	2580	2470	600
650	2745	2940	2285	2940	2940	2940	2940	2940	2940	2940	2940	2160	2210	1825	2375	2530	2425	650
700	2655	2775	2210	2840	2840	2840	2840	2840	2840	2840	2840	2110	2170	1800	2330	2485	2390	700
750	2535	2535	2140	2660	2660	2660	2660	2660	2660	2660	2660	2065	2135	1765	2290	2460	2350	750
800	2055	2055	1850	2540	2540	2540	2540	2540	2540	2540	2540	2030	2110	1730	2255	2435	2330	800
850	1595	1595	1490	2435	2435	2435	2435	2435	2435	2435	2435	1980	2090	1690	2230	2425	2290	850
900	1150	1115	855	2245	2245	2245	2245	1870	2245	2245	1870	1945	2075	-	2210	2245	2245	900
950	685	685	685	1405	1575	1595	1930	1370	1885	1930	1370	1910	1930	-	1930	1930	1930	950
1000	430	430	430	825	1010	1080	1335	995	1270	1820	995	1770	1820	-	1820	1820	1820	1000
1050	-	-	-	-	790	720	875	720	855	1800	720	1630	1800	-	1800	1800	1765	1050
1100	-	-	-	-	-	480	550	495	565	1510	480	1285	1525	-	1560	1610	1305	1100
1150	-	-	-	-	-	325	345	310	375	1115	310	1030	1185	-	1185	1370	945	1150
1200	-	-	-	-	-	205	205	170	255	720	170	825	925	-	925	1030	685	1200
1250	-	-	-	-	-	-	-	-	-	-	-	670	735	-	705	910	515	1250
1300	-	-	-	-	-	-	-	-	-	-	-	565	585	-	550	685	375	1300
1350	-	-	-	-	-	-	-	-	-	-	-	465	480	-	430	515	290	1350
1400	-	-	-	-	-	-	-	-	-	-	-	380	380	-	325	380	225	1400
1450	-	-	-	-	-	-	-	-	-	-	-	290	290	-	255	290	165	1450
1500	-	-	-	-	-	-	-	-	-	-	-	205	205	-	190	205	130	1500

NOTE

1. See temperature notes for all materials (page # 50)
2. Pressures are in pounds per square inch, gage (psig)

Pressure-Temperature Ratings ASME B16.5
class 2500

Material Group	1.1	1.2	1.4	1.5	1.7	1.9	1.10	1.13	1.14	1.15	1.17	2.1	2.2	2.3	2.4	2.5	2.7	
-20 to 100	6170	6250	5145	5805	6250	6250	6250	6250	6250	6250	6250	6000	6000	5000	6000	6000	6000	-20 to 100
200	5655	6250	4715	5805	6250	6250	6250	6250	6250	6250	6135	5000	5160	4260	5400	5520	5300	200
300	5450	6070	4545	5725	6070	6015	6070	6070	6070	6070	5830	4480	4660	3800	4960	5140	4840	300
400	5280	5865	4390	5520	5880	5775	5880	5880	5880	5880	5570	4140	4280	3500	4600	4800	4520	400
500	5025	5540	4185	5350	5540	5540	5540	5540	5540	5540	5385	3880	3980	3280	4300	4520	4280	500
600	4730	5040	3945	5040	5040	5040	5040	5040	5040	5040	5040	3680	3760	3100	4060	4300	4120	600
650	4575	4905	3805	4905	4905	4905	4905	4905	4905	4905	4905	3600	3680	3040	3960	4220	4040	650
700	4425	4630	3685	4730	4730	4730	4730	4730	4730	4730	4730	3520	3620	3000	3880	4140	3980	700
750	4230	4230	3565	4430	4430	4430	4430	4430	4430	4430	4430	3440	3560	2940	3820	4100	3920	750
800	3430	3430	3085	4230	4230	4230	4230	4230	4230	4230	4230	3380	3520	2880	3760	4060	3880	800
850	2655	2655	2485	4060	4060	4060	4060	4060	4060	4060	4060	3300	3480	2820	3720	4040	3820	850
900	1915	1855	1430	3745	3745	3745	3745	3115	3745	3745	3115	3240	3460	-	3680	3745	3745	900
950	1145	1145	1145	2345	2630	2655	3220	2285	3145	3220	2285	3180	3220	-	3220	3220	3220	950
1000	715	715	715	1370	1685	1800	2230	1655	2115	3030	1655	2950	3030	-	3030	3030	3030	1000
1050	-	-	-	-	1315	1200	1455	1200	1430	3000	1200	2715	3000	-	3000	3000	2945	1050
1100	-	-	-	-	-	800	915	830	945	2515	800	2145	2545	-	2600	2685	2170	1100
1150	-	-	-	-	-	545	570	515	630	1855	515	1715	1970	-	1970	2285	1570	1150
1200	-	-	-	-	-	345	345	285	430	1200	285	1370	1545	-	1545	1715	1145	1200
1250	-	-	-	-	-	-	-	-	-	-	-	1115	1230	-	1170	1515	855	1250
1300	-	-	-	-	-	-	-	-	-	-	-	945	970	-	915	1145	630	1300
1350	-	-	-	-	-	-	-	-	-	-	-	770	800	-	715	860	485	1350
1400	-	-	-	-	-	-	-	-	-	-	-	630	630	-	545	630	370	1400
1450	-	-	-	-	-	-	-	-	-	-	-	485	485	-	430	485	275	1450
1500	-	-	-	-	-	-	-	-	-	-	-	345	345	-	315	345	215	1500

NOTE

1. See temperature notes for all materials (page #50)
2. Pressures are in pounds per square inch, gage (psig)

Maximum Allowable Hydrostatic Shell Test Pressures (At Ambient Temperature)

Material Group	Shell Test Pressures (All Pressures Are Gage)							
	CLASS 75	CLASS 150	CLASS 300	CLASS 400	CLASS 600	CLASS 900	CLASS 1500	CLASS 2500
1.1	225	450	1125	1500	2225	3350	5575	9275
1.2	225	450	1125	1500	2250	3375	5625	9375
1.4	175	375	950	1250	1875	2775	4650	7725
1.5	200	400	1050	1400	2100	3150	5225	8700
1.7	225	450	1125	1500	2250	3375	5625	9375
1.9	225	450	1125	1500	2250	3375	5625	9375
1.10	225	450	1125	1500	2250	3375	5625	9375
1.13	225	450	1125	1500	2250	3375	5625	9375
1.14	225	450	1125	1500	2250	3375	5625	9375
1.15	---	450	1125	1500	2250	3375	5625	9375
2.1	225	425	1100	1450	2175	3250	5400	9000
2.2	225	425	1100	1450	2175	3250	5400	9000
2.3	175	350	900	1200	1800	2700	4500	7500
2.4	225	425	1100	1450	2175	3250	5400	9000
2.5	225	425	1100	1450	2175	3250	5400	9000
2.6	200	400	1025	1350	2025	3025	5050	8400
2.7	200	400	1025	1350	2025	3025	5050	8400

CONNECTION BOLTING INFORMATION HEAT-TREATED ALLOY STUDS, BOLTS AND NUTS

ALLOY STEEL STUD BOLTING MATERIALS

The following grades of heat treated alloy steel studs are commonly used for high-pressure or extreme service in diameters of ¼ in. to 4 in., inclusive. Other grades and other diameters are available on special order.

ASTM 193, Grade B7

Heat treated chromium-molybdenum steel recommended for medium high temperature service. (Liquid quench -50° to 900° F, Air quench -40° to 900° F)

ASTM A193, Grade B7M

Similar to B7 studs except that the minimum yield and tensile strength requirements are reduced and the hardness controlled to 235 Brinell maximum. Recommended for use in corrosive environments. (-50° to 900° F)

ASTM A193, Grade B16

A heat treated chromium-molybdenum-vanadium steel recommended for high pressure, high temperature service. (-50° to 1100° F)

ASTM A320, Grade L7

This grade is intended for low temperature service down to minus 150° F and has a minimum Charpy impact value of 20 ft. lbs. at this temperature. (-50° to 1100° F)

ASTM A320, Grade L7M

Similar to L7 studs except that the minimum yield and tensile strength requirements are reduced and the hardness controlled to 235 Brinell maximum. This stud is recommended for use in low temperature corrosive environments. (-50° to 1100° F)

ASTM A320, Grade L43

This grade is intended for low temperature service down to minus 150° F and has a minimum Charpy impact value of 20 ft. lbs. at this temperature. Available in sizes up to a 4 inch diameter. (-150° to 1100° F)

ASTM A193, Grade B8

These Chromium-Nickel (AISI 304) austenitic steel studs are recommended for use in corrosive environments. (-325° to 1500° F)

ASTM A193, Grade B8M

These chromium-nickel molybdenum (AISI 316) austenitic steel studs are recommended for use in corrosive environments. (-325° to 1500° F)

NOTE

All data per ASME B16.5 – 1996

CARBON AND ALLOY STEEL NUTS

ASTM A194, Latest Revision, Grade 2H

Suitable for use in high temperatures and high pressure conditions.

ASTM A194, Grade 2HM

Similar to 2H nuts except this grade is recommended for use in corrosive environments.

ASTM A194, Latest Revision, Grade 4

Heat treated molybdenum steel nuts suitable for severe temperature and pressure conditions.

ASTM A194, Latest Revision, Grade L7

New stamping as per ASTM is 7L. Heat treated chrome-molybdenum steel nuts suitable for extreme temperature and pressure conditions. Suitable for sub-zero service conditions and have minimum Charpy impact values in accordance with ASTM specifications. A320, Grade 7 down to -150° F.

ASTM A194, Grade L7M

New stamping as per ASTM is 7ML. Similar to grade L7 nuts except this grade is recommended for use in corrosive environments.

ASTM A194, Grade 8/8M

Stainless steel nuts recommended for use in corrosive environments.

Connection stud bolting can be furnished by FCI upon request.

BOLT AND NUT DIMENSIONS PER ASME B18.2

Stud Bolt Size	Thread Dimensions		Nut Dimensions		
	Threads Per Inch	Root Area	Across Flats	Across Corners	Nom. Thick.
1/2	13	0.126	0.875	0.969	0.484
5/8	11	0.202	1.063	1.175	0.609
3/4	10	0.302	1.250	1.383	0.734
7/8	9	0.419	1.438	1.589	0.859
1	8	0.551	1.625	1.796	0.984
1 1/8	8	0.728	1.813	2.002	1.109
1 1/4	8	0.929	2.000	2.209	1.219
1 3/8	8	1.155	2.188	2.416	1.344
1 1/2	8	1.405	2.375	2.622	1.469
1 5/8	8	1.680	2.563	2.828	1.594
1 3/4	8	1.980	2.750	3.035	1.719
1 7/8	8	2.300	2.938	3.242	1.844
2	8	2.650	3.125	3.449	1.969
2 1/4	8	3.420	3.500	3.862	2.203
2 1/2	8	4.290	3.875	4.275	2.453
2 3/4	8	5.260	4.250	4.688	2.703
3	8	6.320	4.625	5.102	2.953
3 1/4	8	7.490	5.000	5.515	3.188
3 1/2	8	8.750	5.375	5.928	3.438
3 3/4	8	10.110	5.750	6.341	3.688
4	8	11.570	6.125	6.755	3.938

Calculation of "Nut Stop Diameter"

Nut Stop Diameter = Bolt Circle Diameter - Nut Dimension Across Flats

Example: Determine nut stop diameter of a 16" - 300# RF Equal Barrel 'E' connection

DESIGN DATA

Bolt Circle Diameter = 22.50 inches (ref. 16" - 300# RF flange bolt circle)

Stud Bolt Size = 1.25 inches (ref. 16" - 300# RF flange)

Nut Dimension Across Flats = 2.00 inches (ref. above chart for nut dimension relating to stud bolt size)

Nut Stop Diameter = Bolt Circle Diameter - Nut Dimension Across Flats

Nut Stop Diameter = 22.50 - 2.00 = 20.50 in.

SUGGESTED ASSEMBLY TORQUE VALUES TO PRODUCE CORRESPONDING BOLT LOADS

Size	Tensile Stress Area A_s Sq. In.	SA193 & ASTM 193 B7 Studs with 2H Heavy Hex Nuts A194		
		Clamp Load P Lbs.	Tightening Torque	
			Dry = .223	Lubed = .167
			K	K
			Ft. Lbs.	Ft. Lbs.
1/2-13	0.138	10,350	96	72
9/16-12	0.177	13,275	139	104
5/8-11	0.220	16,500	192	143
3/4-10	0.327	24,525	342	256
7/8-9	0.452	33,900	551	413
1-8	0.594	44,550	828	620
1-1/8-8	0.776	58,200	1,217	911
1-1/4-8	0.984	73,800	1,714	1,284
1-3/8-8	1.215	91,125	2,328	1,744
1-1/2-8	1.471	110,325	3,076	2,303
1-5/8-8	1.769	132,675	4,006	3,000
1-3/4-8	2.06	154,500	5,024	3,763
1-7/8-8	2.41	180,750	6,298	4,716
2-8	2.74	205,500	7,638	5,720
2-1/4-8	3.52	264,000	11,038	8,266
2-1/2-8	4.40	330,000	15,331	11,481

Size	Tensile Stress Area A_s Sq. In.	SA193 & ASTM 193 B7M Studs with A194 2HM Heavy Hex Nuts		
		Clamp Load P Lbs.	Tightening Torque	
			Dry K = .223	Lubed = .167
			K	K
			Ft. Lbs.	Ft. Lbs.
1/2-13		7,866	73	55
9/16-12		10,089	105	79
5/8-11		12,540	146	109
3/4-10		18,639	260	194
7/8-9		25,764	419	314
1-8		33,858	629	471
1-1/8-8		44,232	925	692
1-1/4-8		56,088	1,303	976
1-3/8-8		69,255	1,770	1,325
1-1/2-8		83,847	2,337	1,750
1-5/8-8		100,833	3,045	2,280
1-3/4-8		117,420	3,818	2,860
1-7/8-8		137,370	4,786	3,584
2-8		156,180	5,805	4,347
2-1/4-8		200,640	8,389	6,282
2-1/2-8		250,800	11,652	8,726

Size	Tensile Stress Area A_s Sq. In.	SA320 & ASTM A320 L7 Studs with A194 Gr. 4 or Gr. L7 Heavy Hex Nuts		
		Clamp Load P Lbs.	Tightening Torque	
			Dry = .223	Lubed K = .167
			K	K
			Ft. Lbs.	Ft. Lbs.
1/2-13	0.138	10,350	96	72
9/16-12	0.177	13,275	139	104
5/8-11	0.220	16,500	192	143
3/4-10	0.327	24,525	342	256
7/8-9	0.452	33,900	551	413
1-8	0.594	44,550	828	620
1-1/8-8	0.776	58,200	1,217	911
1-1/4-8	0.984	73,800	1,714	1,284
1-3/8-8	1.215	91,125	2,328	1,744
1-1/2-8	1.471	110,325	3,076	2,303
1-5/8-8	1.769	132,675	4,006	3,000
1-3/4-8	2.06	154,500	5,024	3,763
1-7/8-8	2.41	180,750	6,298	4,716
2-8	2.74	205,500	7,638	5,720
2-1/4-8	3.52	264,000	11,038	8,266
2-1/2-8	4.40	330,000	15,331	11,481

Size	Tensile Stress Area A_s Sq. In.	SA320 & ASTM A320 L7M Studs with A194 Gr. 4 or Gr. L7M Heavy Hex Nuts		
		Clamp Load P Lbs.	Tightening Torque	
			Dry K = .223	Lubed K = .167
			K	K
			Ft. Lbs.	Ft. Lbs.
1/2-13		7,866	73	55
9/16-12		10,089	105	79
5/8-11		12,540	146	109
3/4-10		18,639	260	194
7/8-9		25,764	419	314
1-8		33,858	629	471
1-1/8-8		44,232	925	692
1-1/4-8		56,088	1,303	976
1-3/8-8		69,255	1,770	1,325
1-1/2-8		83,847	2,337	1,750
1-5/8-8		100,833	3,045	2,280
1-3/4-8		117,420	3,818	2,860
1-7/8-8		137,370	4,786	3,584
2-8		156,180	5,805	4,347
2-1/4-8		200,640	8,389	6,282
2-1/2-8		250,800	11,652	8,726

NOTE

1. Tightening torque values from the formula $T = KDP$, where T = tightening torque, lb.ft. K = torque-friction coefficient, D = nominal bolt diameter, in.; and p = bolt clamping load developed by tightening, lb.
2. Clamp load is also known as preload or initial load in tension on bolt. Clamp load (lb.) is calculated by arbitrarily assuming useable bolt strength is 75% of bolt proof load (PSI) times the stress area (sq.in.) of threaded section of each bolt size.
Higher or lower values of clamp load can be used depending on the application requirements and the judgement of the designer.
3. No proof load has been established by ASTM. Values shown in table are assumed at 95% of yield strength.
* Grade 7M nuts at a hardness not exceeding 235HB (or equivalent) shall be used with Grade B7M studs.
4. Last update 1996. Refer to latest edition of applicable code/specification and addendums thereto for required design data.

PROPERTIES OF SEAMLESS AND WELDED STEEL PIPE

Nominal Pipe Size	O.D.	Pipe Sch.	Wall Thk.	I.D.	Weight per Foot	Nominal Pipe Size	O.D.	Pipe Sch.	Wall Thk.	I.D.	Weight per Foot
1/8	0.405	10S	0.049	0.307	0.186	2	2.375	5S	0.065	2.245	1.604
		* 40	0.068	0.269	0.244			10S	0.109	2.157	2.638
		** 80	0.095	0.215	0.314			* 40	0.154	2.067	3.652
1/4	0.540	10S	0.065	0.410	0.330			** 80	0.218	1.939	5.022
		* 40	0.088	0.364	0.424			160	0.344	1.687	7.450
		** 80	0.119	0.302	0.535			XX-STG	0.436	1.503	9.029
3/8	0.675	10S	0.065	0.545	0.423	2 1/2	2.875	5S	0.083	2.709	2.48
		* 40	0.091	0.493	0.567			10S	0.120	2.635	3.53
		** 80	0.126	0.423	0.738			* 40	0.203	2.469	5.79
1/2	0.840	10S	0.065	0.710	0.538			** 80	0.276	2.323	7.66
		* 40	0.083	0.674	0.671			160	0.375	2.125	10.01
		** 80	0.109	0.622	0.850			XX-STG	0.552	1.771	13.69
		160	0.147	0.546	1.087	3	3.500	5S	0.083	3.334	3.03
		XX-STG	0.188	0.464	1.310			10S	0.120	3.260	4.33
3/4	1.050	5S	0.065	0.920	0.684			* 40	0.216	3.068	7.57
		10S	0.083	0.884	0.857			** 80	0.300	2.900	10.25
		* 40	0.113	0.824	1.130			160	0.438	2.624	14.32
		** 80	0.154	0.742	1.473			XX-STG	0.600	2.300	18.58
		160	0.219	0.612	1.940	3 1/2	4.000	5S	0.083	3.834	3.47
1	1.315	XX-STG	0.308	0.434	2.440			10S	0.120	3.760	4.97
		5S	0.065	1.185	0.868			* 40	0.226	3.548	9.11
		10S	0.109	1.097	1.404			** 80	0.318	3.364	12.51
		* 40	0.133	1.049	1.678	4	4.500	5S	0.083	4.334	3.92
		** 80	0.179	0.957	2.171			10S	0.120	4.260	5.61
1 1/4	1.660	160	0.250	0.815	2.850			* 40	0.237	4.026	10.79
		XX-STG	0.358	0.599	3.659			** 80	0.337	3.826	14.98
		5S	0.065	1.530	1.107			120	0.438	3.624	19.00
		10S	0.109	1.442	1.806			160	0.531	3.438	22.60
		* 40	0.140	1.380	2.272	5	5.563	XX-STG	0.674	3.152	27.54
1 1/2	1.900	** 80	0.191	1.278	2.996			5S	0.109	5.345	6.35
		160	0.250	1.160	3.764			10S	0.134	5.295	7.77
		XX-STG	0.382	0.896	5.214			* 40	0.258	5.047	14.62
		5S	0.065	1.770	1.274			** 80	0.375	4.813	20.78
		10S	0.109	1.682	2.085	6	6.625	120	0.500	4.563	27.10
1 1/2	1.900	* 40	0.145	1.610	2.717			160	0.625	4.313	32.96
		** 80	0.200	1.500	3.631			XX-STG	0.750	4.063	38.55
		160	0.281	1.338	4.862			5S	0.109	6.407	7.59
		XX-STG	0.400	1.100	6.408			10S	0.134	6.357	9.29
1 1/2	1.900	5S	0.065	1.770	1.274			* 40	0.280	6.065	18.97
		10S	0.109	1.682	2.085			** 80	0.432	5.761	28.57
		* 40	0.145	1.610	2.717			120	0.562	5.501	36.40
		** 80	0.200	1.500	3.631			160	0.719	5.187	45.30
		160	0.281	1.338	4.862			XX-STG	0.864	4.897	53.16
1 1/2	1.900	XX-STG	0.400	1.100	6.408			5S	0.109	6.407	7.59
		5S	0.065	1.770	1.274			10S	0.134	6.357	9.29
		10S	0.109	1.682	2.085			* 40	0.280	6.065	18.97
		* 40	0.145	1.610	2.717			** 80	0.432	5.761	28.57
		** 80	0.200	1.500	3.631			120	0.562	5.501	36.40

NOTE

- All dimensions are in inches.
- All weights are in pounds.
- Dimensions for STD WT, X-STG, XX-STG, SCH 10,20,30, 40, 60, 80, 100, 120, 140, and 160 are in accordance with ASME B36.10.
- Dimensions for SCH 5S, 10S, 40S, and 80S are in accordance with ASME B36.19.
- * Wall thickness for Schedule 40, 40S, and Standard Weight are identical though 10" nominal pipe size.
- ** Wall thickness for Schedules 80, 80S, and Extra Strong are identical through 8" nominal pipe size.
- ~ Includes Standard Weight.
- ^ Includes Extra Strong.
- The wall thickness shown is subject to a 12.5% Mill tolerance.

PROPERTIES OF SEAMLESS AND WELDED STEEL PIPE

Nominal Pipe Size	O.D.	Pipe Sch.	Wall Thk.	I.D.	Weight per Foot	Nominal Pipe Size	O.D.	Pipe Sch.	Wall Thk.	I.D.	Weight per Foot
8	8.625	5S	0.109	8.407	10	16	16.000	5S	0.165	15.670	28
		10S	0.148	8.329	13			10S	0.188	15.624	32
		20	0.250	8.125	22			10	0.250	15.500	42
		30	0.277	8.071	25			20	0.312	15.375	52
		* 40	0.322	7.981	29			30	0.375	15.250	63
		60	0.406	7.813	36			STD.WT.	0.375	15.250	63
		**80	0.500	7.625	43			40	0.500	15.000	83
		100	0.594	7.437	51			60	0.656	14.688	108
		120	0.719	7.187	61			X-STG	0.500	15.000	83
		140	0.812	7.001	68			80	0.844	14.312	137
10	10.750	160	0.906	6.813	75	18	18.000	100	1.031	13.938	165
		XX-STG	0.875	6.875	72			120	1.219	13.562	193
		5S	0.134	10.482	15			140	1.438	13.124	224
		10S	0.165	10.420	19			160	1.594	12.812	245
		20	0.250	10.250	28			5S	0.165	17.670	31
		30	0.307	10.136	34			10S	0.188	17.624	36
		* 40	0.365	10.020	40			10	0.250	17.500	47
		60	0.500	9.750	55			20	0.312	17.375	59
		^ 80S	0.500	9.750	55			30	0.438	17.124	82
		80	0.594	9.562	64			STD.WT.	0.375	17.250	71
12	12.750	100	0.719	9.312	77			40	0.562	16.876	105
		120	0.844	9.062	89			60	0.750	16.500	138
		140	1.000	8.750	104			X-STG	0.500	17.000	93
		160	1.125	8.500	116			80	0.938	16.124	171
		XX-STG	1.000	8.750	104			100	1.156	15.688	208
		5S	0.156	12.438	21			120	1.375	15.250	244
		10S	0.180	12.390	24			140	1.562	14.876	275
		20	0.250	12.250	33			160	1.781	14.438	309
		30	0.330	12.090	44	20	20.000	5S	0.188	19.624	40
		~ 40S	0.375	12.000	50			10S	0.218	19.564	46
14	14.000	40	0.406	11.938	54			10	0.250	19.500	53
		60	0.562	11.626	73			20	0.375	19.250	79
		^ 80S	0.500	11.750	65			30	0.500	19.000	105
		80	0.688	11.374	89			STD.WT.	0.375	19.250	79
		100	0.844	11.062	108			40	0.594	18.812	123
		120	1.000	10.750	126			60	0.812	18.376	167
		140	1.125	10.500	140			X-STG	0.500	19.000	105
		160	1.312	10.126	161			80	1.031	17.938	209
		XX-STG	1.000	10.750	126			100	1.281	17.438	256
		5S	0.156	13.688	23	24	24.000	120	1.500	17.000	297
16	16.000	10S	0.188	13.624	28			140	1.750	16.500	342
		10	0.250	13.500	37			160	1.969	16.062	379
		20	0.312	13.376	46			5S	0.218	23.564	55
		30	0.375	13.250	55			10S	0.250	23.500	63
		STD.WT.	0.375	13.250	55			10	0.250	23.500	63
		40	0.438	13.124	63			20	0.375	23.250	95
		60	0.594	12.812	85			30	0.562	22.876	141
		X-STG	0.500	13.000	72			STD.WT.	0.375	23.250	95
		80	0.750	12.500	107			40	0.688	22.624	171
		100	0.938	12.124	131			60	0.969	22.062	238
18	18.000	120	1.094	11.812	151			X-STG	0.500	23.000	125
		140	1.250	11.500	171			80	1.219	21.562	297
		160	1.406	11.188	190			100	1.531	20.938	367
		5S	0.156	15.750	31			120	1.812	20.376	429
		10S	0.188	15.624	36			140	2.062	19.876	484
		20	0.250	15.500	42			160	2.344	19.312	542
		30	0.312	15.375	52			5S	0.218	23.564	55
		* 40	0.322	15.250	63			10S	0.250	23.500	63
		60	0.406	15.000	83			10	0.250	23.500	63
		**80	0.500	14.876	105			20	0.375	23.250	95
		100	0.594	14.688	138			30	0.562	22.876	141

NOTE

- All dimensions are in inches.
- All weights are in pounds.
- Dimensions for STD WT, X-STG, XX-STG, SCH 10,20,30, 40, 60, 80, 100, 120, 140, and 160 are in accordance with ASME B36.10.
- Dimensions for SCH 5S, 10S, 40S, and 80S are in accordance with ASME B36.19.
- * Wall thickness for Schedule 40, 40S, and Standard Weight are identical though 10" nominal pipe size.
- ** Wall thickness for Schedules 80, 80S, and Extra Strong are identical through 8" nominal pipe size.
- ~ Includes Standard Weight.
- ^ Includes Extra Strong.
- The wall thickness shown is subject to a 12.5% Mill tolerance.

HARDNESS CONVERSION TABLE

Approximate Equivalent Hardness Numbers and Tensile Strengths for Vickers Hardness Numbers for Steel*

Vickers Hardness No.	Brinell Hardness No., 3000-kg load, 10-mm ball		Rockwell Hardness No.				Rockwell Superficial Hardness No., Superficial Brale Indenter			Tensile strength (approx) MPs	Tensile strength (approx) ksi
	Standard ball	Tungsten carbide ball	A scale, 60-kg load, Brale Indenter	B scale, 100-kg load, 1/16-in. diam. ball	C scale, 150-kg load, Brale Indenter	D scale, 100-kg load, Brale Indenter	15M scale 15-kg load	30M scale 30-kg load	45M scale, 45-kg load		
520	(480)	488	76.1	...	50.5	63.5	85.7	69.0	55.6	1793	260
510	(473)	479	75.7	...	49.8	62.9	85.4	68.3	54.7	1751	254
500	(465)	471	75.3	...	49.1	62.2	85.0	67.7	53.9	1703	247
490	(456)	460	74.9	...	48.4	61.6	84.7	67.1	53.1	1662	241
480	(448)	452	74.5	...	47.7	61.3	84.3	66.4	52.2	1620	235
470	441	442	74.1	...	46.9	60.7	83.9	65.7	51.3	1572	228
460	433	433	73.6	...	46.1	60.1	83.6	64.9	50.4	1538	223
450	425	425	73.3	...	45.3	59.4	83.2	64.3	49.4	1496	217
440	415	415	72.8	...	44.5	58.8	82.8	63.5	48.4	1462	212
430	405	405	72.3	...	43.6	58.2	82.3	62.7	47.4	1413	205
420	397	397	71.8	...	42.7	57.5	81.8	61.9	46.4	1372	199
410	388	388	71.4	...	41.8	56.6	81.4	61.1	45.3	1331	193
400	379	379	70.8	...	40.8	56.0	80.8	60.2	44.1	1289	187
390	369	369	70.3	...	39.8	55.2	80.3	59.3	42.9	1248	181
380	360	360	69.8	(110.0)	38.8	54.4	79.8	58.4	41.7	1207	175
370	350	350	69.2	...	37.7	53.6	79.2	57.4	40.4	1172	170
360	341	341	68.7	(109.0)	36.6	52.8	78.6	56.4	39.1	1131	164
350	331	331	68.1	...	35.5	51.9	78.0	55.4	37.8	1096	159
340	322	322	67.6	(108.0)	34.4	51.1	77.4	54.4	36.5	1069	155
330	313	313	67.0	...	33.3	50.2	76.8	53.6	35.2	1034	150
320	303	303	66.4	(107.0)	32.2	49.4	76.2	52.3	33.9	1007	146
310	294	294	65.8	...	31.0	48.4	75.6	51.3	32.5	979	142
300	284	284	65.2	(105.5)	29.8	47.5	74.9	50.2	31.1	951	138
295	280	280	64.8	...	29.2	47.1	74.6	49.7	30.4	938	136
290	275	275	64.5	(104.5)	28.5	46.5	74.2	49.0	29.5	917	133
285	270	270	64.2	...	27.8	46.0	73.8	48.4	28.7	903	131
280	265	265	63.8	(103.5)	27.1	45.3	73.4	47.8	27.9	899	130
275	261	261	63.5	...	26.4	44.9	73.0	47.2	27.1	876	127
270	256	256	63.1	(102.0)	25.6	44.3	72.6	46.4	26.2	855	124
265	252	252	62.7	...	24.8	43.7	72.1	45.7	25.2	841	122
260	247	247	62.4	(101.0)	24.0	43.1	71.6	45.0	24.3	827	120
255	243	243	62.0	...	23.1	42.2	71.1	44.2	23.2	807	117
250	238	238	61.6	99.5	22.2	41.7	70.6	43.4	22.2	793	115
245	233	233	61.2	...	21.3	41.1	70.1	42.5	21.1	779	113
240	228	228	60.7	98.1	20.3	40.3	69.6	41.7	19.9	765	111
230	219	219	...	96.7	(18.0)	...	...	...	...	731	106
220	209	209	...	95.0	(15.7)	...	...	...	...	696	101
210	200	200	...	93.4	(13.4)	...	...	...	...	669	97
200	190	190	...	91.5	(11.0)	...	...	...	...	634	92
190	181	181	...	89.5	(8.5)	...	...	...	...	607	88
180	171	171	...	87.1	(6.0)	...	...	...	...	579	84
170	162	162	...	85.0	(3.0)	...	...	...	...	545	79
160	152	152	...	81.7	(0.0)	...	...	...	...	517	75
150	143	143	...	78.7	...	...	...	...	...	490	71
140	133	133	...	75.0	...	...	...	...	...	455	66
130	124	124	...	71.2	...	...	...	...	...	427	62
120	114	114	...	66.7	...	...	...	...	...	393	57
110	105	105	...	62.3	...	...	...	...	...	...	...
100	95	95	...	56.2	...	...	...	...	...	...	...
95	90	90	...	52.0	...	...	...	...	...	...	...
90	86	86	...	48.0	...	...	...	...	...	...	...
85	81	81	...	41.0	...	...	...	...	...	...	...

* For carbon and alloy steels in the annealed, normalized, and quenched-and-tempered conditions; less accurate for cold work condition and for austenitic steels. The values in **boldface type** correspond to the values in the joint SAE-ASM-ASTM hardness conversions as printed in ASTM E140, Table 2, 1996. The values in parentheses are beyond normal range and are given for information only.

IMPACT ENERGY CONVERSION TABLE

The middle column of figures (**in bold-faced type**) contains the reading (in J or ft-lb) to be converted. If converting from ft-lb to J, read the J equivalent in the column headed "J". If converting from J to ft-lb, read the equivalent in the column headed "ft-lb". 1 ft-lb = 1.355818 J.

ft-lb		J	ft-lb		J	ft-lb		J	ft-lb		J
0.7376	1	1.3558	28.7649	39	52.8769	56.7923	77	104.3980	129.0734	175	237.2681
1.4751	2	2.7116	29.5025	40	54.2327	57.5298	78	105.7538	132.7612	180	244.0472
2.2127	3	4.0675	30.2400	41	55.5885	58.2674	79	107.1096	136.4490	185	250.8263
2.9502	4	5.4233	30.9776	42	56.9444	59.0050	80	108.4654	140.1368	190	257.6054
3.6878	5	6.7791	31.7152	43	58.3002	59.7424	81	109.8212	143.8246	195	264.3845
4.4254	6	8.1349	32.4527	44	59.6560	60.4801	82	111.1771	147.5124	200	271.1636
5.1629	7	9.4907	33.1903	45	61.0118	61.2177	83	112.5329	154.8880	210	284.7218
5.9005	8	10.8465	33.9279	46	62.3676	61.9552	84	113.8887	162.2637	220	298.2799
6.6381	9	12.2024	34.6654	47	63.7234	62.6928	85	115.2445	169.6393	230	311.8381
7.3756	10	13.5582	35.4030	48	65.0793	63.4303	86	116.6003	177.0149	240	325.3963
8.1132	11	14.9140	36.1405	49	66.4351	64.1679	87	117.9562	184.3905	250	338.9545
8.8507	12	16.2698	36.8781	50	67.7909	64.9055	88	119.3120	191.7661	260	352.5126
9.5883	13	17.6256	37.6157	51	69.1467	65.6430	89	120.6678	199.1418	270	366.0708
10.3259	14	18.9815	38.3532	52	70.5025	66.3806	90	122.0236	206.5174	280	379.6290
11.0634	15	20.3373	39.0908	53	71.8583	67.1182	91	123.3794	213.8930	290	393.1872
11.8010	16	21.6931	39.8284	54	73.2142	67.8557	92	124.7452	221.2686	300	406.7454
12.5386	17	23.0489	40.5659	55	74.5700	68.5933	93	126.0911	228.6442	310	420.3036
13.2761	18	24.4047	41.3035	56	75.9258	69.3308	94	127.4469	236.0199	320	433.8617
14.0137	19	25.7605	42.0410	57	77.2816	70.0684	95	128.8027	243.3955	330	447.4199
14.7512	20	27.1164	42.7786	58	78.6374	70.8060	96	130.1585	250.7711	340	460.9781
15.4888	21	28.4722	43.5162	59	79.9933	71.5435	97	131.5143	258.1467	350	474.5363
16.2264	22	29.8280	44.2537	60	81.3491	72.2811	98	132.8702	265.5224	360	488.0944
16.9639	23	31.1838	44.9913	61	82.7049	73.0186	99	134.2260	272.8980	370	501.6526
17.7015	24	32.5396	45.7288	62	84.0607	73.7562	100	135.5818	280.2736	380	515.2108
18.4390	25	33.8954	46.4664	63	85.4165	74.4938	105	142.3609	287.6492	390	528.7690
19.1766	26	35.2513	47.2040	64	86.7723	81.1308	110	149.1400	295.0248	400	542.3272
19.9142	27	36.6071	47.9415	65	88.1282	84.8196	115	155.9191	302.4005	410	555.8854
20.6517	28	37.9629	48.6791	66	89.4840	88.5075	120	162.6982	309.7761	420	569.4435
21.3893	29	39.3187	49.4167	67	90.8398	92.1953	125	169.4772	317.1517	430	583.0017
22.1269	30	40.6745	50.1542	68	92.1956	95.8831	130	176.2563	324.5273	440	596.5599
22.8644	31	42.0304	50.8918	69	93.5514	99.5709	135	183.0354	331.9029	450	610.1181
23.6020	32	43.3862	51.6293	70	94.9073	103.2587	140	189.8145	339.2786	460	623.6762
24.3395	33	44.7420	52.3669	71	96.2631	106.9465	145	196.5936	346.6542	470	637.2344
25.0771	34	46.0978	53.1045	72	97.6189	110.6343	150	203.3727	354.0298	480	650.7926
25.8147	35	47.4536	53.8420	73	98.9747	114.3221	155	210.1518	361.4054	490	664.3508
26.5522	36	48.8094	54.5796	74	100.3305	118.0099	160	216.9308	368.7811	500	677.9090
27.2898	37	50.1653	55.3172	75	101.6863	121.6977	165	223.7099			
28.0274	38	51.5211	56.0547	76	103.0422	125.3856	170	230.4890			

WEIGHT OF CIRCULAR STEEL PLATES PER 1" OF THICKNESS

Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness	Dia. Inches	Weight per Inch Thickness
1	0.22	9	18.02	17	64.30	25	139.07	33	242.31	41	374.04	49	534.29
1 1/8	0.28	9 1/8	18.53	17 1/8	65.25	25 1/8	140.46	33 1/8	244.15	41 1/8	376.31	49 1/8	537.02
1 1/4	0.35	9 1/4	19.04	17 1/4	66.21	25 1/4	141.86	33 1/4	245.99	41 1/4	378.60	49 1/4	539.76
1 3/8	0.42	9 3/8	19.56	17 3/8	67.17	25 3/8	143.27	33 3/8	247.85	41 3/8	380.90	49 3/8	542.50
1 1/2	0.50	9 1/2	20.08	17 1/2	68.14	25 1/2	144.68	33 1/2	249.71	41 1/2	383.22	49 1/2	545.25
1 5/8	0.59	9 5/8	20.61	17 5/8	69.12	25 5/8	146.11	33 5/8	251.57	41 5/8	385.51	49 5/8	548.01
1 3/4	0.68	9 3/4	21.15	17 3/4	70.10	25 3/4	147.54	33 3/4	253.45	41 3/4	387.84	49 3/4	550.78
1 7/8	0.78	9 7/8	21.70	17 7/8	71.09	25 7/8	148.97	33 7/8	255.33	41 7/8	390.16	49 7/8	553.55
2	0.89	10	22.25	18	72.09	26	150.41	34	257.22	42	392.48	50	556.33
2 1/8	1.01	10 1/8	22.81	18 1/8	73.10	26 1/8	151.86	34 1/8	259.11	42 1/8	394.84	50 1/8	559.11
2 1/4	1.13	10 1/4	23.38	18 1/4	74.11	26 1/4	153.32	34 1/4	261.01	42 1/4	397.19	50 1/4	561.90
2 3/8	1.26	10 3/8	23.95	18 3/8	75.13	26 3/8	154.78	34 3/8	262.92	42 3/8	399.54	50 3/8	564.70
2 1/2	1.39	10 1/2	24.53	18 1/2	76.15	26 1/2	156.25	34 1/2	264.84	42 1/2	401.89	50 1/2	567.51
2 5/8	1.54	10 5/8	25.12	18 5/8	77.19	26 5/8	157.73	34 5/8	266.76	42 5/8	404.27	50 5/8	570.32
2 3/4	1.69	10 3/4	25.71	18 3/4	78.22	26 3/4	159.22	34 3/4	268.69	42 3/4	406.65	50 3/4	573.14
2 7/8	1.84	10 7/8	26.32	18 7/8	79.27	26 7/8	160.71	34 7/8	270.63	42 7/8	409.03	50 7/8	575.97
3	2.01	11	26.92	19	80.32	27	162.21	35	272.57	43	411.41	51	578.80
3 1/8	2.18	11 1/8	27.54	19 1/8	81.39	27 1/8	163.71	35 1/8	274.52	43 1/8	413.82	51 1/8	581.64
3 1/4	2.36	11 1/4	28.16	19 1/4	82.45	27 1/4	165.22	35 1/4	276.48	43 1/4	416.20	51 1/4	584.49
3 3/8	2.54	11 3/8	28.79	19 3/8	83.53	27 3/8	166.74	35 3/8	278.44	43 3/8	418.60	51 3/8	587.34
3 1/2	2.73	11 1/2	29.43	19 1/2	84.61	27 1/2	168.27	35 1/2	280.41	43 1/2	421.04	51 1/2	590.21
3 5/8	2.93	11 5/8	30.07	19 5/8	85.70	27 5/8	169.80	35 5/8	282.39	43 5/8	423.45	51 5/8	593.07
3 3/4	3.14	11 3/4	30.72	19 3/4	86.79	27 3/4	171.34	35 3/4	284.38	43 3/4	425.88	51 3/4	595.95
3 7/8	3.35	11 7/8	31.38	19 7/8	87.89	27 7/8	172.89	35 7/8	286.37	43 7/8	428.32	51 7/8	598.83
4	3.57	12	32.04	20	89.00	28	174.44	36	288.37	44	430.76	52	601.72
4 1/8	3.80	12 1/8	32.71	20 1/8	90.12	28 1/8	176.01	36 1/8	290.38	44 1/8	433.22	52 1/8	604.62
4 1/4	4.03	12 1/4	33.39	20 1/4	91.24	28 1/4	177.57	36 1/4	292.39	44 1/4	435.69	52 1/4	607.52
4 3/8	4.27	12 3/8	34.08	20 3/8	92.37	28 3/8	179.15	36 3/8	294.41	44 3/8	438.15	52 3/8	610.43
4 1/2	4.52	12 1/2	34.77	20 1/2	93.51	28 1/2	180.73	36 1/2	296.42	44 1/2	440.62	52 1/2	613.35
4 5/8	4.77	12 5/8	35.47	20 5/8	94.65	28 5/8	182.32	36 5/8	298.46	44 5/8	443.08	52 5/8	616.27
4 3/4	5.03	12 3/4	36.17	20 3/4	95.80	28 3/4	183.91	36 3/4	300.50	44 3/4	445.57	52 3/4	619.20
4 7/8	5.30	12 7/8	36.88	20 7/8	96.96	28 7/8	185.52	36 7/8	302.56	44 7/8	448.07	52 7/8	622.14
5	5.58	13	37.60	21	98.13	29	187.13	37	304.60	45	450.56	53	625.09
5 1/8	5.86	13 1/8	38.33	21 1/8	99.30	29 1/8	188.74	37 1/8	306.67	45 1/8	453.08	53 1/8	628.04
5 1/4	6.15	13 1/4	39.06	21 1/4	100.48	29 1/4	190.37	37 1/4	308.74	45 1/4	455.60	53 1/4	631.00
5 3/8	6.45	13 3/8	39.80	21 3/8	101.66	29 3/8	192.00	37 3/8	310.81	45 3/8	458.10	53 3/8	633.96
5 1/2	6.75	13 1/2	40.55	21 1/2	102.85	29 1/2	193.64	37 1/2	312.90	45 1/2	460.65	53 1/2	636.94
5 5/8	7.06	13 5/8	41.31	21 5/8	104.05	29 5/8	195.28	37 5/8	314.97	45 5/8	463.17	53 5/8	639.92
5 3/4	7.38	13 3/4	42.07	21 3/4	105.26	29 3/4	196.93	37 3/4	317.07	45 3/4	465.72	53 3/4	642.90
5 7/8	7.70	13 7/8	42.84	21 7/8	106.47	29 7/8	198.59	37 7/8	319.19	45 7/8	468.27	53 7/8	645.90
6	8.01	14	43.62	22	107.69	30	200.25	38	321.29	46	470.82	54	648.90
6 1/8	8.35	14 1/8	44.39	22 1/8	108.92	30 1/8	201.93	38 1/8	323.42	46 1/8	473.37	54 1/8	651.91
6 1/4	8.69	14 1/4	45.18	22 1/4	110.15	30 1/4	203.61	38 1/4	325.54	46 1/4	475.94	54 1/4	654.92
6 3/8	9.04	14 3/8	45.98	22 3/8	111.40	30 3/8	205.29	38 3/8	327.66	46 3/8	478.52	54 3/8	657.94
6 1/2	9.40	14 1/2	46.78	22 1/2	112.64	30 1/2	206.99	38 1/2	329.82	46 1/2	481.10	54 1/2	660.97
6 5/8	9.77	14 5/8	47.59	22 5/8	113.90	30 5/8	208.69	38 5/8	331.94	46 5/8	483.71	54 5/8	664.01
6 3/4	10.14	14 3/4	48.41	22 3/4	115.16	30 3/4	210.39	38 3/4	334.10	46 3/4	486.28	54 3/4	667.94
6 7/8	10.52	14 7/8	49.23	22 7/8	116.43	30 7/8	212.11	38 7/8	336.25	46 7/8	488.89	54 7/8	670.10
7	10.90	15	50.06	23	117.71	31	213.83	39	338.43	47	491.50	55	673.15
7 1/8	11.30	15 1/8	50.90	23 1/8	118.99	31 1/8	215.56	39 1/8	340.61	47 1/8	494.13	55 1/8	676.22
7 1/4	11.70	15 1/4	51.75	23 1/4	120.28	31 1/4	217.29	39 1/4	342.79	47 1/4	496.76	55 1/4	679.29
7 3/4	12.10	15 3/8	52.60	23 3/8	121.58	31 3/8	219.03	39 3/8	344.97	47 3/8	499.37	55 3/8	682.36
7 1/2	12.52	15 1/2	53.46	23 1/2	122.88	31 1/2	220.78	39 1/2	347.16	47 1/2	502.04	55 1/2	685.45
7 5/8	12.94	15 5/8	54.32	23 5/8	124.19	31 5/8	222.54	39 5/8	349.37	47 5/8	504.67	55 5/8	688.54
7 3/4	13.36	15 3/4	55.20	23 3/4	125.51	31 3/4	224.30	39 3/4	351.58	47 3/4	507.33	55 3/4	691.64
7 7/8	13.80	15 7/8	56.08	23 7/8	126.83	31 7/8	226.07	39 7/8	353.79	47 7/8	509.97	55 7/8	694.74
8	14.24	16	56.96	24	128.16	32	227.85	40	355.99	48	512.66	56	697.85
8 1/8	14.69	16 1/8	57.86	24 1/8	129.50	32 1/8	229.63	40 1/8	358.23	48 1/8	515.32	56 1/8	700.97
8 1/4	15.14	16 1/4	58.76	24 1/4	130.85	32 1/4	231.42	40 1/4	360.47	48 1/4	518.01	56 1/4	704.10
8 3/8	15.61	16 3/8	59.66	24 3/8	132.20	32 3/8	233.22	40 3/8	362.71	48 3/8	520.68	56 3/8	707.23
8 1/2	16.08	16 1/2	60.58	24 1/2	133.57	32 1/2	235.02	40 1/2	364.95	48 1/2	523.40	56 1/2	710.37
8 5/8	16.55	16 5/8	61.50	24 5/8	134.93	32 5/8	236.83	40 5/8	367.21	48 5/8	526.09	56 5/8	713.52
8 3/4	17.04	16 3/4	62.43	24 3/4	136.30	32 3/4	238.65	40 3/4	369.48	48 3/4	528.78	56 3/4	716.67
8 7/8	17.53	16 7/8	63.36	24 7/8	137.68	32 7/8	240.48	40 7/8	371.75	48 7/8	531.50	56 7/8	719.83

CONVERSION FACTORS

Change	To	Multiply By	Change	To	Multiply By
A			G		
atmospheres	ft of water (at 4 °C)	33.90	gallons	cu cms	3,785.0
atmospheres	in of mercury (at 0 °C)	29.92	gallons	cu feet	0.1337
atmospheres	kgs/sq cm	1.0333	gallons	cu inches	231.0
atmospheres	pounds/sq in	14.70	gallons	cu meters	3.785 x 10 ⁻³
B			gallons	liters	3.785
bars	atmospheres	0.9869	gallons (liq Br. Imp.)	gallons (U.S. liq)	1.20095
BTU	foot-lbs	778.3	gallons (U.S.)	gallons (Imp.)	0.83267
BTU	joules	1,054.8	gallons of water	pounds of water	8.3453
BTU	kilowatt-hrs	2.298 x 10 ⁻⁴	grams	dynes	980.7
C			grams	kilograms	0.001
calories, gram (mean)	BTU (mean)	3.9685 x 10 ⁻³	grams	milligrams	1,000.0
Centigrade	Fahrenheit	(C° x 9/5) + 32	grams	ounces (avdp)	0.03527
centimeters	feet	3.281 x 10 ⁻²	grams	ounces (troy)	0.03215
centimeters	inches	0.3937	grams	poundals	0.07093
centimeters	kilometers	10 ⁻⁵	grams	pounds	2.205 x 10 ⁻³
centimeters	meters	0.01	grams/cu cm	pounds/cu ft	62.43
centimeters	millimeters	10.0	grams/cu cm	pounds/cu in	0.03613
cubic centimeters	cu feet	3.531 x 10 ⁻⁵	grams/sq cm	pounds/sq ft	2.0481
cubic centimeters	cu inches	0.06102	H		
cubic centimeters	cu meters	10 ⁻⁶	horsepower	BTU/min	42.44
cubic centimeters	gallons (U.S. liq)	2.642 x 10 ⁻⁴	horsepower	foot-lbs/min	33,000.0
cubic centimeters	liters	0.001	horsepower	foot-lbs/sec	550.0
cubic feet	cu inches	1,728.0	horsepower	kilowatts	0.7457
cubic feet	cu meters	0.02832	horsepower	watts	745.7
cubic feet	gallons (U.S. liq)	7.48052	I		
cubic feet	liters	28.32	inches	centimeters	2.540
cubic inches	cu cms	16.39	inches	meters	2.540 x 10 ⁻²
cubic inches	cu feet	5.787 x 10 ⁻⁴	inches	millimeters	25.40
cubic inches	cu meters	1.639 x 10 ⁻⁵	inches	mils	1,000.0
cubic inches	gallons	4.329 x 10 ⁻³	inches	feet	0.0833
cubic meters	cu cms	10 ⁶	inches of mercury	atmospheres	0.03342
cubic meters	cu feet	35.31	inches of mercury	inches of water	13.6
cubic meters	cu inches	61,023.0	inches of mercury	feet of water	1.1333
cubic meters	gallons (U.S. liq)	264.2	inches of mercury	kgs/sq cm	0.03453
cubic meters	liters	1,000.0	inches of mercury	kgs/sq meter	345.3
D			inches of mercury	pounds/sq ft	70.73
dynes	joules/cm	10 ⁻⁷	inches of mercury	pounds/sq in	0.4912
dynes	joules/meter (newtons)	10 ⁻⁵	inches of water (at 4°C)	atmospheres	2.458 x 10 ⁻³
dynes	kilograms	1.020 x 10 ⁻⁶	inches of water (at 4°C)	inches of mercury	0.07355
dynes	poundals	7.233 x 10 ⁻⁵	inches of water (at 4°C)	kgs/sq cm	2.540 x 10 ⁻³
dynes	pounds	2.248 x 10 ⁻⁵	inches of water (at 4°C)	ounces/sq in	0.5781
E			inches of water (at 4°C)	pounds/sq ft	5.204
ergs	BTU	9.480 x 10 ⁻¹¹	inches of water (at 4°C)	pounds/sq in	0.03613
ergs	foot-pounds	7.367 x 10 ⁻⁸	J		
ergs	joules	10 ⁻⁷	joules	BTU	9.480 x 10 ⁻⁴
ergs/sec	horsepower	1.341 x 10 ⁻¹⁰	joules	ergs	10 ⁷
F			joules	foot-pounds	0.7376
feet	centimeters	30.48	joules	watt-hrs	2.778 x 10 ⁻⁴
feet	meters	0.3048	joules/cm	grams	1.020 x 10 ⁻⁴
feet	millimeters	304.8	joules/cm	dynes	10 ⁷
feet	inches	12.0	joules/cm	joules/meter (newtons)	100.0
feet of water	atmospheres	0.02950	joules/cm	poundals	723.3
feet of water	in of mercury	0.8826	joules/cm	pounds	22.48
feet of water	pounds/sq ft	62.43	K		
feet of water	pounds/sq in	0.4335	kilograms	dynes	980,665.0
Fahrenheit	Centigrade	(° F - 32) x 5/9	kilograms	grams	1,000.0
foot-pounds	BTU	1.286 x 10 ⁻³	kilograms	joules/cm	0.09807
foot-pounds	ergs	1.356 x 10 ⁷	kilograms	joules/meter (newtons)	9.807
foot-pounds	joules	1.356	kilograms	poundals	70.93
foot-pounds	kilowatt-hrs	3.766 x 10 ⁻⁷	kilograms	pounds	2.205
kilograms	tons (short)	1.102 x 10 ⁻³	pounds	kilograms	0.4536
kilograms/cu meter	grams/cu cm	0.001	pounds	ounces	16.0
kilograms/cu meter	pounds/cu ft	0.06243	pounds	ounces (troy)	14.5833

CONVERSION FACTORS

Change	To	Multiply By	Change	To	Multiply By
K			P		
kilograms/cu meter	pounds/cu in	3.613×10^{-5}	pounds	poundals	32.17
kilograms/cu meter	pounds/mil-foot	3.405×10^{-10}	pounds	pounds (troy)	1.21528
kilograms/meter	pounds/ft	0.6720	pounds	tons (short)	0.0005
kilograms/sq cm	dynes	980,665.0	pounds of water	cu feet	0.01602
kilograms/sq cm	atmosphere	0.9678	pounds of water	cu inches	27.68
kilograms/sq cm	feet of water	32.81	pounds of water	gallons	0.1198
kilograms/sq cm	inches of mercury	28.96	pounds-feet	cm-dynes	1.356×10^7
kilograms/sq cm	pounds/sq ft	2,048.0	pounds-feet	cm-grams	13,825.0
kilograms/sq cm	pounds/sq in	14.22	pounds-feet	meter-kgs	0.1383
kilograms/sq meter	atmosphere	9.678×10^{-5}	pounds/ft	kgs/meter	1.488
kilograms/sq meter	bars	98.07×10^{-6}	pounds/in	gms/cm	178.6
kilograms/sq meter	feet of water	3.281×10^{-3}	pounds/sq ft	atmospheres	4.725×10^{-4}
kilograms/sq meter	inches of mercury	2.896×10^{-3}	pounds/sq ft	feet of water	0.01602
kilograms/sq meter	pounds/sq ft	0.2048	pounds/sq ft	inches of mercury	0.01414
kilograms/sq meter	pounds/sq in	1.422×10^{-3}	pounds/sq ft	kgs/sq meter	4.882
kilograms/sq mm	kgs/sq meter	10^6	pounds/sq ft	pounds/sq in	6.944×10^{-3}
kilowatts	BTU/min	56.92	pounds/sq in	atmospheres	0.06804
kilowatts	foot-lbs/min	4.426×10^4	pounds/sq in	inches of water	27.68
kilowatts	foot-lbs/sec	737.6	pounds/sq in	feet of water	2.307
kilowatts	horsepower	1.341	pounds/sq in	inches of mercury	2.036
kilowatts	watts	1000.0	pounds/sq in	kgs/sq meter	703.1
kilowatt-hrs	BTU	3413.0	pounds/sq in	pounds/sq in	144.0
kilowatt-hrs	ergs	3.600×10^{13}	S		
kilowatt-hrs	foot-pounds	2.655×10^6	short tons	pounds	2,000.0
kilowatt-hrs	joules	3.6×10^6	short tons	long tons	0.89285
L			slug	kilogram	14.59
liters	cu cm	1,000.0	slug	pounds	32.17
liters	cu feet	0.03531	square centimeters	sq feet	1.076×10^{-3}
liters	cu inches	61.02	square centimeters	sq inches	0.1550
liters	cu meters	0.001	square centimeters	sq meters	0.0001
liters	gallons (U.S. liq)	0.2642	square centimeters	sq millimeters	100.0
long tons	pounds	2,240.0	square feet	sq cms	929.0
M			square feet	sq inches	144.0
meters	centimeters	100.0	square feet	sq meters	0.09290
meters	feet	3.281	square feet	sq millimeters	9.290×10^4
meters	inches	39.37	square feet	sq cms	6.452
meters	millimeters	1,000.0	square inches	sq feet	6.944×10^{-3}
miles (statue)	feet	5,280.0	square inches	sq millimeters	645.2
miles (statue)	meters	1,609.0	square kilometers	sq cms	10^{10}
millimeters	centimeters	0.1	square kilometers	sq feet	10.76×10^6
millimeters	feet	3.281×10^{-3}	square kilometers	sq inches	1.550×10^9
millimeters	inches	0.03937	square kilometers	sq meters	10^6
mils	inches	0.001	square meters	sq cms	10^4
N			square meters	sq feet	10.76
newtons	dynes	10^5	square meters	sq inches	1,550.0
O			square meters	sq millimeters	10^6
ounces	grams	28.349527	square millimeters	sq cms	0.01
ounces	pounds	0.06250	square millimeters	sq feet	1.076×10^{-5}
ounces	ounces (troy)	0.9115	square millimeters	sq inches	1.550×10^{-3}
P			T		
Poise	gram/cm sec	1.0	tons (long)	kilograms	1,016.0
pounds (avoirdupois)	ounces (troy)	14.5833	tons (long)	pounds	2,240.0
poundals	dynes	13,826.0	tons (long)	tons (short)	1.120
poundals	joules/cm	1.383×10^{-3}	tons (metric)	kilograms	1,000.0
poundals	joules/meter (newtons)	0.1383	tons (metric)	pounds	2,205.0
poundals	kilograms	0.01410	W		
poundals	pounds	0.03108	watts	BTU/hr	3.4129
pounds	dynes	44.4823×10^4	watts	BTU/min	0.05688
pounds	grams	453.5924	watts	ergs/sec	10^7
pounds	joules/cm	0.04448	watts	horsepower	1.341×10^{-3}
pounds	joules/meter (newtons)	4.448	watts	kilowatts	0.001



TERMS AND CONDITIONS OF SALE

Forged Components, Inc. herein after called "the Company" agrees with the Purchasers, that for a period of one year after the date of shipment, the Company with respect to its product sold will warrant the product to be free from manufacturing defects, and if defective, will either repair or replace the product without charge or refund the purchase price, at the option of the Company, providing the following conditions are complied with:

1. The Company is promptly notified in writing of such defect immediately upon discovery of same and if the Company requests, the defective product or products are promptly forwarded to the F.O.B. Company's plant where made; and
2. The defect is not due to faulty installation, misalignment of parts, vibration, ordinary wear and tear, corrosion, erosion, unusual pressure surges of pulsation, water hammer, temperature shocking, or fouling; and
3. That the product has not been altered or modified after leaving the Company's plant.

In respect of other product or items of equipment or accessories, included in the equipment "sold", purchased or obtained from or made by other manufacturers or their suppliers, the Purchaser accepts such equipment, items of equipment and accessories on the basis of the particular manufacturers warranty, if any, and no other and the Purchaser agrees that there is no warranty, representation condition or agreement in respect of such equipment, items of equipment or accessories, on the part of the Company, whatsoever relating to such equipment, items of equipment or accessories.

It is agreed and understood that the Company's liability in respect to the sale is strictly limited to the sale price replacement of the product as hereinbefore specified and that the Company shall not, in any event, be liable for any damages whether for loss of use or business interruption or expense occasioned by the use of defective product or any other claim for damages, consequential or otherwise, whatsoever.

The Company's liabilities as above set out shall not be extended because of advice given by the Company in connection with the design, installation or use of any product. The Company does not assume responsibility for the accuracy of Purchaser's calculations or specifications or design specifications.

The Company makes no other warranty, condition or representation of any nature whatsoever, either expressed or implied, by statute or otherwise, except as herein contained.

Purchaser agrees that if the products sold hereinunder are by Purchaser re-sold, Purchaser will include in the contract for re-sale, provisions that limit recoveries against the Company in accordance with this paragraph.

PRICE All prices are quoted F.O.B. Humble, Texas unless otherwise specified in the quotation. Prices quoted are subject to change without notice prior to the Company's acceptance of Purchase Order, and it is understood that the price stated herein is based upon the Company's cost under existing law and conditions. If such is increased by the enactment of any, applicable law or by the increase of the cost of any of the components of the equipment purchased from others, the amount of such increased costs shall be added to the price stated. This quotation is made with the understanding that any sales, use, excise, or any other tax imposed by any present or future law on any of the materials, components or equipment included in this quotation or measured by the quantity or value thereof or by all or any part of the receipts from the sale thereof, exclusive of taxes upon net income, shall be added to the amount to be paid hereinunder.

Prices may be subject to a surcharge to Purchasers, who, by reason of current or prior trade or business practices or course of dealings with the Company have increased or may increase marketing or distribution costs.

Any Sales Tax, Manufacturer's Tax, or Use Tax imposed by Federal, State or Municipal Law, or taxes imposed by other countries to which the product is sold will have the applicable tax added to the prices and are to be paid by Purchaser.

FREIGHT Quotations specifically including freight or other transportation charges are only estimates based on routing at the Company's option and current rates. The Company will favor Purchaser's routing whenever same does not cause an increase in freight or other transportation charges, or whenever such increase is guaranteed by the Purchaser. Charges for freight or other transportation will be modified to reflect actual rates at the time of shipment, including hauling permits and transportation taxes.

RISK Title and risk to the equipment shall pass to the Purchaser when delivered to the carrier of the Company's selection, or to the carrier designated by the Purchaser; but the Company reserves the right to retain or resume possession until the purchase price is fully paid.

LIEN The Company hold's a vendor's lien on the equipment to secure payment of the purchase price, and the Purchaser agrees to execute such documents as may be required by the Company's solicitors to make fully effective this provision.

PAYMENT Terms are net 30 days following shipment or notification to Purchaser that the product is ready for delivery. Payment shall be due pro rata on all partial shipments. The extension of credit is at all times subject to the approval of the Company's credit department. Purchaser represents that Purchaser is solvent and can and will pay for products/equipment delivered to Purchaser in accordance with the terms hereof. If Purchaser's financial condition at any time does not in the judgement of the Company justify continuance of the work or shipment hereinunder on specified terms, The Company retains the right to require full or partial payment in advance. Interest at rate shown on invoice will be added to the unpaid balance after the said 30 days.

TIME OF DELIVERY Delivery schedules specified in the quotation are approximate only, and shipment will be made within reasonable proximity thereto. The Company will not be responsible for any damage whatsoever caused by delay in shipment whether the same results from caused within or beyond the control of the Company. Deferred deliveries are subject to the Company's written approval. Material quoted as being available from stock is normally available for immediate shipment but subject to prior sale.

SHORTAGES AND RETURNS Claims for shortages must be filed within ten (10) days of receipt of shipment. Product cannot be returned without prior written consent from the Company.

CANCELLATION Orders entered on the Company's books, can only be cancelled with the Company's written consent and upon terms which will indemnify the Company against all loss. Upon request to cancel, the Company will advise amount of cancellation charges, in addition to charges for dies, work in progress, products produced, engineering and design, inspection, material and other incurred costs. The Company reserves the right, at its discretion to cancel the order if the Purchaser becomes bankrupt or insolvent.

DESIGN CHANGES The Company shall not be required to make any changes in applicable product or specifications requested by Purchaser after acceptance of the Company's quotation, which shall increase the Company's cost until there has been agreement upon the price adjustment for such changes. Should Purchaser change the material specification of the order after order placement, Purchaser may incur material cancellation charges in accordance with the preceding Cancellation clause pending material status at time of requested change. Catalog product presentations including catalog dimensions, designs and specifications are representative of product availability at time of publication only. Actual geometry dimensions and designs are subject to designs and manufacturing changes without notice.

OWNERSHIP OF PLANS All plans, drawings or specifications furnished by the Company to the Purchaser shall remain the property of the Company and Purchaser agrees that it will make no use of such plans, drawings, or specifications and will not disclose the same to others without the express permission of the Company in writing.

OWNERSHIP OF TOOLING All dies, tooling, and patterns required to produce the product/item shall remain the property of the Company. Payment for such items or other items/equipment of preparation does not entitle the Purchaser to any right, title, and interest in same.

PATENT RIGHTS The Company assumes no responsibility for the manufacture and sale to Purchaser of the product, equipment, items specified by Purchaser is an infringement of patent rights of other persons, companies, organizations, etc. Purchaser assumes responsibility for and will protect and hold harmless the Company against charges of such infringement, if any, except as to the Company's own manufacturing equipment and processes.

INSPECTION AND TESTING The product may be inspected by Purchaser or Purchaser's authorized representative during manufacture at the Company's plant. Particular inspection requirements of the Purchaser must be stated in Purchaser's order. Unless it is otherwise expressly agreed in writing, final inspection and acceptance will be made at the Company's plant. Mill Test Reports (depicting material chemical and physical properties) will be supplied with all standard manufactured Code products. Supplementary/special inspection and testing requirements will be furnished upon request.

LIMITATION The Company shall not be responsible or liable for any loss, default, damage, delay or failure to deliver the product herein described including, without limitation, caused by fire, strikes, floods, embargoes, differences with workmen, civil or military authority, governmental actions or orders, insurrection or riot, by failure of the manufacturers or suppliers to deliver equipment or materials when promised, or beyond the reasonable control of the Company.

MODIFICATION OF TERMS OF QUOTATION The quotation, if accepted, shall constitute the entire agreement between the parties and these conditions may be modified only in writing on the face of the quotation in the office of the Company. In the event of conflict between these terms and the terms of any purchase order issued by Purchaser, Purchaser agrees that the terms of this quotation shall govern. Clerical and stenographic errors are subject to correction.

FORCE MAJURE Any delay in or failure of performance of the Company shall not constitute default hereinunder if the extent of such delays or failure of performance is caused by occurrence beyond the control of the Company, including but not limited to acts of God, expropriation or confiscation of facilities, act of war, rebellion, fires, strikes, labor shortages, inability to secure material, thefts, accidents or any causes whether or not of the same class or kind as those specifically above named which are not within the control of the Company and which by the exercise of reasonable diligence, the Company is unable to prevent or prevail against. Should any acts or events of this provision delay the Company, then the time for performance by the Company shall be extended by a period of time equal to time lost by reason of such delay.

DELAYS Should any delays such as standby time or shutdown time, or any causes whether or not of the same class or kind as those specifically above mentioned which are not within the control of the Company and which by the exercise of reasonable diligence, the Company is unable to prevent or provide against will be charged to Purchaser's account.

DAMAGES In no event shall the Company be liable for any special or consequential loss or damages, of anticipated profits, loss resulting from delays, or loss of use of equipment or any installation into which its product may be installed.

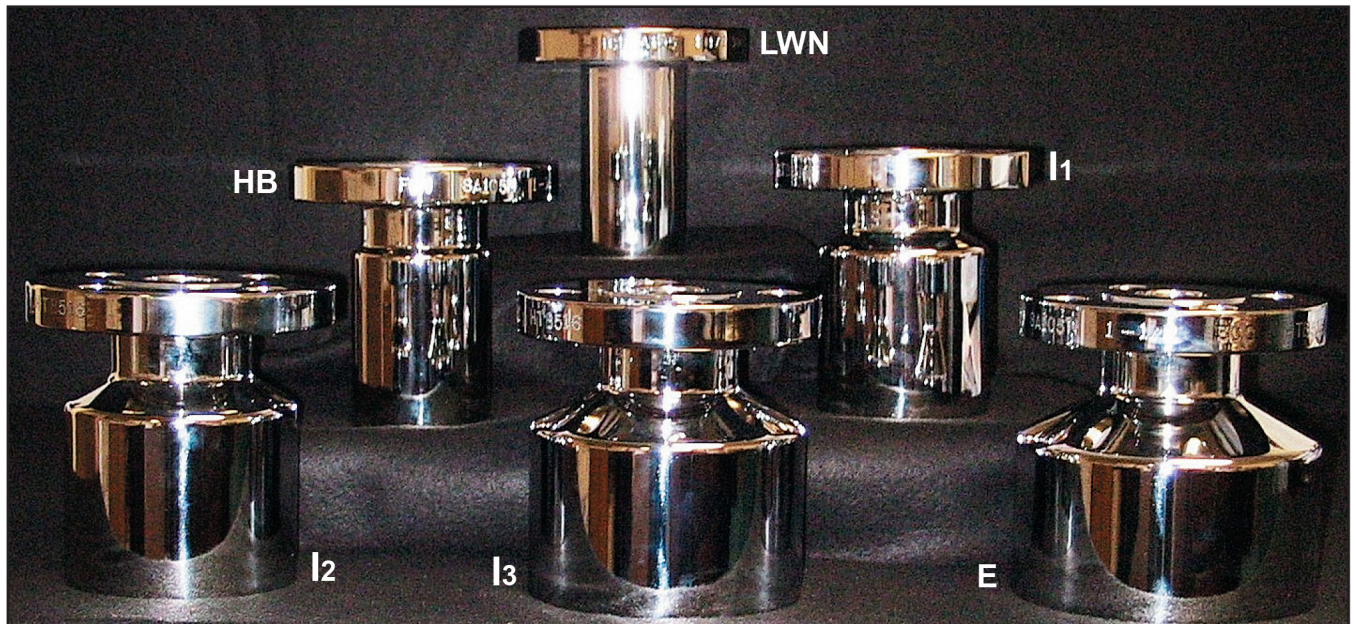
SERVICE CHARGE ON LATE PAYMENT For those Purchasers who elect to go beyond 30 days, a service charge of 1 1/2% per month, 18% per annum, will be added for each 30 day increment or part thereof, for which the payment is late. The service charge will be billed each period, based on account analysis and aging.

INTERPRETATION The situs of this agreement shall be in the state of Texas and it shall be covered by the law of this state.

These terms and conditions shall control in any contract resulting from or arising out of this quotation, price sheet, or acknowledgement, regardless of printed terms, conditions or provisions found in responses hereto or documents giving rise hereto, all of such printed matters incorporated therein being deemed waived insofar as the same differ from these terms and conditions, unless such differing terms, conditions or provisions shall be specifically asserted for inclusion in written form other than printing and be specifically accepted by the Company as a change in these terms and conditions by express reference in writing. The applicability of this paragraph is an express condition to any contract being formed between the Company and Purchaser.

The above and forgoing terms and conditions are the final expressions of the terms and conditions of the contract which may be or is formed between the Company and Purchaser and they are intended also as a complete and exhaustive statement of the terms and conditions of such agreement.

STANDARD PRODUCTS



Standard Integral Forged Pressure Vessel Connections



Cylindrical Contoured Studding Outlet



Integral Forged Connections



Flat Bottom Weld Stubs



Q-Lip Neck Attachment



24" 1500 lb Type E Nozzle 42 1/4" Long



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