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GRAYLOC®
PRODUCTS
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Grayloc®
Product Catalog

Grayloc® Products

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- Custom design
- Finite element analysis
- Retrofit designs
- Testing program development
- Project technical support
- State of the art metal-to-metal seal designs

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- MIL-1-45208A inspection system requirements
- ISO 9001
- Total product materials traceability Complete calibration program, with certifications,
- traceable to the National Calibration
- Bureau of Standards and Technology

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- Large service oriented finished goods inventory : Action team for critical orders
- Factory trained field service technicians available 24 hours a day, 7 days a week
- Packaging and shipment preparation that exceeds industry standards
- Project management

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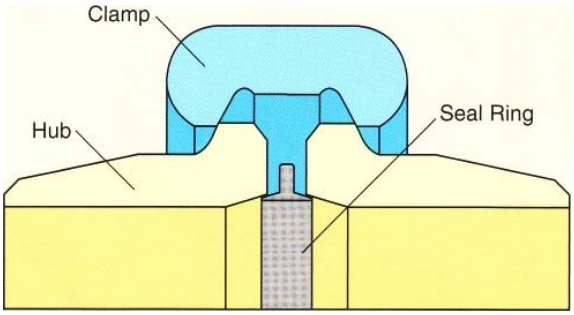
The Grayloc product guarantee is only valid when the installation and maintenance instructions on page 30 are followed. For any questions about Grayloc Products or their selection, installation, use, or service, please contact the nearest office listed on the back cover for professional assistance and service.

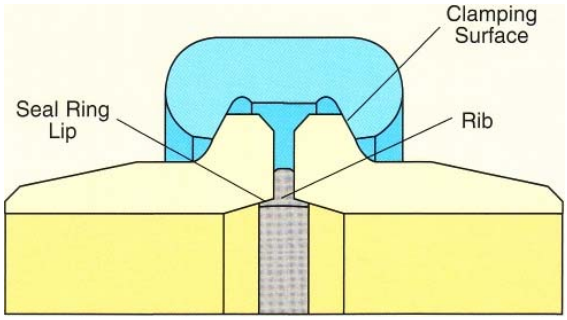
The Grayloc Metal-to-Metal Seal

A Grayloc® connector has three components:

- **Metal Seal Ring** - The seal ring resembles a "T" cross section. The leg of the "T" forms a rib that is held by the hub faces as the connection is madeup. The two arms form lip seals that create an area of sealing surface with the inner surface of the hub. Internal pressure works to reinforce this seal.
- **Two Hubs -** The clamp fits over the two hubs and forces them against the seal ring rib. As the hubs are drawn together by the clamp assembly, the seal ring lips deflect against the inner sealing surfaces of the hubs. This deflection elastically loads the lips of the seal ring against the inner sealing surface of the hub, forming a self-energized seal.
- **Clamp Assembly -** Designed to provide nearly 360° clamping contact with the hubs. A relief notch in the center of the clamp segments allow even distribution of makeup forces. No specific orientation is required when installed.

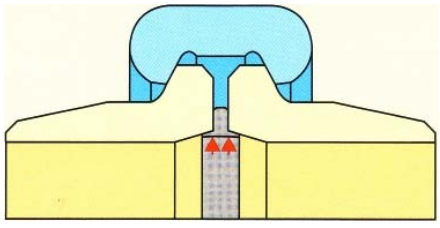
How the Grayloc Connector Seals



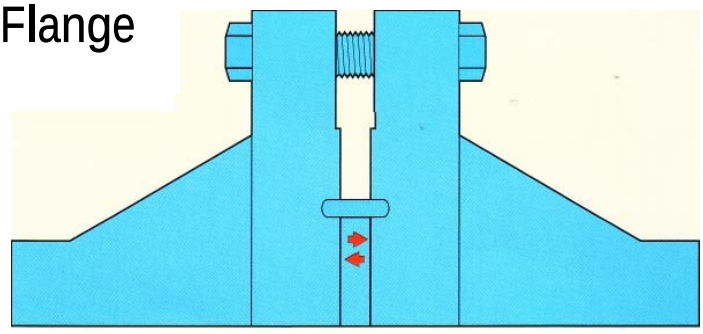


Rib of the seal ring is clamped between hub faces. Lips of The seal ring engage inner hub surface in an interference fit which deflects the lips to achieve a seal.

Under Pressure: Grayloc Connector vs. Flange



Internal pressure energizes the Grayloc seal lips, reinforcing the seal.



Pressure acts directly on the flange faces reducing seal integrity.

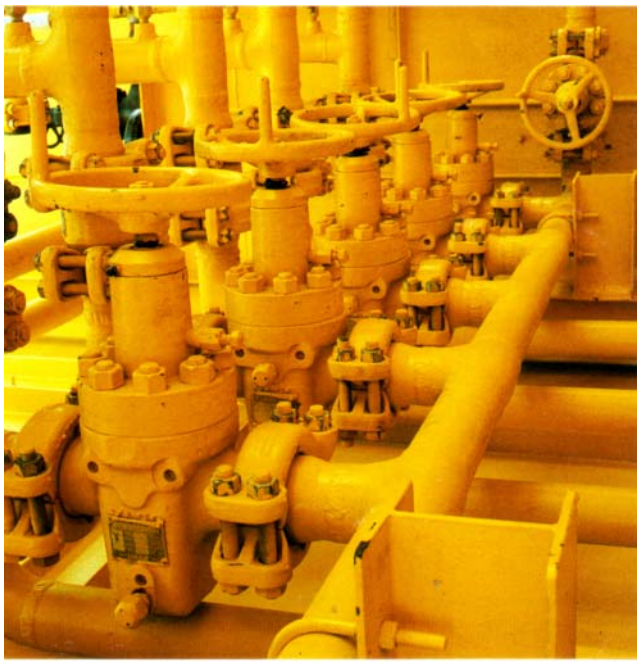
Grayloc Connector Applications

The simplicity, sealing efficiency, and economy of the Grayloc® connector benefits a wide range of industries in various applications:

- **Petrochemical Industry -** Reactor vessel nozzles, vessel closures, general piping/valve ends in petroleum refining and chemical processing plants.
- **Synthetic Fuels, Coal Gasification, and Coal Liquefaction -** General piping, vessel closures, reactor vessels, and valve ends.
- **Power Industry –** General piping/valve ends, steam lines, pump inlet/outlet lines, and chemical clean out closures.
- **Oil and Gas Production -** Onshore and offshore wellheads, tees and ells, manifolds, chokes, valve ends, compressors, general piping, loading risers and pipelines.
- **Marine -** Subsea piping and riser systems, floating production, storage, offloading (FPSO) vessels, and tanker loading and unloading facilities.
- **Aerospace –** Rocket test stands, fuel lines, hydraulic and pneumatic piping systems.
- **Food Processing -** Sanitary/general piping connectors, vessel closures and valve ends.
- **Environmental -** Hazard waste disposal and fugitive emissions containment.

The Office of Coal Research, U.S. Department of the Interior, and the American Gas Association jointly sponsored a program to develop coal gasification technology. On this pre-quench tower for raw gas purification, two Grayloc vessel closures and several smaller Grayloc connectors were used for pressures of 1,650 psi and temperatures to 650° F.

Photograph courtesy of the Institute of Gas Technology.



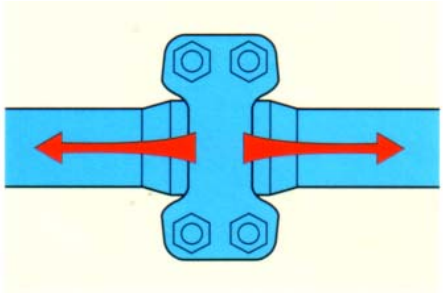
The use of Grayloc connectors, on a Centex Oil and Gas, Inc. platform in the Gulf of Mexico, saved 15" of horizontal space on the separator manifolding of this skid-mounted production unit, and reduced the total topside platform weight by more than 11 tons.

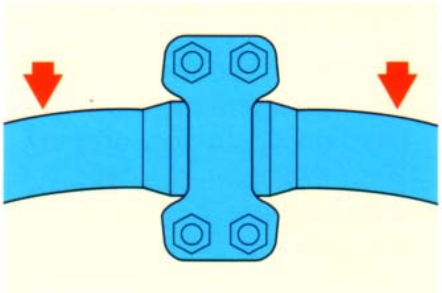
Tension, Compression, Bending

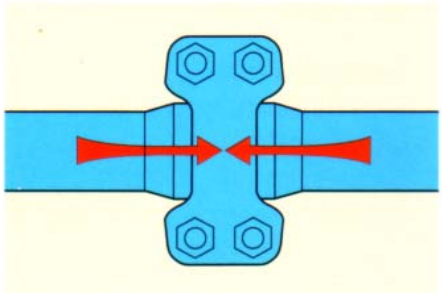
Anything the pipe can take, so can the Grayloc Connector

When manufactured from the same material as the pipe, the Grayloc® connector surpasses the strength of the pipe and that of most other components that may be connected.

The rib of the seal ring prevents the seal lip from being crushed by over-tightening. While it acts as a positive stop during makeup, the rib also transfers compressive and bending loads from one hub element to another. The rib bearing area is ample to carry the most severe loading that a piping system can withstand.







Tension

- Withstands greater tension loads than conventional ANSI flanges
- In most cases, withstands more tension loading than the pipe itself
- In destructive tests, pipe can be loaded in tension to failure without causing the Grayloc connector to leak

Bending

- Numerous independent tests have shown that Grayloc connectors withstand severe bending loads without leaking or loosening
- In one test, 2'/2" GR 20 Grayloc connector was welded to 2'/2" Sch. XX pipe and subjected to a 2" cold bend, 36" on center - connector did not leak and clamp bolting remained tight

Compression

- In normal piping applications, it is not possible to overload the Grayloc connector or seal ring in compression
- When very high compressive loads occur, the maximum load on the connector is determined by the limit of the pipe
- In most cases, the area f the seal ring rib is equal to or larger than that of the cross section of adjoining pipe

Examples of Grayloc connector applications in extreme service conditions

Vibration :	80 to 200 cycles per second under 6,600 psi
High Temperature :	Service experience to 1700° F.
Low Temperature:	Routine liquefied gas service including liquid Hydrogen and nitrogen to -425 ° F
Thermal Shock :	Routine service with temperature changes up to 300° F per hour.
Corrosion :	Liquid sodium service at 1200 ° F.
Zero Leak Rate :	10^{-6} atm cc/s Helium

Service Extremes

Vibration, heat, cold and thermal shock often accompany service in which Grayloc connectors are heavily loaded. Grayloc connectors consistently withstand severe situations without routine maintenance. Special designs permit maintenance free service even under the extreme conditions shown in the table.

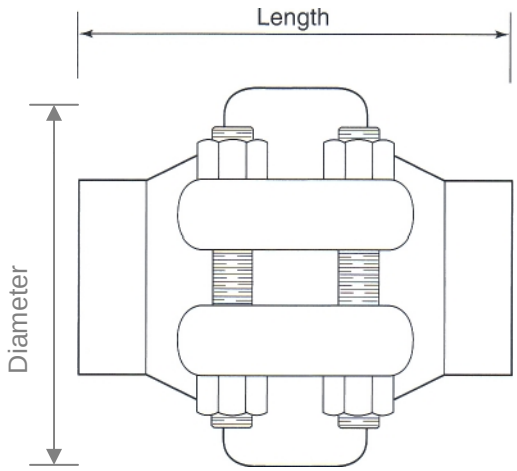
Conserves Space and Weight

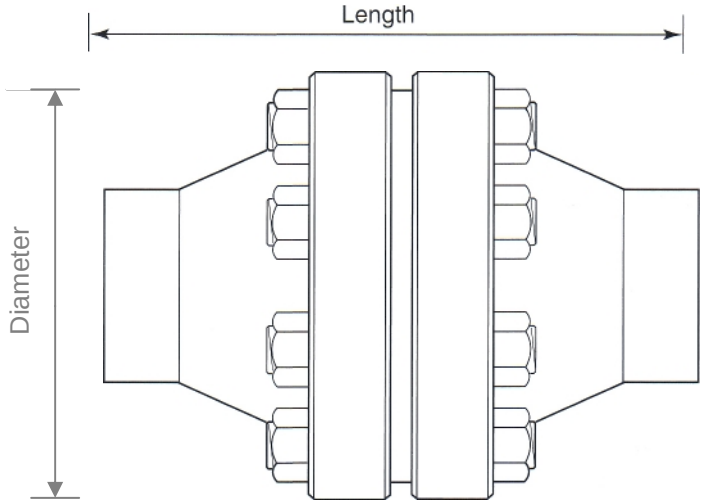
The Grayloc® connector is significantly lighter and smaller than a comparably rated ANSI or API ring joint flange connection, providing an opportunity to design lightweight, compact systems. Close piping and hookup arrangements can be easily made as the clamp completely rotates around the hub.

- Smaller diameter
- Shorter length
- No bolt holes to align

Grayloc vs. Flanges

Size	Connection	W.P. (psi)	Diameter (inches)	Length (inches)	Weight (pounds)
3"	Grayloc Connector	6,593	6.875	6.750	37
	ANSI 1500 Flange	3,705	10.500	9.250	121
	API 5000 Flange	5,000	10.500	8.625	92
6"	Grayloc Connector	6,359	12.000	9.500	144
	ANSI 1500 Flange	3,705	15.500	13.500	407
	API 5000 Flange	5,000	15.500	14.250	365
10"	Grayloc Connector	5,368	17.625	12.325	415
	ANSI 1500 Flange	3,705	23.000	20.000	1100
	API 5000 Flange	5,000	23.000	20.875	1032





Saves Time and Money

The Grayloc® connector can be assembled or disassembled quicker and easier than a flange connection. Usually, 3 to 8 Grayloc connectors can be assembled/disassembled in the same time as one flange connection.

- No bolt holes to align
- Only 4 bolts to tighten (8 -24 for a conventional flange)
- Torque required – as much as 70% lower than for a RTJ flange

Maintenance is simple with only four bolts to remove. No periodic re-tightening of bolts is required once the connector is in service.

The necessary inventory of spare parts is significantly reduced since the Grayloc connector is sized according to pipe size, schedule, and service. In most instances, only one Grayloc connector size is necessary for each pipe size and seal rings can be reused.

Versatile Design

The standard Grayloc assembly has two hubs arranged for butt welding to pipe. However, a complete line of other piping components is available for most pipe sizes and service conditions.

- Hubs (socket weld /threaded)
- Tees and ells
- Nozzles

Heavy duty connectors for oilfield and other applications are available.

Other equipment manufacturers (valves, pumps, compressors, vessel, etc.) are licensed to machine Grayloc hub profile/ seats integral to their products.

How to Select Grayloc Connectors

Hub Material Selection Chart		
ANSI Group No.	**Designation Steel**	**Forging**
1.1	Carbon	(1)A105 A350-LF2
1.2	3½ Ni	A350-LF3
1.4	Carbon	A350-LF1
1.5	C- ½ Mo	A182-F1
1.7	½ Cr- ½ Mo	A182-F2
1.9	1Cr- ½ Mo 1 ½ Cr- ½ Mo	A182-F12 A182-F11
1.10	2 ¼ Cr-1Mo	A182-F22
1.13	5Cr- ½ Me	A182-F5 A182-F5a
1.14		A182-F9
2.1	18Cr-8Ni	A182-F304 A182-F304H
2.2	16Cr-12Ni-2Mo	(1)A182-F316 A182-F316H
2.4	18Cr-10Ni-Ti	A182-F321 A182-F321H
2.5	18Cr-10Ni-Cb	A182-F347 A182-F347H A182-F348 A182-F348H
2.7	25Cr-20Ni	A182-F310
3.5	Alloy 600	B564-N06600
3.6	Alloy 800	B564-N08800
3.8	Alloy C276 Alloy 625 Alloy 825	3574-N10276 B564-N06625 B425-N08825
…	Duplex	A182 -F51 A182- F53 A182- F55

(1) Standard Grayloc materials referenced in this catalog

	ANSI Pressure Ratings Ceiling				
Temperature,°F	**600**	**900**	**1500**	**2500**	**4500**
-20 to 100	1500	2250	3750	6250	11250
200	1500	2250	3750	6250	11250
300	1455	2185	3640	6070	10925
400	1410	2115	3530	5880	10585
500	1330	1995	3325	5540	9965
600	1210	1815	3025	5040	9070
650	1175	1765	2940	4905	8825
700	1135	1705	2840	4730	8515

Notes to Grayloc Selection Chart

1. Corrosion allowance: 1/32" for 1" nominal and 1/16" for larger pipe sizes.
2. Connectors listed in the Grayloc Selection Chart exceed the ANSI ceiling pressure ratings. Actual ratings are available upon request.
3. Ratings are based on carbon steel clamps.

Grayloc® Selection Chart -20°F. to +700°F.					
ANSI Flange Series					
	600	**900**	**1500**	**2500**	**4500**
Nominal Pipe Size	**Grayloc Size**				
½	1 GR 5	1 GR 5	1 GR 5	1 GR 4	1 GR 4
¾	1 GR 7	1 GR 7	1 GR 5	1 GR 4	1 GR 4
1	1 GR 11	1 GR 11	1 GR 7	1 GR 5	1 GR 5
1 ½	1½ GR 14	1½ G R	1½ GR 14	1½ GR 11	1½ GR 11
2	2 GR 20	2 GR 20	2 GR 20	2 GR 14	2 GR 11
2 ½	2½ GR 25	2½ GR 25	2½ GR 25	2½ GR 20	2½ GR 20
3	3 GR 27	3 GR 27	3 GR 25	3 GR 23	3 GR 20
4	4 GR 40	4 GR 34	4 GR 34	4 GR 31	4 GR 23
5	5 GR5 2	5 GR 46	5 GR 46	5 GR 40	5 GR 31
6	6 GR 62	6 GR 62	6 GR 52	6 GR 46	6 GR 34
8	8 GR 82	8 GR 76	8 GR 67	8 GR 52	8 GR 46
10	10 H 97	10 H 94	10 H 84	10 H 72	10 H 62
12	12 M 120	12 M 112	12M 102	12 M 82	X12M 72
14	X14 GR 130	X14 GR 120	X14 GR 106		
16	X16 GR 140	Additional sizes available upon			
18	X18 GR 170				
20	X20 GR 180				
24	X24 GR 220				

EXAMPLE

2" ANSI 1500 = 2 GR20 Grayloc

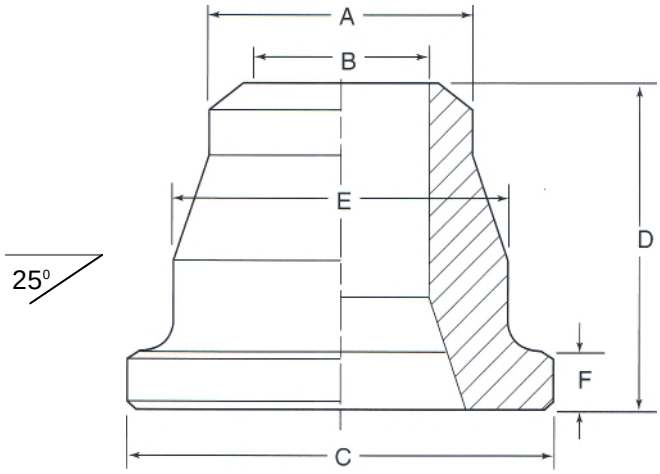
Pipe Size Grayloc Clamp Size

Grayloc Ring Size to Match Pipe ID

Butt Weld Hubs

Grayloc® hubs are usually made of the same generic material as the other system components they connect. Standard hub materials are SA105 carbon steel and SA182-F316 stainless steel, but they can be manufactured from most machinable metals, including all of the carbon, low alloy, austenitic stainless steels, MONEL*, INCONEL*, titanium and zirconium alloys.

Sealing surfaces on carbon steel and low alloy steel weld hubs and fittings are protected by electroless nickel coating. The welding bevel and all part tolerances are in accordance with ANSI B16.5.

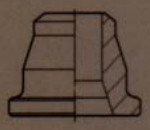


** MONEL and INCONEL are trademarks of International Nickel Company.*

Nominal Pipe Size	Sched. or Weight	Hub Size	Part Number Carbon Stl. SA105	Part Number Stainless Stl. SA1S2-F316(5)	Approx. Weight (l b.)	Seal Ring Size	Clamp Size	Pipe OD A	Pipe ID B	Dimensions (Inches) C	D(1)	E	F	Depth of Recess(2)
½	40	1 GR5	52192D	55955D	0.68	5	1	0.840	0.622	2.000	1.750	1.500	0.313	.....
	80	1 GR5	52193D	53439D	0.68	5	1	0.840	0.546	2.000	1.750	1.500	0.313	.....
	160	1 GR4	52194D	53686D	0.67	4	1	0.840	0.466	2.000	1.750	1.500	0.313	.....
	XX	1 GR4	52195D	53437D	0.73	4	1	0.840	0.252	2.000	1.750	1.500	0.313	.....
¾	40	1 GR7	52196D	53440D	0.62	7	1	1.050	0.824	2.000	1.750	1.500	0.313	.....
	80	1 GR7	52233D	53218D	0.60	7	1	1.050	0.742	2.000	1.750	1.500	0.313	.....
	160	1 GR5	52198D	53442D	0.71	5	1	1.050	0.612	2.000	1.750	1.500	0.313	.....
	XX	1 GR4	52199D	53447D	0.76	4	1	1.050	0.434	2.000	1.750	1.500	0.313	.....
1	40	1 GR11	53225D	53231 D	0.51	11	1	1.315	1.049	2.000	1.750	1.500	0.313	.....
	80	1 GR11	53226D	53232D	0.54	11	1	1.315	0.957	2.000	1.750	1.500	0.313	.....
	160	1 GR7	53227D	53233D	0.66	7	1	1.315	0.815	2.000	1.750	1.500	0.313	.....
	XX	1 GR5	53228D	53234D	0.78	5	1	1.315	0.599	2.000	1.750	1.500	0.313	.....
1½	40	1 ½ GR14	52100D	52813D	1.68	14	1 ½	1.900	1.610	3.125	2.375	2.375	0.437	.....
	80	1 ½ GR14	52101D	52814D	1.83	14	1 ½	1.900	1.500	3.125	2.375	2.375	0.437	.....
	160	1 ½ GR14	52102D	52815D	2.01	14	1 ½	1.900	1.338	3.125	2.375	2.375	0.437	.....
	XX	1 ½ GR14	52103D	52816D	2.15	14	1 ½	1.900	1.100	3.125	2.375	2.375	0.437	.....
	XX	1 ½ GR11	52134D	52442D	2.38	11	1 ½	1.900	1.100	3.125	2.375	2.375	0.500	.....
2	40	2 GR20	52104D	52821D	2.36	20	2	2.375	2.067	3.625	2.750	2.875	0.437	.....
	80	2 GR20	52105D	52822D	2.59	20	2	2.375	1.939	3.625	2.750	2.875	0.437	.....
	160	2 GR20	52115D	52823D	2.93	20	2	2.375	1.689	3.625	2.750	2.875	0.437	.....
	XX	2G R14	52113D	52824D	3.40	14	2	2.375	1.503	3.625	2.750	2.875	0.437	.....
	XX	2 GR11 (3)(4)	52337D	999628D	4.00	11	2	2.375	1.503	3.625	2.812	2.875	0.559	0.059

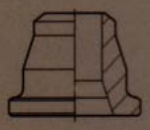
(1) Length of hub ("D" dimension) may increase when used with wall thickness greater than standard pipe schedules.
(2) Depth of seal ring seat recess. (3) Hub with recessed seal ring seat. (4) Hub ID slightly less than pipe ID.

(5) SA479TP316 maybe substituted based on material availability. (6) Carbon steel hub part numbers with "D" suffix are dual certified to A105/A350LF2.
(7) Stainless steel hub part numbers with "D" suffix are dual certified to A 182F316/316L.



Nom. Pipe Size	Sched. or Weight	Hub Size	Part Number Carbon Stl. SA105	Part Number Stainless Stl. SA182-F316[5]	Approx. Weight (l b.)	Seal Ring Size	Clamp Size	Pipe OD A	Pipe ID B	Dimensions (Inches) C	DO)	E	F	Depth of Recess[2].
2 ½	40	2' ½ GR25	52215D	52825D	5.86	25	2 ½ -3	2.875	2.469	5.000	3.250	4.000	0.500	.....
	80	2 ½ GR25	52216D	52826D	6.36	25	2 ½ -3	2.875	2.323	5.000	3.250	4.000	0.500	.....
	160	2 ½ GR20[1]	52218D	52827D	7.16	20	2 ½ -3	2.875	2.125	5.000	3.250	4.000	0.500	.....
	XX	2 ½ GR20	52219D	52828D	7.75	20	2 ½ -3	2.875	1.771	5.000	3.250	4.000	0.500	.....
3	40	3 GR27[4]	52204D	52844D	4.95	27	2 ½ -3	3.500	3.068	5.000	3.250	4.000	0.500	.....
	80	3 GR27	52205D	52845D	5.50	27	2 ½ -3	3.500	2.900	5.000	3.250	4.000	0.500	.....
	160	3 GR25	52226D	52846D	6.53	25	2 ½ -3	3.500	2.624	5.000	3.250	4.000	0.500	.....
	XX	3 GR25	52227D	52847D	7.23	25	2 ½ -3	3.500	2.300	5.000	3.250	4.000	0.500	.....
	XX	3 GR23	52247D	53848D	8.00	23	2 ½ -3	3.500	2.300	5.000	3.250	4.000	0.500	.....
	XX	3 GR20[4]	52160D	53668D	9.00	20	2 ½ -3	3.500	2.300	5.000	3.250	4.000	0.500	.....
4	40	4 GR40	52302D	52851D	6.97	40	4	4.500	4.026	6.000	3.625	5.000	0.500	.....
	80	4 GR40	52303D	52852D	7.80	40	4	4.500	3.826	6.000	3.625	5.000	0.500	.....
	120	4 GR34	52418D	55888D	9.39	34	4	4.500	3.624	6.000	3.625	5.000	0.500	.....
	160	4 GR34	52311D	52853D	10.13	34	4	4.500	3.438	6.000	3.625	5.000	0.500	.....
	XX	4 GR31	52314D	52854D	11.60	31	4	4.500	3.152	6.000	3.625	5.000	0.500	.....
	...	4 GR27	.....	.....	.....	27	4	4.500	.....	6.000	3.625	5.000	0.500	.....
	...	4 GR25	.....	.....	15.00	25	4	4.500	.....	6.000	3.625	5.000	0.500	.....
5	40	5 GR52	52380D	52867D	11.00	52	5	5.563	5.047	7.500	4.375	6.500	0.625	.....
	80	5 GR52	52381 D	135344D	11.00	52	5	5.563	4.813	7.500	4.375	6.500	0.625	.....
	160	5 GR46	52385D	142751 D	17.00	46	5	5.563	4.313	7.500	4.375	6.500	0.625	.....
	XX	5 GR40	52383D	52870D	21.53	40	5	5.563	4.063	7.500	4.375	6.500	0.625	.....
	...	5 GR34	.....	.....	26.00	34	5	5.563	.....	7.500	4.375	6.500	0.625	.....
	...	5 GR31	.....	.....	28.00	31	5	5.563	.....	7.500	4.375	6.500	0.625	.....
6	40	6 GR62	52400D	52874D	22.00	62	6	6.625	6.065	9.250	4.625	7.750	0.750	.....
	80	6 GR62	52401 D	52875D	24.17	62	6	6.625	5.761	9.250	4.625	7.750	0.750	.....
	160	6 GR52	52413D	52876D	33.19	52	6	6.625	5.189	9.250	4.625	7.750	0.812	.....
	XX	6 GR52	52414D	52877D	33.75	52	6	6.625	4.897	9.250	4.625	7.750	0.812	.....
	XX	6GR40[3][4]	52321 D	55891D	37.11	46	6	6.625	4.897	9.250	4.750	7.750	0.934	0.122
	...	6 R40[3]	.....	.....	43.00	40	6	6.625	.....	9.250	4.750	7.750	0.934	0.122
8	40	8 GR82	52405	.....	32.00	82	8 or X8	8.625	7.981	11.500	5.375	10.000	0.750	.....
	80	8 GR76	52425G	52882	41.00	76	8 or X8	8.625	7.625	11.500	5.375	10.000	0.750	.....
	160	8 GR72	52423G	52880	50.00	72	8 or X8	8.625	6.813	11.500	5.375	10.000	0.750	.....
	XX	8 GR72	52422G	52881	50.00	72	8 or X8	8.625	6.875	11.500	5.375	10.000	0.750	.....
	XX	8 GR67	H90208-48	H90208-49	52.00	67	8 or X8	8.625	6.875	11.500	5.375	10.000	0.750	.....
	...	8 GR62	.....	.....	69.00	62	8 or X8	8.625	.....	11.500	5.375	10.000	0.750	.....
	...	8 GR52[3]	.....	.....	78.00	52	8 or X8	8.625	.....	11.500	5.500	10.000	0.934	0.122
10	40	10H102	52518	52900	55.00	102	10H or X10H	10.750	10.020	13.625	6.000	11.625	1.250	.....
	60	10H97	52519	52901	55.00	97	10H or X10H	10.750	9.750	13.625	6.000	11.625	1.250	.....
	80	10H97	52520	52902	55.00	97	10H or X10H	10.750	9.564[8]	13.625	6.000	11.625	1.250	.....
	160	10H84	52521	52903	89.00	84	10H or X10H	10.750	8.500	13.625	6.000	11.625	1.250	.....
	....	10H94	.....	.....	65.00	94	10H or X10H	10.750	.....	13.625	6.000	11.625	1.250	.....
	....	10H82	.....	.....	100	82	10H or X10H	10.750	.....	13.625	6.000	11.625	1.250	.....
	....	10H72	.....	.....	115	72	10H or X10H	10.750	.....	13.625	6.000	11.625	1.250	.....
	....	10H62[3]	.....	.....	136	62	10H or X10H	10.750	.....	13.625	8.000	11.625	1.434	0.184

(1) Length of hub ("D" dimension) may increase when used with wall thickness greater than standard pipe schedules. (2) Depth of seal ring seat recess.
(3) Hub with recessed seal ring seat. (4) Hub ID slightly less than pipe ID. (5) SA479TP316 maybe substituted based on material availability.



(6) Carbon steel hub part numbers with "D" suffix are dual certified to A105/A350LF2. (7) Stainless steel hub part numbers with "D" suffix are dual certified to A 182F316/316L.. (8) ID is 9.750 for stainless steel and 9.562 for other steel.

Nom. Pipe Size	Sched. or Weight	Hub Size	Part Number		Approx. Weight (lb.)	Seal Ring Size	Clamp Size	Pipe OD	Pipe ID					Depth of ..
			Carbon Stl. SA105	Stainless Stl. SA182-F316[5]				A	B	C	DO)	E	F	Recess[2]
12	STD	12M120	52596	52904	70	120	12M or X12M	12.750	12.000	16.000	6.625	14.000	1.375	.....
	XS	12M120	52597	52905	70	120	12M or X12M	12.750	11.750	16.000	6.625	14.000	1.375	.....
	80	12M112[4]	52598	52906	98	112	12M or X12M	12.750	11.752	16.000	6.625	14.000	1.250	.....
	160	12M102	52599G	52907	129	102	12M or X12M	12.750	10.126	16.000	6.625	14.000	1.375	.....
	.....	12M82[3]	.....	.....	182	82	12M or X12M	12.750	.....	16.000	8.000	14.000	1.599	0.184
Nominal I.D.		**Grayloc Sizes and Hub Dimensions for Large I.D. Applications are Provided Below**												
11		X14GR112	.....	.....	....	112	X14			17.250	7.000	15.750	0.687	.....
		P112	.....	.....	....	112	P or 5P			18.500	7.250	16.500	1.125	.....
12		X14GR120	.....	.....	202	120	X14			17.250	7.000	15.750	0.812	.....
		P120	.....	.....	153	120	P or 5P			18.500	7.250	16.500	1.250	.....
		S120	.....	.....	271	120	S			21.000	7.875	19.000	1.750	.....
12 ½		S125	.....	.....	....	125	S			21.000	7.875	19.000	1.750	.....
		P125	.....	.....	....	125	P or 5P			18.500	7.250	18.500	1.250	.....
		X14GR125	.....	.....	....	125	X14			17.250	7.000	15.750	0.812	.....
13		X14GR130	.....	.....	....	130	X14			17.250	7.000	15.750	0.750	.....
		P130	.....	.....	....	130	P or 5P			18.500	7.250	16.500	1.250	.....
		S130	.....	.....	....	130	S			21.000	7.875	19.000	1.625	.....
14		X16GR140	.....	.....	....	140	X16			19.500	8.250	18.000	1.934	.....
		S140	.....	.....	....	140	S			21.000	8.250	19.000	1.934	.....
15		X16GR152	.....	.....	....	152	X16			19.500	7.750	18:000	0.750	.....
		S152	.....	.....	194	152	S			21.000	7.875	19.000	1.625	.....
16		X18GR160	.....	.....	....	160	X18			21.750	8.250	20.250	0.750	.....
		U160	.....	.....	403	160	U			25.000	8.750	23.000	1.625	.....
17		X18GR170	.....	.....	....	170	X18			21.750	8.250	20.250	0.750	.....
		X20GR170	.....	.....	....	170	X20			24.500	8.750	23.000	0.760	.....
18		X20GR180	.....	.....	....	180	X20			24.500	8.750	23.000	0.750	.....
		U180	.....	.....	331	180	U			25.000	8.750	23.000	1.625	.....
19		U192	.....	.....	....	192	U			25.000	8.750	23.000	1.625	.....
		X20GR192	.....	.....	....	192	X20			24.500	8.750	23.000	0.750	.....
20		X20GR200	.....	.....	....	200	X20			24.500	8.750	23.000	0.750	.....
		3V200	.....	.....	686	200	3V			26.000	9.000	24.000	1.250	.....
		3W200	.....	.....	....	200	3W			29.500	9.750	27.500	1.250	.....
21		3W215	.....	.....	....	215	3W			29.500	9.750	27.500	1.250	.....
		X24GR215	.....	.....	....	215	X24			29.500	9.750	27.500	1.000	.....
22		3W226	.....	.....	....	226	3W			29.500	9.750	27.500	1.250	.....
		X24GR226	.....	.....	....	226	X24			29.500	9.750	27.500	1.000	.....
23		X24GR232	.....	.....	....	232	X24			29.500	9.750	27.500	1.000	.....
24		X24GR240	.....	.....	....	240	X24			29.500	9.750	27.500	1.000	.....
		Y240	.....	.....	....	240	Y			31.250	10.000	29.250	1.625	.....
26		30GR264	.....	.....	....	264	30			33.500	10.500	31.500	1.000	.....
29		30GR292	.....	.....	....	292	30			33.500	10.500	31.500	1.000	.....

(1) Length of hub ("D" dimension) may increase when used with wall thickness greater than standard pipe schedules.

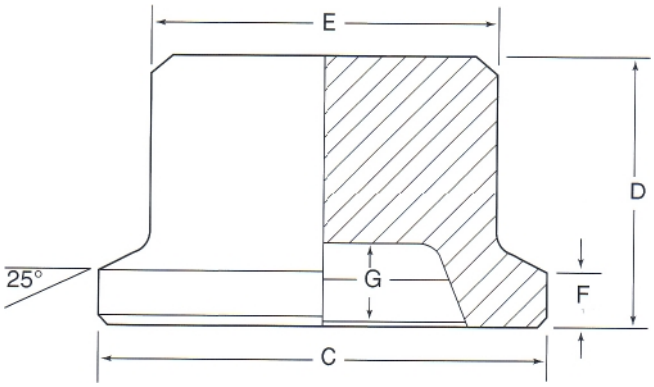
(2) Depth of seal ring seat recess. (3) Hub with recessed seal ring seat. (4) Hub ID slightly less than pipe ID.

(5) SA479TP316 may be substituted based on material availability. (6) Carbon steel hub part numbers with "D" suffix are dual certified to A105/A350LF2. (7) Stainless steel hub part numbers with "D" suffix are dual certified to A182F316/316L.

(8) ID is 11.750 for stainless steel and 11.374 for other steel.

Blind Hubs

- Stocked for standard-sized Grayloc® connectors
- Full pressure rating of the Grayloc connector
- Can be used as closures for pressure vessels, heat exchangers, pumps, compressors, etc.
- Can be drilled and tapped for instrumentation
- Can be customized to fit specific requirements



Hub Size	Part Number		Approx. Weight (lb.)	Seal Ring Size	Clamp Size	Dimensions (inches)					Depth of Recess(1)
	Carbon Stl. SA105	Stainless Stl. SA182-F316(3)				C	D	E	F	G	
1 GR4	58955D	59497D	1.02	4	1	2.000	1.750	1.500	0.313	0.438	.....
1 GR5	58922D	59525D	1.01	5	1	2.000	1.750	1.500	0.313	0.438	.....
1 GR7	58915D	59523D	0.95	7	1	2.000	1.750	1.500	0.313	0.563	.....
1 GR11	59592D	59524D	0.94	11	1	2.000	1.750	1.500	0.313	0.563	
1 ½ GR11	59050D	59300D	3.11	11	1 ½	3.125	2.125	2.375	0.500	0.563	.....
1 ½ GR14	59000D	59305D	2.82	14	1 ½	3.125	2.125	2.375	0.437	0.688	.....
2 GR11(2)	59044D	59366D	3.85	11	2	3.625	1.750	2.875	0.559	0.563	0.059
2 GR14	59053D	59310D	3.96	14	2	3.625	2.000	2.875	0.437	0.688	.....
2 GR20	59002D	59315D	3.63	20	2	3.625	2.000	2.875	0.437	0.688	.....
2 ½ GR20	59022D	59320D	9.61	20	2 ½ -3	5.000	2.500	4.000	0.500	0.688	.....
2 ½ GR23	46180D	59241D	9.39	23	2 ½ -3	5.000	2.500	4.000	0.500	0.688	.....
2 ½ GR25	59020D	59325D	9.15	25	2 ½ -3	5.000	2.500	4.000	0.500	0.688	.....
3 GR20	59022D	59320D	9.61	20	2' ½ 3	5.000	2.500	4.000	0.500	0.688	.....
3 GR23	46180D	95241 D	9.39	23	2 ½ -3	5.000	2.500	4.000	0.500	0.688	.....
3 GR25	59020D	59325D	9.15	25	2' ½ -3	5.000	2.500	4.000	0.500	0.688	.....
3 GR27	59006D	59330D	8.32	27	2 ½ -3	5.000	2.500	4.000	0.500	0.938	.....
4 GR25	59028D	59275D	16.59	25	4	6.000	2.875	5.000	0.500	0.688	.....
4 GR27	58879D	H90103-33D	15.80	27	4	6.000	2.875	5.000	0.500	0.938	.....
4 GR31	59024D	59345D	15.57	31	4	6.000	2.875	5.000	0.500	0.938	.....
4 GR34	59060D	59340D	14.90	34	4	6.000	2.875	5.000	0.500	0.938	.....
4 GR40	59010D	59335	9.72	40	4	6.000	2.125	5.000	0.500	1.000	.....
5 GR31	59146D	H90154-4	33.83	31	5	7.500	3.500	6.500	0.625	0.938	.....
5 GR34	59147D	59278D	32.00	34	5	7.500	3.500	6.500	0.625	0.938	.....
5 GR40	58261D	59347D	31.78	40	5	7.500	3.500	6.500	0.625	1.000	.....
5 GR46	59148D	134752D	30.00	46	5	7.500	2.875	6.500	0.625	1.125	.....
5 GR52	58992D	134751D	29.00	52	5	7.500	2.875	6.500	0.625	1.000	.....
6 GR40(2)	59149D	95087D	50.00	40	6	9.250	3.375	7.750	0.934	1.000	0.122
6 GR46(2)	59150D	59282D	49.00	46	6	9.250	3.375	7.750	0.934	1.125	0.122
6 GR52	59064D	59350D	47.02	52	6	9.250	3.500	7.750	0.812	1.000	.....
6 GR62	59014D	59349D	35.43	62	6	9.250	2.875	7.750	0.750	1.000	.....

(1) Depth of seal ring recess.
(2) Hub with recessed seal ring seat.
(3) SA479TP316 may be substituted based on material availability.
(4) Carbon steel hub part numbers with "D" suffix are dual certified to A105/A350LF2.
(5) Stainless steel hub part numbers with "D" suffix are dual certified to A 182F316/316L.

Hub Size	Part Number		Approx. Weight	Seal Ring	Clamp	Dimensions (inches)					Depth of
	Carbon Stl. SA105	Stainless Stl. SA182-F316[3]	(lb.)	Size	Size	C	D	E	F	G	Recess[1]
8 GR52([2])	59152	55891	92	52	8 or X8	11.500	3.875	10.000	0.934	1.000	0.122
8 GR62	59071	59285	92	62	8 or X8	11.500	4.250	10.000	0.750	1.000	.....
8 GR67	.....	.....	87	67	8 or X8	11.500	3.500	10.000	0.750	1.000	.....
8 GR72	59066	59358	75	72	8 or X8	11.500	3.500	10.000	0.750	1.000	.....
8 GR76	59153	59286	70	76	8 or X8	11.500	3.000	10.000	0.750	1.000	.....
8 GR82	59016	59357	68	82	8 or X8	11.500	3.000	10.000	0.750	1.000	.....
10H62([2])	59157	.....	155	62	10H or X10H	13.625	4.500	11.625	1.434	1.000	0.184
10H72	59164	.....	160	72	10H or X10H	13.625	5.000	11.625	1.250	1.000	.....
10H82	58265	.....	150	82	10H or X10H	13.625	5.000	11.625	1.250	1.000	.....
10H84	59156	H90252-3	150	84	10H or X10H	13.625	4.250	11.625	1.250	1.000	.....
10H94	46269	.....	110	94	10H or X10H	13.625	3.750	11.625	1.250	1.125	.....
10H97	59154	59287	105	97	10H or X10H	13.625	3.500	11.625	1.250	1.125	.....
12M82([2])	59160	.....	230	82	12M or X12M	16.000	5.000	14.000	1.559	1.000	0.184
12M102	59159	.....	240	102	12M or X12M	16.000	5.250	14.000	1.375	1.125	.....
12M112	59176	59292	175	112	12M or X12M	16.000	4.250	14.000	1.250	1.125	.....
12M120	59158	.....	170	120	12M or X12M	16.000	3.875	14.000	1.375	1.125	.....
X14GR112	.....	.....	235	112	X 14	17.250	4.750	15.750	0.687	1.125	.....
P102	.....	130037	341	102	P or 5P	18.500	5.750	16.500	1.250	1.125	.....
P112	.....	.....	340	112	P or 5P	18.500	6.000	16.500	1.250	1.125	.....
X14GR120	.....	.....	270	120	X14	17.250	5.250	15.750	0.812	1.125	.....
P120	.....	.....	331	120	P or 5P	18.500	6.000	16.500	1.250	1.125	.....
S120	.....	.....	595	120	S	21.000	7.500	19.000	1.625	1.125	.....
S125	.....	.....	510	125	S	21.000	7.500	19.000	1.750	1.250	.....
P125	.....	.....	325	125	P or 5P	18.500	6.000	16.500	1.250	1.250	.....
X14GR125	.....	.....	225	125	X14	17.250	4.750	15.750	0.812	1.125	.....
X14GR130	.....	.....	210	130	X14	17.250	4.250	15.750	0.750	1.125	.....
P130	129669	.....	283	130	P or 5P	18.500	6.000	16.500	1.250	1.250	.....
S130	.....	.....	497	130	S	21.000	7.000	19.000	1.688	1.250	.....
X16GR140	.....	.....	265	140	X16	19.500	4.750	18.000	0.750	1.250	.....
S140	.....	.....	480	140	S	21.000	6.375	19.000	1.688	1.250	.....
X16GR152	.....	.....	255	152	X16	19.500	4.375	18.000	0.750	1.500	.....
S152	.....	.....	423	152	S	21.000	6.375	19.000	1.688	1.500	.....
X18GR160	.....	.....	347	160	X18	21.750	5.500	20.250	0.750	1.500	.....
U160	.....	.....	787	160	U	25.000	7.250	23.000	1.870	1.750	.....

(1) Depth of seal ring seat recess.
(2) Hub with recessed seal ring seat.
(3) SA479TP316 may be substituted based on material availability.

Hub Size	Part Number Carbon Stl. SA105	Part Number Stainless Stl. SA182-F316[3]	Approx. Weight (lb.)	Seal Ring Size	Clamp Size	Dimensions (inches) C	D	E	F	G	Depth of Recess[1]
X18GR170	.....	.....	330	170	X18	21.750	4.750	20.250	0.750	1.500	.....
X20GR170	.....	.....	554	170	X20	24.500	5.750	23.000	0.750	1.500	.....
X20GR180	.....	.....	525	180	X20	24.500	5.750	23.000	0.750	1.500	.....
U180			764	180	U	25.000	6.625	23.000	1.625	1.500	.....
U192	.....	.....	752	192	U	25.000	6.625	23.000	1.625	1.500	.....
X20GR192	.....	.....	505	192	X20	24.500	5.125	23.000	0.750	1.500	.....
X20GR200	.....	.....	185	200	X20	25.500	5.250	23.000	0.750	1.500	.....
3V200	.....	.....	635	200	3V	26.000	6.125	24.000	1.250	1.500	.....
3W200	.....	...,..	1165	200	3W	29.500	7.250	27.500	1.250	1.500	.....
3W215	.....	.....	1,165	215	3W	29.500	7.000	27.500	1.250	1.625	.....
X24G R215	.....	.....	846	215	X24	29.500	6.875	27.500	1.000	1.625	.....
3W226	.....	.....	1,115	226	3W	29.500	6.750	27.500	1.250	1.625	.....
X24GR226	.....	.....	830	226	X24	29.500	6.875	27.500	1.000	1.625	.....
X24GR232	.....	.....	805	232	X24	29.500	6.000	27.500	1.000	1.625	.....
X24GR240	.....	.....	790	240	X24	29.500	6.000	27.500	1.000	1.625	.....
Y240	.....	.....	1215	240	Y	31.250	7.125	29.250	1.625	1.625	.....
30GR264	.....	.....	1,205	264	30	33.500	6.500	31.500	1.000	1.625	.....
30G R292	.....	.....	785	292	30	33.500	4.750	31.500	1.000	1.625	.....

Heavy Duty Blind Hubs

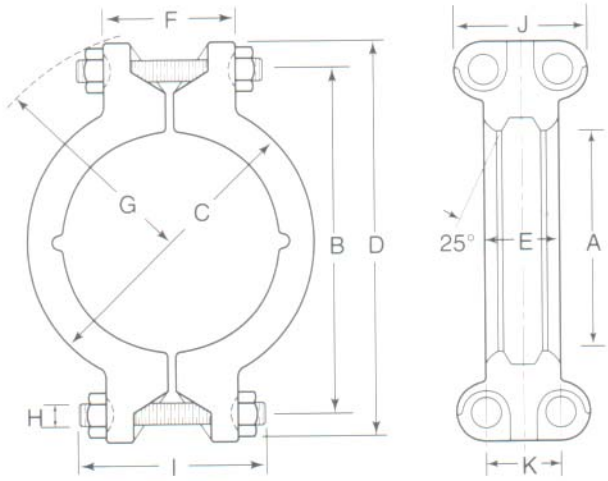
B20	58954	59410	8	20	B	4.750	2.750	3.750	0.625	0.688	.....
C25	48892	.....	13	25	C	5.500	2.625	4.500	0.625	0.688	.....
D31	128056	.....	24	31	D	6.750	3.250	5.750	0.625	0.938	.....
5E40	58261D	59347D	32	40	5E	7.500	3.500	6.500	0.625	1.000	.....
6F40	59149D	95087D	72	40	6F	9.250	3.750	7.750	0.812	1.000	.....
G72	.....	.....	78	72	G	11.500	3.500	9.500	1.000	1.000	.....
B20	58954	59410	8	20	B	4.750	2.750	3.750	0.625	0.688	.....
C25	48892	.....	13	25	C	5.500	2.625	4.500	0.625	0.688	.....

(1) Depth of seal ring seat recess.
(2) Hub with recessed seal ring seat.
(3) SA479TP316 may be substituted based on material availability.
(4) Carbon steel hub part numbers with "D" suffix are dual certified to A105/A350LF2.
(5) Stainless steel hub part numbers with "D" suffix are dual certified to A182F316/316L.

Clamp Assemblies

Grayloc® connector clamp part numbers with the WB suffix are complete with bolting. Both clamps and bolting can be individually purchased if required. Refer to page 29 for required bolting torque.

Clamp Materials		
arbon Steel	**lloy Steel**	**Stainless Steel**
SA266-GR3	A193 B7/B7M	SA182-F304
A487-GR 1B,	ISI 4140	SA182-F316
B,4B or 4A	A182-F22	SA351-CF8M
	A217-WCB	
	A217-WC9	

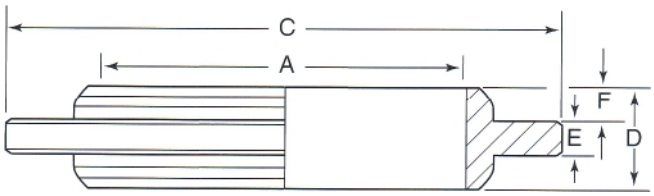


Clamp Size	Part Number Clamp Assembly w/Bolting Carbon Steel	Alloy Steel	Stainless Steel	Approx. Wt (lb.) (3)	Part Number Stud w/Nut Carbon Steel (1)	Stainless Steel (2)	Dimensions (inches) A	B	C	D	E	F	G	H	I	J	K
1	49513WB	A90019-5WB	50163WB	3.3	70944	70359	1.687	3.187	2.813	4.250	1.375	2.250	2.625	½	3.500	2.313	1.250
1 A	49500WB	A90043-1WB	48501 WB	9.8	69001	70442	2.687	5.000	4.500	6.500	2.000	3.250	4.000	5/8	5.000	3.125	1.625
2	49501W8	A90148-5WB	48502WB	13.5	69002	70443	3.188	5.750	5.062	7.500	2.000	3.625	4.500	¾	5.250	3.500	1.813
2 ½ -3	49502WB	A90413-6WB	48503WB	20.5	69003	70444	4.375	7.500	6.875	9.250	2.375	4.500	5.250	¾	6.000	3.500	1.813
4	49503WB	A90372-4WB	48504WB	31.4	69006	70445	5.375	8.500	8.125	10.500	2.375	5.250	6.000	7/8	7.000	4.063	2.063
5	50214WB	51727WB	161959WB	44.0	69008	70437	6.875	10.250	9.750	12.375	3.000	6.125	7.375	1	8.500	4.438	2.313
6	49508WB	A90059-2WB	A90059-6WB	68.0	69009	70446	8.375	12.625	12.000	15.000	3.500	6.625	8.750	1 1/8	9.375	4.813	2.437
8	90099-1WB	A90099-1WB	125600WB	95.0	69010	70447	10.625	15.250	14.500	18.250	3.500	7.500	9.875	1¼	10.500	5.875	2.875
X8(4)	166399WB	166399WB	124202WB	135	69027	70449	10.625	16.250	15.125	19.000	4.125	7.500	10.750	1⅜	11.000	6.000	3.250
10H	90444-9WB	A90444-9WB	49539WB	230	69028	70448	12.250	18.250	17.625	22.000	5.500	10.000	12.750	1 5/8	14.125	7.375	3.625
X100)	49133WB	.....	49589WB	325	69033	70438	12.250	19.500	18.250	23.500	6.500	10.000	13.500	1¾	16.000	7.500	3.750
12M	H90788-10	H90788-10	49540WB	295	69033	70438	14.625	22.000	20.250	25.750	5.750	10.000	14.500	1¾	16.000	7.500	3.750
X12M(4)	49135WB	A90445-2WB	49460WB	500	69035	70482	14.625	23.250	21.500	27.250	7.250	11.000	15.750	2	18.500	8.500	4.500
X14	H90315-11W	A90648-1WB	H90315-5WB	252	71763	128545	16.375	22.250	21.375	26.000	5.000	10.875	14.500	1 5/8	17.000	7.375	3.625
P	49137WB	H90847-2WB	50268WB	405	70091	70484	17.125	25.000	23.000	29.000	6.062	10.000	16.000	2	16.500	8.250	4.250
5P	138197WB	H90316-10WB	.....	796	69795	.....	17.125	28.000	25.625	33.000	8.000	12.250	18.625	2 ½	20.000	10.500	5.500
S	49139WB	H90328-7WB	.....	899	69605	137732	19.687	30.125	27.500	34.625	8.750	12.500	19.750	2 ½	22.000	10.500	5.500
X16	90649-1WB	A90649-1WB	11580WB	276	71762	100666	18.625	24.000	23.625	27.750	5.000	13.000	15.625	1 ¾	19.500	7.625	3.875
U	49142WB	H90471-3	49417WB	992	.....	137732	23.687	33.875	31.250	39.000	8.750	14.000	21.500	2 ½	22.000	11.000	5.500
X18	H90287-4	.....	.....	300	H9013618	.....	20.875	25.750	25.875	29.500	5.000	14.375	17.500	1 7/8	21.500	8.000	4.125
3V	49143WB	H90883-2	.....	982	106889	.....	24.687	35.000	32.937	39.250	8.000	13.000	22.000	2¼	24.000	9.250	5.000
X20	49144WB	.....	.....	384	114791	.....	23.625	28.312	29.125	32.187	5.000	17.125	18.750	2	24.750	8.500	4.375
X24	90789-3WB	.....	100667WB	649	H90136-172	.....	28.625	34.250	34.560	38.875	6.250	18.375	22.500	2¼	27.000	9.500	5.000
3W	.....	.....	.....	1131	.....	.....	28.187	37.000	36.437	41.500	8.000	20.000	23.250	2½	29.500	11.000	5.500
3Y(5)	23559WB	.....	.....	1500	.....	.....	29.937	44.000	42.500	48.000	12.687	18.500	33.000	3¼	25.500	14.250	7.500
30(5)	49523WB	.....	.....	625	69026	70483	32.313	40.500	37.875	45.000	5.750	13.250	24.750	2¼	20.750	9.500	5.000

(1) Stud material. SA 193-87; nut material, SA 194-GR2 or 2H.
(2) Stud material, SA 193-88, solution treated; nut material, SA 194-GRB.
(3) Includes weight of studs and nuts.
(4) X clamp sizes are heavy-duty to uprate connections. Sizes of corresponding hubs and seal rings do not change when X clamps are used.
(5) Available in three-piece, six-bolt construction only.

Seal Rings

Grayloc® seal rings are available in a number of carefully selected materials and are coated to provide lubrication during makeup. For applications greater than 750° F., consult Grayloc Products for proper selection of materials and coatings. Seal rings manufactured from materials or coatings other than those named may be furnished to meet specific service conditions.



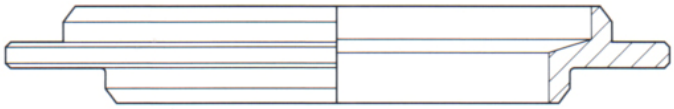
Seal Ring Size	Part Number				Approx. Weight (lb.)	Dimensions (inches)				
	Carbon Steel - NACE[3]		AISI 630 (17-4 PH) SS - NACE[3]							
	-50° to + 350° F[1]		-452° to +450°F[1]	-452° to +750°F[1]						
	PTFE(2) Coated	MoS_2 with Graphite Coated	PTFE(2) Coated	MoS_2 with Graphite Coated		A	C	D	E	F
4	50554N	50586N	51230N	51267N	0.04	0.500	1.000	0.375	0.125	0.125
5	50563N	50587N	51231 N	51268N	0.05	0.625	1.094	0.375	0.125	0.125
7	66020N	50588N	51232N	51269N	0.06	0.906	1.375	0.375	0.125	0.125
11	50551N	50589N	51233N	51270N	0.08	1.125	1.734	0.375	0.125	0.125
14	50553N	50591 N	51235N	51272N	0.31	1.610	2.625	0.563	0.250	0.156
16	H90026-3	50605N	51205N	66203N	0.41	1.868	2.688	0.625	0.250	0.189
20	50557N	50592N	51236N	51273N	0.50	2.063	3.250	0.750	0.250	0.250
23	50569N	146396N	66175N	51284N	0.54	2.375	3.500	0.750	0.250	0.250
25	50570N	50593N	51237N	51274N	0.70	2.672	4.000	0.750	0.250	0.250
27	50622N	50594N	51238N	51275N	0.70	3.063	4.250	0.750	0.250	0.250
31	50561 N	50595N	51239N	51276N	0.76	3.250	4.500	0.750	0.250	0.250
34	50562N	50596N	51240N	51277N	0.89	3.688	5.000	0.750	0.250	0.250
40	66040N	50597N	51241 N	51278N	1.28	4.063	5.500	1.000	0.250	0.375
42	151677	H90364-3	103727	51186N	1.35	4.188	6.625	1.000	0.250	0.375
46	66041 N	66100N	51245N	66225N	1.58	4.750	6.188	1.000	0.250	0.375
52	50623N	50598N	51242N	51133N	1.65	5.313	6.625	1.000	0.250	0.375
62	50566N	50599N	51243N	51279N	4.00	6.065	7.875	1.375	0.375	0.500
67	H90643-3	H90643-26	H90643-1	H90643-15	4.50	6.875	8.750	1.375	0.375	0.500
72	50567N	50618N	51246N	66242N	4.95	7.250	9.500	1.375	0.375	0.500
76	66042N	166380N	51247N	66226N	5.58	7.750	10.000	1.375	0.375	0.500
82	66043N	142024N	51248N	66227N	5.16	8.250	10.125	1.375	0.375	0.500
84	66044N	66102N	51249N	66228N	6.72	8.500	11.125	1.375	0.375	0.500
87	66057N	50601 N	51229N	66244N	6.97	8.875	11.500	1.375	0.375	0.500
91	167659N	66526N	A90368-2	.....	7.10	9.125	13.000	1.375	0.375	0.500
94	66817N	.....	66176N	66229N	7.24	9.500	12.000	1.375	0.375	0.500
97	66046N	H90041-4	66177N	66230N	8.00	9.875	12.000	1.375	0.375	0.500
102	50564N	50616N	66178N	51283N	6.08	10.250	12.000	1.375	0.375	0.500
106	50692N	.....		66199N	7.00	10.750	12.625	1.375	0.375	0.500
112	66047N	50584N	66179N	66231 N	13.44	11.250	14.125	1.625	0.625	0.500
120	66048N	159280N	66180N	66232N	7.42	12.000	13.875	1.375	0.375	0.500
122	.....	66791 N	.....	66233N	8.00	12.250	14.125	1.375	0.375	0.500
125	.....	.....	.....	.....	8.50	12.625	14.500	1.375	0.375	0.500
130	66050N	159281N	66182N	66234N	9.00	13.000	15.000	1.500	0.500	0.500
134	66793N		66183N	66235N	10.00	13.500	15.500	1.500	0.500	0.500
137	50568N	50606N	50443N	50440N	10.50	13.875	16.500	1.625	0.625	0.500
140	72691 N	159278N	66624N	66198N	11.00	14.000	16.500	1.500	0.500	0.500
144	.....	.....	.....	.....	12.50	14.500	17.000	1.500	0.500	0.500
152	.....	66108N	66184N	66236N	14.00	15.250	17.750	1.500	0.500	0.500
160	122371 N	159279N	72761 N	66246N	15.50	16.000	18.500	1.500	0.500	0.500
162	.....	.....	.....	.....	15.80	16.250	18.500	1.500	0.500	0.500
164	H90818-1N	H90818-2	H90818-3	H90818-4	16.00	16.500	18.750	1.500	0.500	0.500
170	66052N	66109N	.....	66237N	18.00	17.000	19.500	1.750	0.500	0.625
180	170091N	128160N	.....	66599N	19.00	18.000	20.500	1.750	0.500	0.625
182	.....	.....	.....	.....	19.00	18.250	20.500	1.750	0.500	0.625
192	.....	.....	66186N	66238N	20.00	19.250	22.000	1.750	0.500	0.625
200	118230N	66530N	66939N	66726N	21.00	20.000	22.750	1.750	0.500	0.625
210	66723N	66114N	50442N	50439N	21.00	21.000	24.000	2.000	0.500	0.750
215	.....	.....	.....	.....	21.50	21.625	24.125	2.000	0.500	0.750
220	.....	50982N	.....	72916N	22.00	22.000	25.000	2.000	0.500	0.750
226	.....	.....	.....	.....	22.50	22.750	25.250	2.000	0.500	0.750
232	.....	.....	.....	.....	23.75	23.245	26.375	2.000	0.500	0.750
240	.....	66115N	50441N	66249N	24.00	24.000	27.250	2.000	0.500	0.750
244	.....	66115N	50441N	66249N	25.00	24.500	27.750	2.000	0.500	0.750

(1) Temperature is a major factor in the selection of the proper seal ring, but consideration also must be given to the effect the flow medium will have on the material and coating selected.(2) Teflon, a registered trademark of E. I. DuPont de Nemours & Co. (3) Grayloc seal rings are certified to NACE MR-O1-75.

Seal Rings

Transition Seal Rings

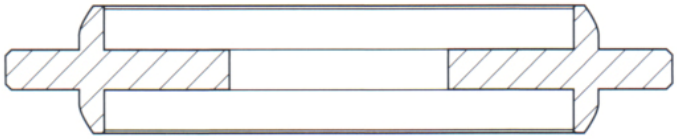
In normal piping applications, the same Grayloc® clamps are used for all schedules of a given size pipe. The ring, however, can vary with the schedule of pipe. Transition rings can be special ordered to connect hubs of the same size that have different ring seats. Transition hubs (reducing and enlarging) are recommended when designing transition piping.



Transition Seal Ring

Restriction Seal Rings

- Are used in restriction service to reduce flow
- Excellent and quick means of installing restriction plates into lines with Grayloc connectors
- Provides pressure drop or regulates flow where precise metering is not required



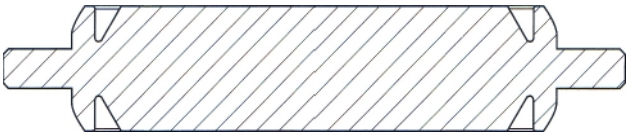
Restriction Seal Ring

Blind Seal Rings

- Are used for isolating sections of pipe and in-line blind service
- Pressure ratings available upon request
- Suitable for many normal operating conditions
- High pressure applications should be evaluated by Grayloc Products

Orifice Seal Rings

- Meets the requirements of American Gas Association (A.G.A.)
- Can be manufactured with replaceable orifice plates
- Integral orifice plate design



Blind Seal Ring

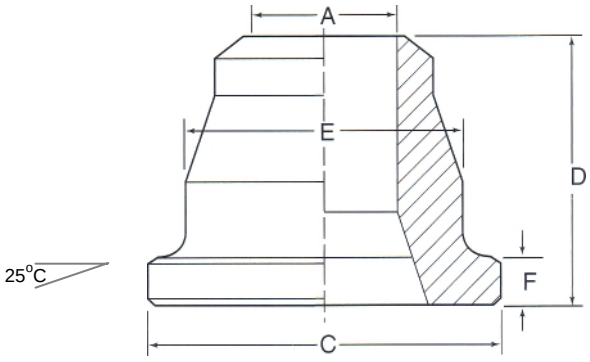
Orifice Seal Ring

Heavy-Duty Connectors

For oilfield applications or when pressure ratings exceed those of common ANSI flanges and standard Grayloc® connectors (refer to page 29 for API flange to Grayloc connector conversion chart).

Can be furnished for piping systems of high strength material (X-52, HY-100, T-1) to comply with API standards for service up to 30,000 psi

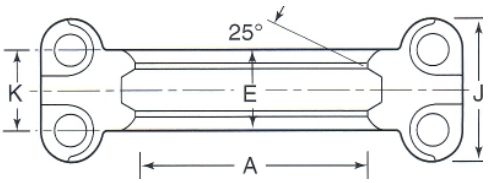
Contact a Grayloc Products representative for additional information on applications, sizes, and materials

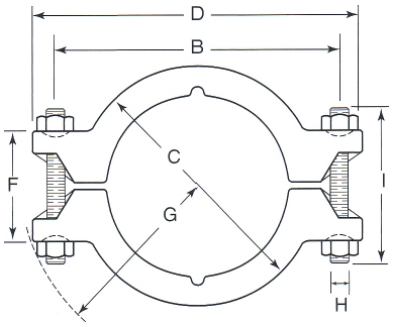


Heavy Duty Butt Weld Hubs

Hub Size	Seal Ring Size	Clamp Size	Hub LD. A	Dimensions (inches) C	D(1)	E	F	Approx. Wt. (lb.)
B 20	20	B	2.062	4.750	3.250	3.750	0.625	10.0
C 25	25	C	2.672	5.500	3.500	4.500	0.625	13.5
D 31	31	D	3.250	6.750	4.000	5.750	0.625	22.5
E 40	40	E	4.062	7.500	4.375	6.500	0.625	28.0
F 40	40	F or XF	4.062	9.250	4.625	7.750	0.812	45.5
G 72	72	G or XG	7.250	11.500	5.375	9.500	1.000	50.0

(1) Hub length may increase when used with wall thickness in excess of standard pipe schedules





Heavy Duty Clamps

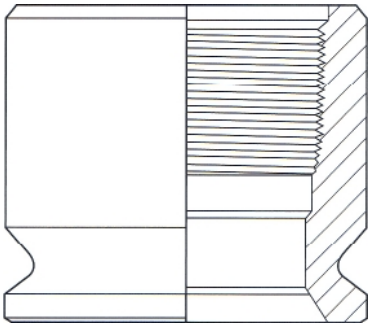
Clamp Size	Part Number Carbon Steel A1S1 1045 Q & T	Part Number Carbon Steel Studs w/Nuts(2)	Dimensions (inches) A	B	C	D	E	F	G	H	I	J	K	Approx. Wt. (lb.)(1)
B	50209G	69007	4.125	7.250	6.875	9.000	2.875	5.000	5.500	0.875	6.750	3.750	2.000	27.00
C	A90090-1(3)	69006	4.875	8.000	7.750	10.000	3.000	5.250	6.000	0.875	7.000	4.062	2.062	29.95
D	A90037-1(3)	69008	6.125	9.562	9.000	11.750	3.000	5.750	7.000	1.000	8.500	4.437	2.312	42.51
E	51727(3)	69008	6.875	10.250	9.750	12.375	3.000	6.125	7.375	1.000	8.500	4.437	2.312	52.00
F	A90059-2(3)	69009	8.375	12.625	12.000	15.000	3.500	6.625	8.750	1.125	9.375	4.812	2.437	73.00
XF	H90662-1(3)	71548	8.375	12.625	12.875	15.000	4.000	8.375	9.125	1.125	11.750	4.812	2.437	86.00
G	123218(3)	69027	10.125	16.000	14.750	18.750	4.500	7.000	10.500	1.375	11.000	6.000	3.125	133.0
XG	H90759-4 (3)	136609	10.125	16.000	15.625	19.125	5.125	9.250	10.687	1.375	13.250	6.000	3.125	190.0

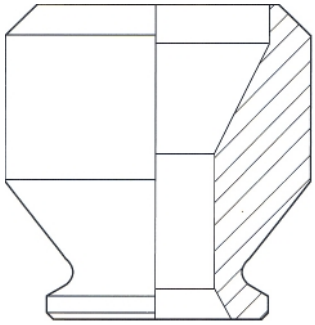
(1) Includes weight of studs and nuts. (2) Stud material - SA 193-87; nut material - SA 194-GR2 or 2H.
(3) Clamp material - SA193 87.

Hubs

Since Grayloc® connectors are very versatile, they can be used in many diverse applications. Some applications are suggested in the following examples. Special applications may require custom design. Contact the nearest Grayloc Products representative for special product assistance.

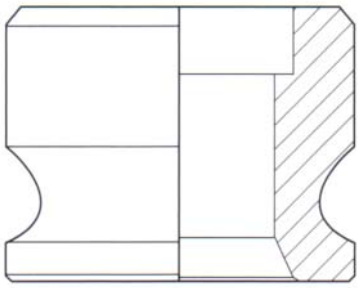
Threaded Hubs





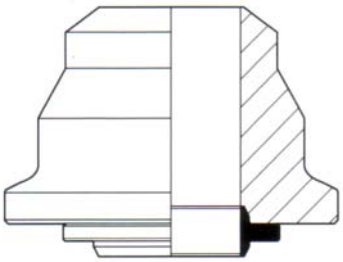
Other Products and Piping Accessories

Socket Weld Hubs



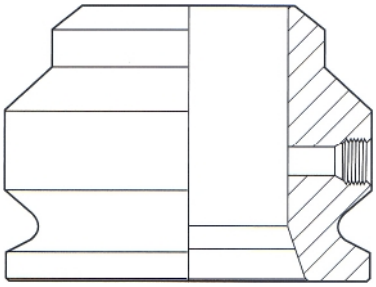
- Designed for socket welding to standard and special pipe sizes
- Female socket weld ends and male pin-type socket weld ends are available
- Socket weld hub lengths are the same as the "D" dimensions for butt weld hubs

Streamline Bore Hubs



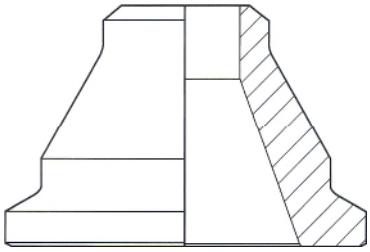
- Unobstructed bore design
- Manufactured for sanitary processes
- N.P.T. threads in accordance with Screw-Thread Standards in Federal Services H-28 Handbook
- External threads and industrial or customer standards are available

Pressure-Tapped Hubs



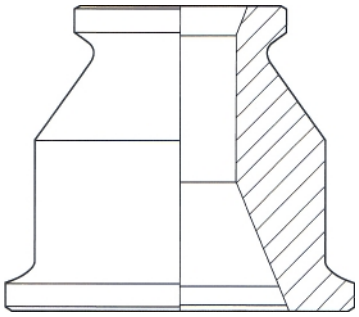
- Used for instrumentation, chemical injection, flushing or sampling.
- Eliminates the problem of drilling and tapping after the system is assembled
- Can be threaded to customer specification, e.g., N.P.T. and MC

Enlarging Hubs



- Joins pipe of one diameter to pipe, vessel nozzles, or similar fittings of a different diameter
- Eliminates the need for concentric reducers

Adapters

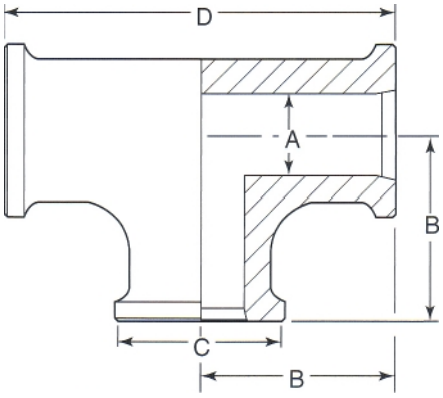


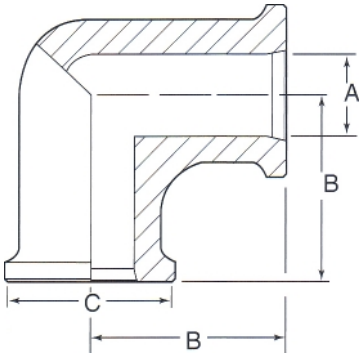
- Used to join different-sized Grayloc hubs already fabricated to the pipe
- Equivalent of concentric reducers in a welded system

Fittings

To reduce space and make complicated piping assemblies easier to install and maintain, a full line of Grayloc® tees and ells are available.

- Manufactured from closed die/block forgings and castings
- Minimum centerline-to-face dimensions
- Crosses are available upon request





Hub Size	Part Number (2) Tee SA105	Tee SA182-F316	Ell SA105	Ell SA182-F316	Seal Ring Size	Clamp Size	Dimensions (inches) A	B	C	Approx. Wei ht (lb.) D	Tee	Ell
1 GR 4	54791	54795	54798	54804	4	1	0.500	3.000	2.000	6.000	3.5	2.5
1 GR 5	54792	54796	151698	54805	5	1	0.625	3.000	2.000	6.000	3.5	2.5
1 GR 7	54793	54412	H90284-7	54414	7	1	0.906	3.000	2.000	6.000	3.0	2.0
1 G R 11	54794	54797	54801	54807	11	1	1.125	3.000	2.000	6.000	3.0	2.0
1 ½ GR 11	54169	54241	54106	54153	11	1 ½	1.125	4.000	3.125	8.000	19	12
1 ½ GR 14	54173	54242	54107	54156	14	1 ½	1.610	4.000	3.125	8.000	17	10
2G R 11(1)	54355	54367	54377	54386	11	2	1.125	4.063	3.625	8.125	20	13
2 GR 14	54178	54243	54114	54162	14	2	1.610	4.000	3.625	8.000	18	11
2 GR 20	54179	54244	54117	54129	20	2	2.063	4.000	3.625	8.000	16	10
2 ½ GR 20	54180	54245	54118	54163	20	2 ½ -3	2.063	5.375	5.000	10.750	65	33
2 ½ GR 25	54196	54246	54119	54145	25	2 ½ -3	2.672	5.375	5.000	10.750	53	26
3 G R 20	54180	54245	54118	54163	20	2 ½ -3	2.063	5.375	5.000	10.750	65	33
3 GR 25	54196	54246	54119	54145	25	2 ½ -3	2.672	5.375	5.000	10.750	53	26
3 GR 27	54197	54247	54122	54146	27	2 ½ -3	3.063	5.375	5.000	10.750	45	21
4 GR 25	54360	54369	54379	54388	25	4	2.672	6.000	6.000	12.000	78	45
4 GR 31	54356	54354	H90635-1	54168	31	4	3.250	6.000	6.000	12.000	65	40
4 GR 34	54357	54316	54126	154033	34	4	3.688	6.000	6.000	12.000	55	35
4 GR 40	54358	54352	54125	54174	40	4	4.063	6.000	6.000	12.000	40	30
5 GR 31	54940	54370	54380	54389	31	5	3.250	8.000	7.500	16.000	200	160
5 GR 34	54941	54371	54381	54390	34	5	3.688	8.000	7.500	16.000	185	150
5 GR 40	147274	54233	54123	54147	40	5	4.063	8.000	7.500	16.000	175	140
5 GR 46	54942	54372	54382	54391	46	5	4.750	8.000	7.500	16.000	145	120
5 G R 52	54232	54373	54144	54213	52	5	5.313	8.000	7.500	16.000	120	90
6 GR 40(1)	54943	54375	54384	54393	40	6	4.063	9.125	9.250	18.250	335	275
6 GR 46(1)	54944	54376	54385	54394	46	6	4.750	9.125	9.250	18.250	300	250
6 GR 52	54203	54253	H90284-6	54181	52	6	5.313	9.000	9.250	18.000	275	230
6 GR 62	54206	54254	54130	54182	62	6	6.063	9.000	9.250	18.000	230	190

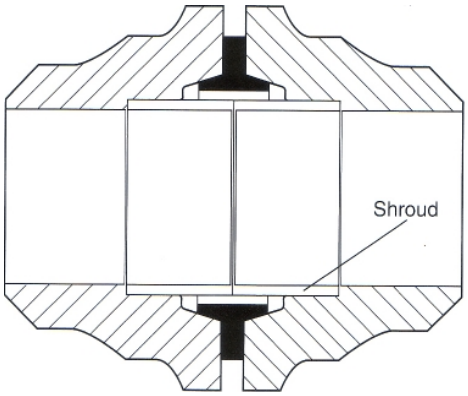
(1) Hub with recessed seal ring seat.

(2) For small quantity orders, items may be furnished from block forgings instead of contoured forged profiles as shown above. Part numbers for block shaped tees/ ells may be different than those shown above.

Special Connectors

Shrouded Bore Connector

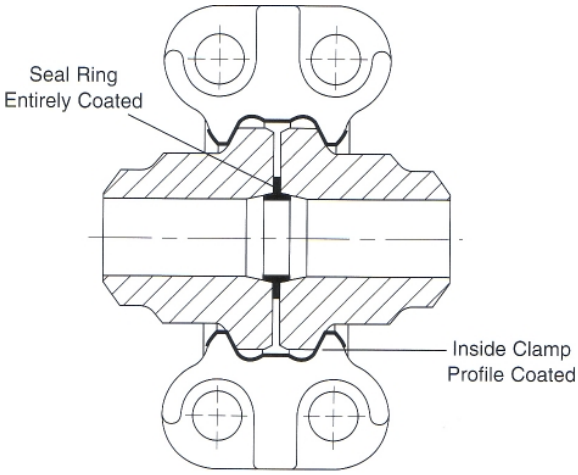
The Grayloc® seal ring can be protected in environments where thermal cycling occurs and in erosive service. To achieve this protection, non-erosion rings are recommended to shroud the bore. The shroud consists of two insertable pieces usually made from similar material as the hub. However, it can also be machined integral to the hub, which eliminates the insertable ring.



Shrouded Bore Connector

Insulating Connector

Grayloc insulating connectors are used in piping systems to prevent galvanic action or where it is necessary to electrically isolate one section of pipe. Grayloc clamps and seal rings are selectively coated with a specialty polymer coating. The connectors are tested before shipment to assure a minimum resistance of 200 megohms at 500 volts DC.



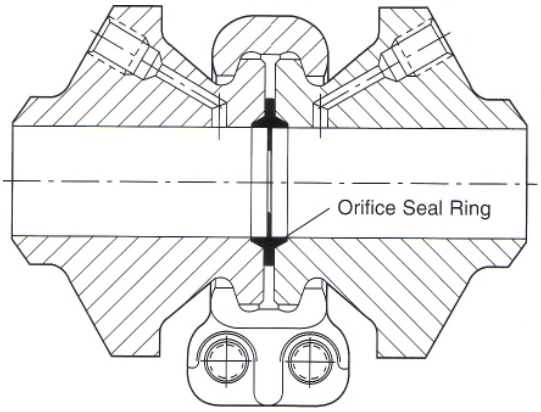
Insulating Connector

Orifice Union

Designed to accommodate "flange-type" pressure taps and universal-type orifice plates.

- Orifice plate held in position by hold down screws
- "Flange-type" pressure taps, perpendicular to the bore, are drilled directly into hubs
- Pressure taps are usually ½ " N.P.T., but can vary in size and type according to customer specifications
- Only the orifice plate is exposed to the flow

The Grayloc seal ring and orifice plate can be manufactured as an integral unit assuring a leak-free seal in conjunction with a quick disconnect measuring device.

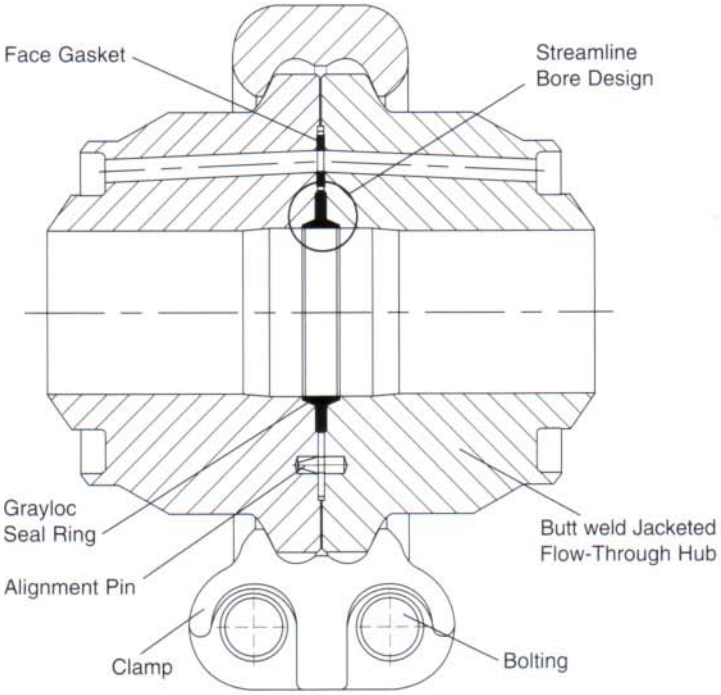


Orifice Union

Jacketed Connectors

Flow-Through Jacketed Connector

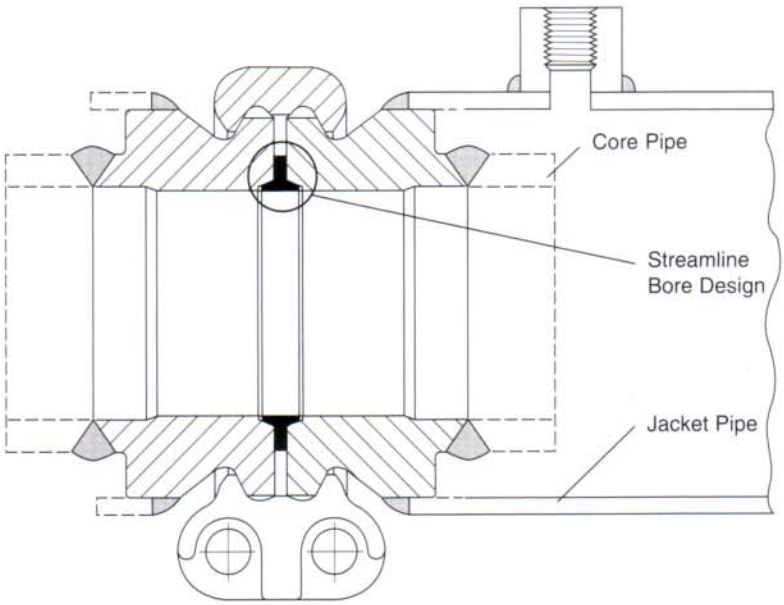
- Unobstructed (Streamline) bore design
- Provides in-line passage of the jacket fluid through the connector
- Metal seal for core pipe prevents contamination of fluid or leakage to the atmosphere
- External jacket seal is formed by a face seal gasket
- Uniform heat transfer



Flow-Through Jacketed Connector

Non Flow-Through Jacketed Connector

Grayloc non flow-through connectors are designed to accommodate both core and jacket piping. These connectors can be used with jumper piping or double pipe heat exchangers. A streamline bore is also a standard for these connectors.



Non Flow-Through Jacketed Connector

Remotely Operated Connectors

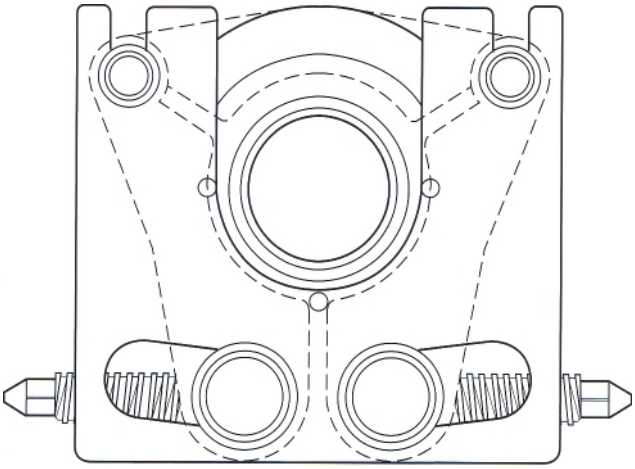
The Grayloc® remotely operated connector is a field-proven mechanical connector used in hazardous environments, personnel restricted areas, and automated (batch-type) operations. Like the standard Grayloc connector, the remotely operated connector has metal-to-metal seal integrity.

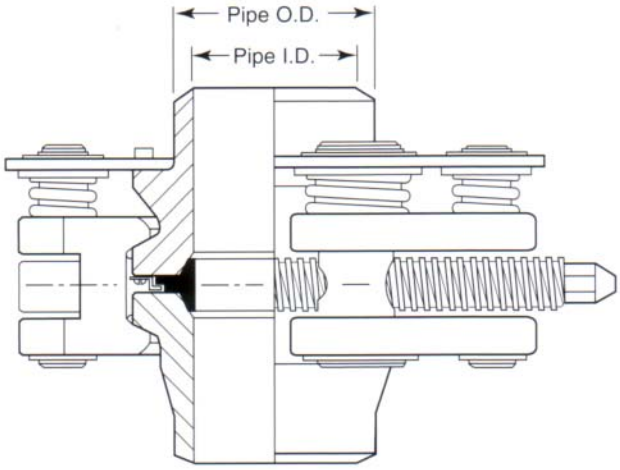
Operation

- Simple, reliable trunnion and screw mechanism
- Single drive screw adaptable to different power drives
- Self-supporting base plate
- Retained seal ring
- Can be manually operated

Design Technology

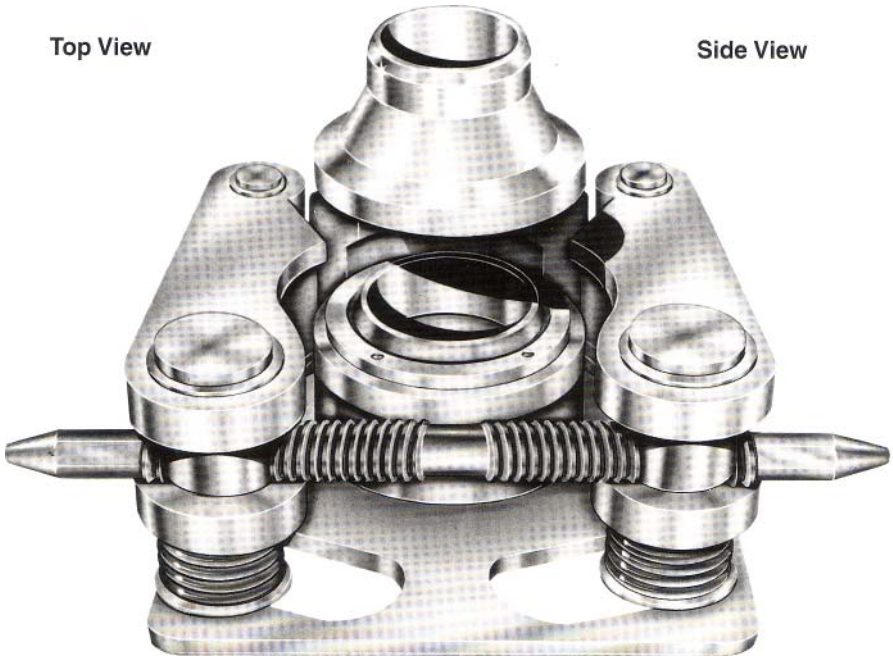
- Zero leak rate (10^{-6} at cc/s Helium)
- Quick disconnect, opens closes in seconds
- Compatible with hydraulic, pneumatic, or electric power
- Unitized design





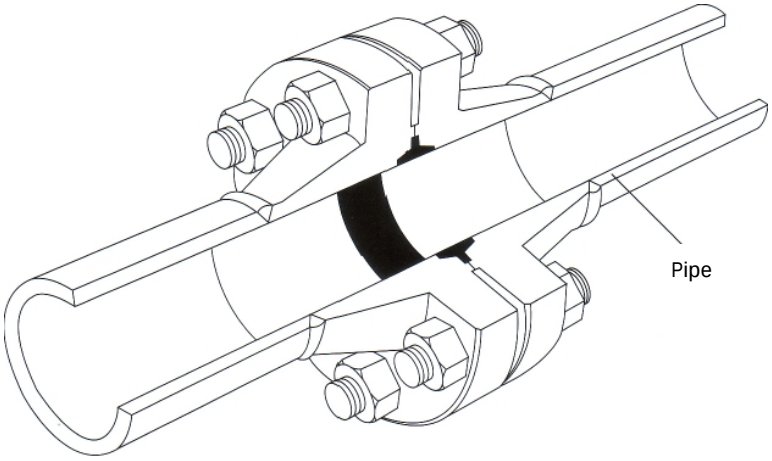
Top View

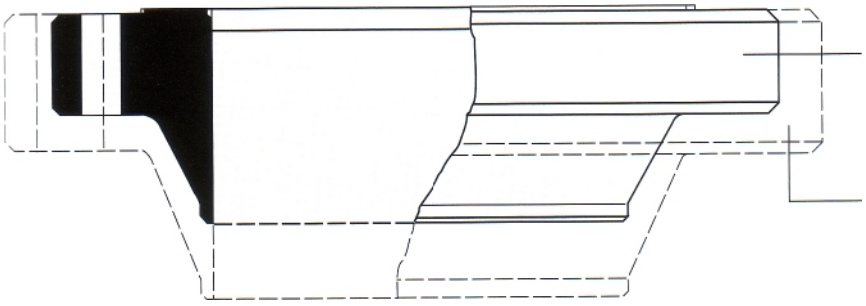
Side View



Grayloc® Compact Flanges

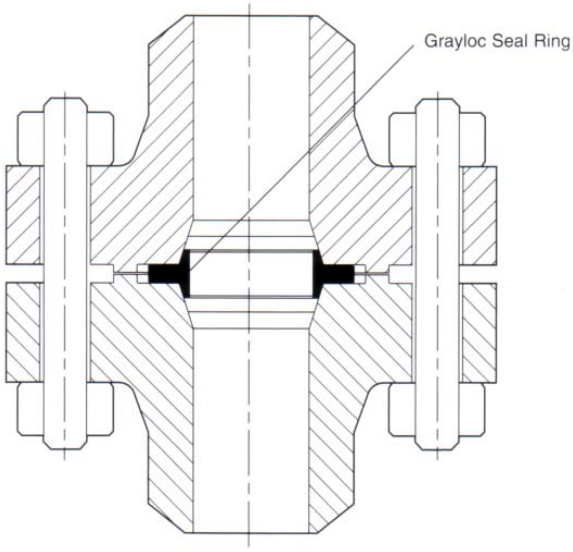
- Smaller and lighter than standard ANSI/API flange
- Using the self-energizing seal ring, the flange has a higher tolerance to vibration, temperature extremes, and external loading
- Off-the-shelf studs and nuts
- The rating of a flanged connection can be upgraded if a Grayloc seat is machined in the face and bore of the connection to accept the Grayloc seal ring





18" - 1500 Class GCF weldneck
O.D. 31"
Weight 680 Ibs.

18" - 1500 Class ANSI weldneck O.D. 36"
Weight 1625 Ibs.



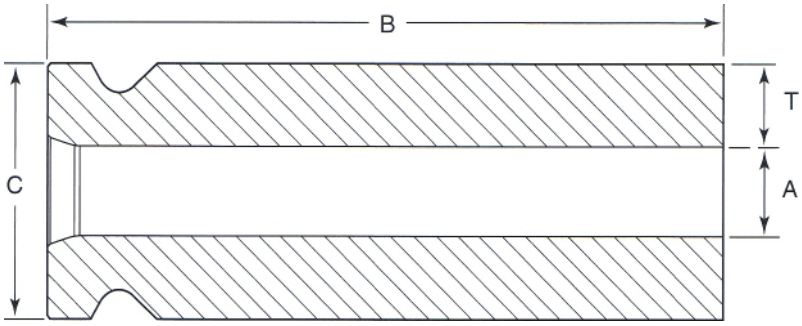
Grayloc Compact Flange (GCF)

Nozzles

Grayloc® nozzles are designated for pressure vessels that require

Longer nozzle projections.

- Manufactured with extra wall thickness to allow welding directly to the vessel with no additional reinforcement
- Stub end may be saddled or otherwise machined to match the contour of the vessel wall
- Available in most machinable materials
- For corrosive environments, seats and nozzle bores can be for protected with weld-deposited overlays or liners
- Sealing surfaces of standard carbon and low alloy steel nozzles are protected by electroless nickel coating
- Standard lengths and sizes are listed in the following chart, other configurations are available based on application.

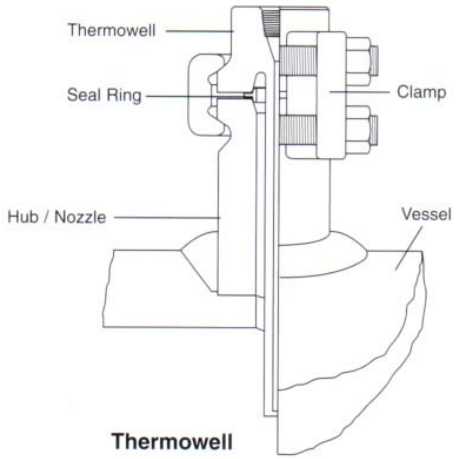


Connector Size	Part Number SA105	Part Number SA182-F316(2)	Ring Size	Clamp Size	Dimensions (inches) A	B(3)	C	T	Approx. Weight (lb.)
1 GR4	54938	100757	4	1	0.500	9.000	2.000	0.750	14
1 GR5	54423	H90389-3	5	1	0.625	9.000	2.000	0.688	13
1 GR7	54848	.....	7	1	0.906	9.000	2.000	0.547	12
1 GR11	54447	54624	11	1	1.125	9.000	2.000	0.438	1 i
1½ GR11(1)	54450	54650	11	1 ½	1.125	9.000	3.125	1.000	17
1 ½ GR14	54451	.....	14	1 ½	1.610	9.000	3.125	0.758	15
2 GR11	54486	54630	11	2	1.125	9.059	3.625	1.250	24
2 GR14	54454	54605	14	2	1.610	9.000	3.625	1.007	21
2 GR20	54453	54629	20	2	2.063	9.000	3.625	0.781	18
2½ GR20	54928	54632	20	2 ½ - 3	2.063	9.000	5.000	1.468	55
2½ GR25	54458	54631	25	2 ½ - 3	2.672	9.000	5.000	1.164	48
3 GR20	54928	54632	20	2 ½ - 3	2.063	9.000	5.000	1.468	55
3 GR25	54458	54631	25	2 ½ - 3	2.672	9.000	5.000	1.164	48
3 GR27	54457	54904	27	2 ½ - 3	3.063	9.000	5.000	0.968	41
4 GR25	54489	54635	25	4	2.672	12.000	6.000	1.664	78
4 GR31	54461	54636	31	4	3.250	12.000	6.000	1.375	68
4 GR34	54460	54911	34	4	3.688	12.000	6.000	1.156	60
4 GR40	54459	54973	40	4	4.063	12.000	6.000	0.968	52
5 GR31	.....	.....	31	5	3.250	12.000	7.500	2.125	122
5 GR34	.....	.....	34	5	3.688	12.000	7.500	1.906	113
5 GR40	.....	.....	40	5	4.063	12.000	7.500	1.718	106
5 GR46	.....	.....	46	5	4.750	12.000	7.500	1.375	90
5 GR52	.....	.....	52	5	5.313	12.000	7.500	1.093	75
6 GR40(1)	.....	.....	40	6	4.063	12.125	9.250	2.593	184
6 GR46(1)	.....	.....	46	6	4.750	12.125	9.250	2.250	168
6 GR52	54463	56121	52	6	5.313	12.000	9.250	1.968	153
6 GR62	.....	.....	62	6	6.063	12.000	9.250	1.593	130

(1) Hub with recessed seal ring seat. (2) SA479TP316 maybe substituted based on material availability.
(3) Nozzle lengths can be supplied based on customer requirements.

Thermowells

Grayloc® thermowell one-piece, solid construction assemblies are smaller and lighter than flanged thermowell assemblies. Metal-to-metal sealing makes Grayloc thermowell assemblies capable of higher pressures and temperatures.

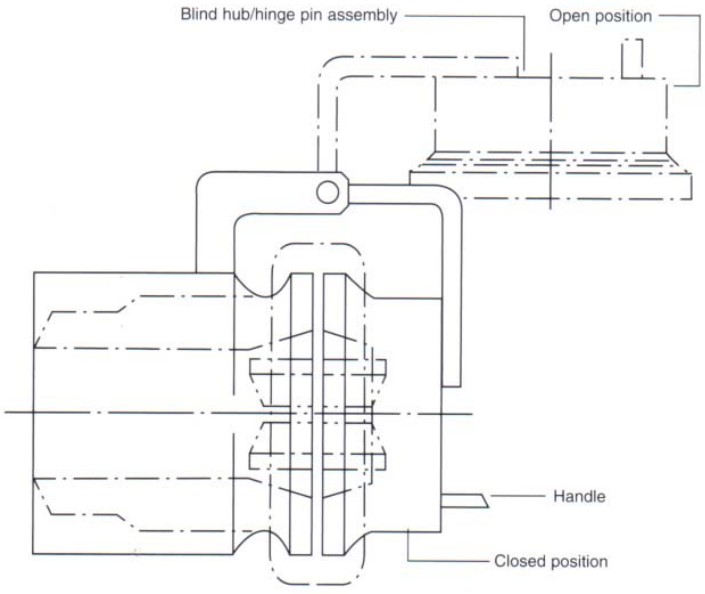


Thermowell

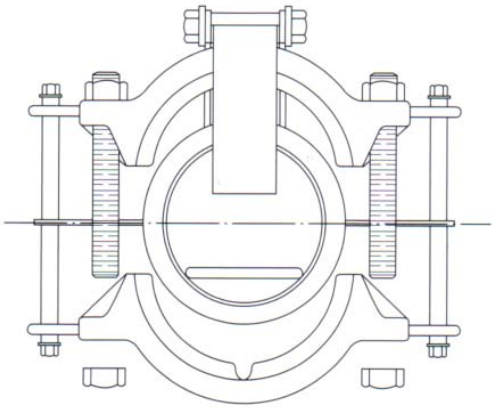
Hinged VesseL Closures

Grayloc hinged closures are used as manways on pressure vessels in many industrial applications. They have all the design features of the basic advantage of fixed mounting onto the vessel.

- Effective, dependable, convenient, simple makeup
- Clamp hanger assembly supports the clamp segments that remain in position around the outside of the nozzle when fully open
- Blind hub can be hinged vertically or horizontally for maximum accessibility
- Blind hub swings easily into position with no alignment or lifting of heavy parts
- Seal ring is retained with either the blind hub or nozzle to protect its sealing surfaces when the closures is open
- Manufactured to conform to the requirements of ASME Codes, Sections I and VIII
- If required, complete design evaluations, ASME partial data report and detailed stress analysis can be furnished



Top View

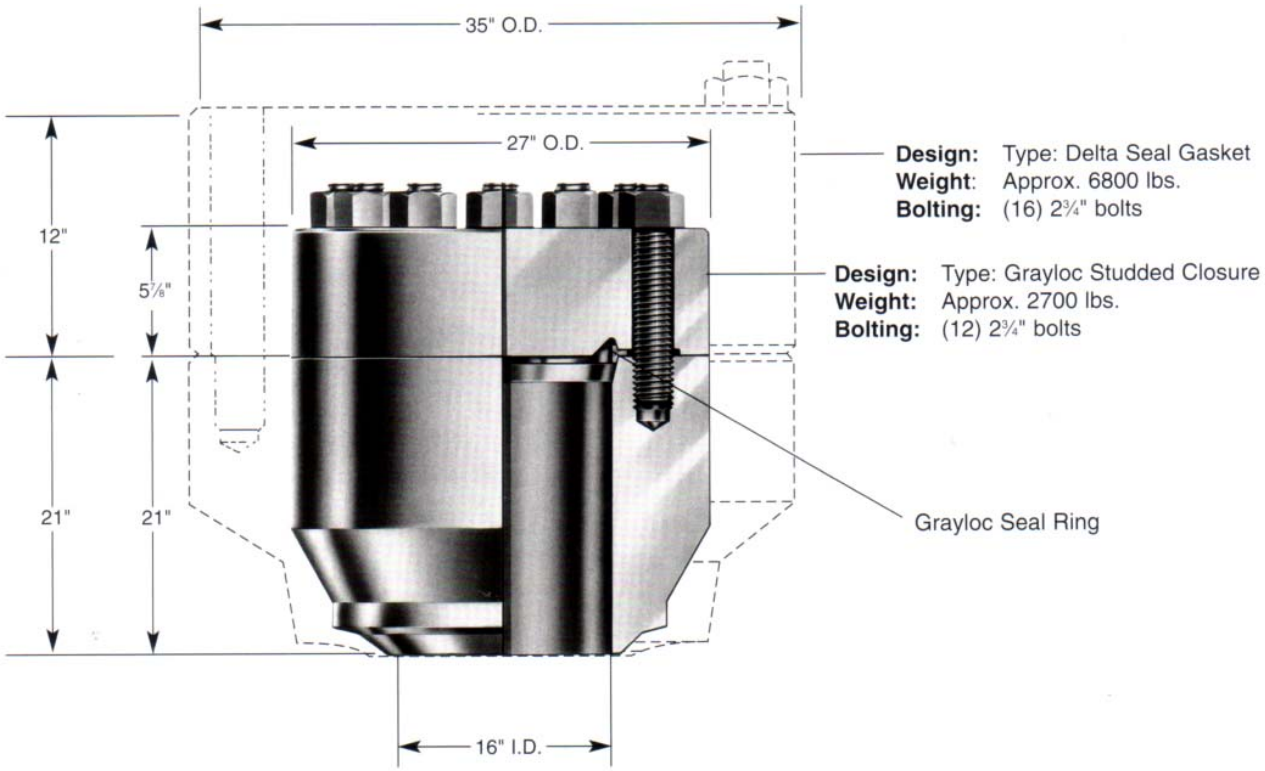

Hinged Vessel Closure

Studded Vessel Closure

Grayloc® studded vessel closures offer cost savings and design advantages for manufactures of pressure vessels, pump, and heat exchangers.

- Sizes range from 8” to 60” in diameter and from 1,000 to 32,000 psi operating pressure
- Variations in diameter, size, and spacing of studs on standard sizes can be specified, as well as other closure sizes and pressure ratings that require special design
- Typical studded vessel closure materials include SA105, SA350 LF2, SA182 F22 and SA182 F316.

  Closures are designed base on the adjoining pressure vessel material
- Seal surfaces of unlined closres are protected from oxidation by electroless nickel plating unless otherwise specified
- Corrosion-resistant liners and protective weld overlays are available
- Studs through 4” are furnished with heavy-duty nuts, and larger studs are furnished with sleeve nuts
- In some applications, stud tensioners are not required
- Unless specified otherwise, closures comply with the ASME Boiler and Pressure Vessel Code, Section VIII and can be designed in accordance with Section 1 or customer-specified requirements
- Seal ring is recessed to ease assembly and prevent damage from overtightening
- Varied weld end preparation available to suit fabrication requirements



API Flange to Grayloc® **Connector Conversion**

Conversion and Torque Requirements

Nominal Size & of API Flange (inches)	Maximun Working Pressure (psi)	Corresponding Grayloc Connector
1 13/16	10,000-8BX	B16
	15,000-6BX	B16
2 1/16	2,000-6B	B20
	3,000-613	B20
	5,000-613	B20
	10,000-8BX	B20
	15,000-6BX	B20
2 9/16	2,000-613	C25
	3,000-613	C25
	5,000-613	C25
	10,000-6BX	C25
	15,000-8BX	C25
3 1/8	2,000-613	D31
	3,000-613	D31
	5,000-613	D31
3 1/16	10,000-6BX	D27
	15,000-8BX	D27
4 1/16	2,000-613	E40
	3,000-813	E40
	5,000-613	E40
	10,000-6BX	F40R
	15,000-6BX	F40R
5 1/8	10,000-BX	F52
7 1/16	2,000-6B	G72
	3,000-613	G72
	5,000-613	10H72R
	10,000-613X	10H72R
	15,000-6BX	X12M72R

Nominal Size & Bore of API Flange (inches)	Maximun Working Pressure (psi)	Corresponding Grayloc Connector
9	2,000-613	10H91
	3,000-613	10H91
	5,000-613	10H91
	10,000-8BX	12M91
	15,000-6BX	X12M91
11	2,000-6B	12M112
	3,000-6	12M112
	5,000-613	12M112
	10,000-6BX	S112
	15,000-6BX	*
13 5/8	2,000-613	R137
	3,000-613	R137
	5,000-BX	S137
	10,000-6BX	5V137
16¾	2,000-6B	T170
	3,000-6B	V170
	5,000-6BX	3V170
	10,000-8BX	*
18¾	5,000-6BX	*
	10,000-6BX	*
20¾	3,000-813	V210
21¼	2,000-613	*
	5,000-6BX	*
	10,000-8BX	*

* Please consult Grayloc Products for special Grayloc sizing.
Abbreviations: R, recessed seal ring seat.

Notes: 1. 2,000-5,000 psi use 60 ksi minimum yield material for hub.
2. 10,000-15,000 psi use 75 ksi minimum yield material for hub.
3. 80 ksi minimum yield material required for clamp

Bolting Torque Required for Grayloc Clamps*

Stud Bolt Size	Stud Bolt Length (inches)	Clamp Size	Average Torque (ft.-lb.)
½ -13UNC-2	3½	1	17
5/8-11 UNC-2	5	1½	35
¾ -10UNC-2	5¼ , 6	2, 2½ , 3	55
7/8-9UNC-2	7, 6¾	4, C, B	90
1-8UNC-2	8½	5, D, E	140
1 1/8-8N-2	9 3/8	6, F	205
1 ¼ -8N-2	10½	8	290
1 1/8-8N-2	11¾	XF	330
1 3/8-8N-2	11	X8, G, XG	390
1 5/8-8N-2	14¼ , 14 1/8 , 17	H, 10H, X14	630
1 ¾ -8N-2	16, 19 ½	X10H, 12M, X16	870
1 7/8-8N-2	21 ½	X18	1170
2-8N-2	16½ , 18½ , 24¾	P, X12M, X20	1300
2¼ -8N-2	27, 20¾ , 24	X24, 30, 3V	1870
2½ -8N-2	22, 31, 29½ , 20	S, U, 32, 36, 3W, 5P	2570
2¾ -8N-2	28¾	Y	3500
3¼ -8N-2I	35½	40	7100

*** Applies to** two-piece, four-bolt clamps.

General Information

A complete Grayloc® connector consists of two hubs, one seal ring, one set of clamps, stud bolts, and sphericalfaced nuts.

Grayloc hubs are furnished with hub protectors that should be removed only when the hubs are being welded in place, stress relieved, or when the connection is being assembled.

Fabrication

Grayloc hubs may be fabricated to piping or other component equipment by established welding procedures. Initial fit up and alignment tolerances normally used in the fabrication of ANSI flanges are also acceptable for the Grayloc hub. During welding, care should be taken to protect the hub seat from damage such as scratching and weld spatter.

When required, stress relieving of carbon and low alloy steel hubs should be done in compliance with applicable industry codes and requirements. Seats that are nickel-coated must be clean prior to being placed in the furnace.

Before Assembly

The Grayloc seal ring does not seat until the connection is fully tightened; therefore, a small clearance, or standoff, between the ring rib and hub face should be observed when the ring is placed into a mating hub. If no standoff is present, use a new seal ring.

Clean all lubricants and foreign matter from the hub seating surfaces before installation. Use a non-abrasive material to clean the seal rings of all foreign matter. Normally, all seal rings have a coating or plating (cadmium, PTFE, MoS_2) which acts as a lubricant during make-up. In some applications where uncoated/unplated seal rings are used, a light film of clean lubricant is recommended.

When applying lubricant, take special care to ensure that no solid or foreign particles are present in the lubricant. Also, take care to prevent mechanical damage to the seal ring and the hub sealing surfaces.

Before assembly, the hubs must be aligned to allow engagement of the seal ring lips to the hub sealing surfaces. This will ensure proper engagement of the hub and clamp segments. For misaligned systems, it is acceptable to apply external loads to the mating piping (using jacks, comealongs, etc.) to align the hubs prior to assembly.

Assembly

1. Align the hubs so that the seal ring can be installed between the hubs.
2. Install the seal ring in the sealing surface of the hubs. The seal ring should rock slightly; i.e., the seal ring rib should not be able to firmly contact the hub face. If it does not rock, use a new seal ring.
3. Install the clamps around the hubs. Apply lubrication to the hub-clamp contact area to reduce friction; this will aid assembly.
4. Insert the stud bolts into the bolt holes of the clamp ears. Install the nuts, ensuring that the spherical surfaces of the nuts and the clamp are in proper position for mating. Lubrication of the bolting and the spherical faces of the nuts and the clamp is recommended.
5. Tighten the bolting in a criss-cross pattern (i.e., bolt #1, #3, #2, #4) to keep the spacing between the clamp halves approximately equal.
6. To properly preload the Grayloc connector against gasket loads, fluid pressure loading, thermal shock loading, and normal pipe reaction loads, the torque values in the table on page 29 are recommended. Note that torque wrenches are not required, but are recommended for large bolt sizes (1^5/g" and larger) to ensure that the minimum preload values are met. Assembly should include jarring the clamps during the bolting procedures, i.e., a sound blow to the back of the clamp with a soft hammer (torque, jar, torque, jar, etc.) until bolt torque does not change after jarring.
7. At full make-up, the hub faces will shoulder flush against the seal ring rib. The seal ring rib will prevent overtorquing from causing seal damage, but to prevent permanent damage from distortion to the other components of the connection, the maximum torque applied to the connection should not be more than twice the values shown in the table. For extreme misalignment and/or extreme piping loads, torque values 1'h to 2 times the table values are recommended. Lubricated bolting should be used to assemble the Grayloc connector.

Disassembly

Before disassembling the Grayloc connector, bleed all pressure from the line. When removing the clamp, first loosen the bolting and the clamp set from the hubs to allow the safe release of any trapped pressure. Then, remove the bolting completely.

Maintenance

Special maintenance is not required for a Grayloc connector that has been properly assembled. However, when disassembling a connector, check the seal ring for standoff prior to reassembly and visually inspect the hub seats for uniformity and freedom from burrs and deep scratches. These irregularities on ring seal surfaces could cause leakage.

Remove scale, rust, burrs, or deep scratches from a ring seat by lightly polishing with a fine steel wool or crocus cloth around the seat circumference to ensure uniform blending-in of the reworked area. Never lap the hub seat with the seal ring; this practice will damage both the ring and the seat and prevent an effective seal.

The connector should not be tightened while under pressure loading or severe mechanical loads. Do not weld on Grayloc clamps, bolting or seal rings without consulting Grayloc Products.

All components of the Grayloc assembly should be obtained only from Grayloc Products or one of its authorized licensees. Do not substitute non-Grayloc brand parts in Grayloc connectors. Substituting of parts other than Grayloc brand components voids all warranties.

STANDARD TERMS AND CONDITIONS
FOR SALES AGREEMENTS APPLICABLE TO PRODUCTS/SERVICES SUPPLIED BY GRAYLOC PRODUCTS, L.L.C. ("GRAYLOC") TO PURCHASER

1. Acceptance

1.1 Acceptance of any offer to sell by GRAYLOC is limited to Purchaser completely and exclusively accepting all terms and conditions hereof ("Terms"). This Agreement constitutes the entire agreement between the parties and takes precedence over any and all previous verbal or written arrangements in connection with this Agreement. Any deletions, modifications, alterations of or additions to the Terms, to be binding, shall be in writing and signed by an authorized representative of GRAYLOC and the Purchaser. Without limiting the foregoing, it is expressly acknowledged that any Purchaser document received is for order identification convenience only. Any and all provisions on the face or reverse side of any purchase order, or service order, which Purchaser may send to GRAYLOC in connection herewith are expressly objected to by GRAYLOC and waived by Purchaser and made inapplicable to any such purchase, unless both parties expressly agree in writing to include any such, terms and conditions in this Agreement.

1.2 Purchaser's acceptance is hereby expressly limited to the Terms, and acceptance of any part of the products covered hereunder shall be deemed to constitute such acceptance. (If this order constitutes an acceptance of an offer, .such acceptance is expressly made conditional on Purchaser's assent to the Terms and any additional or different terms contained herein, and acceptance of any part of the products covered hereunder shall be deemed to constitute such assent.) GRAYLOC may provide the products from its affiliated company, in which event these Terms will apply. Purchaser may not assign this Agreement without the prior written consent of GRAYLOC.

1.3 For any item of GRAYLOC equipment leased to Purchaser, GRAYLOC's Standard Terms and Condition's of Equipment Lease shall apply, which terms and conditions are incorporated herein by reference.

2. Limited Warranties

GRAYLOC hereby warrants that all products manufactured by GRAYLOC are free of defects of material and workmanship for a period of twelve (12) months from the date shipped, providing that the products are used in the service specified and are properly installed, used and maintained and not altered after initial delivery, corrosion and erosion and normal wear and tear excepted. Purchaser shall give written notice to GRAYLOC of any defects within thirty (30) days of their discovery by Purchaser, within said twelve (12) month period, with a report detailing failure and defects. GRAYLOC reserves iq'e right to require prepaid return of the allegedly defective product to establish a warranty claim. GRAYLOC will, at its option, re,Pair any product found defective during the warranty period without charge, replace the product F.O.B. manufacturing facility, or refund the purchase price paid for the products upon return to GRAYLOC. GRAYLOC shall not be responsible for retrieving or removing defective items (whether manufactured by GRAYLOC or not), or any part thereof, or for reinstalling the same when repaired or replaced, or for any cost incurred in connection with such retrieval, removal or reinstallation. In the case of items or parts not wholly of GRAYLOC's manufacture, but supplied by GRAYLOC, GRAYLOC's liability shall be limited to assisting Purchaser in enforcing the warranty of the manufacturer of the items or parts. GRAYLOC will not be responsible for repairs made by other than GRAYLOC without prior written consent. This warranty is EXCLUSIVE AND, EXCEPT AS STATED HEREIN, GRAYLOC MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO ANY MATTER WHATSOEVER, INCLUDING, WITHOUT LIMITATION, THE WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE, WHICH EXCEED THE FOREGOING WARRANTY. PURCHASER'S SOLE REMEDY AND GRAYLOC'S SOLE OBLIGATION ARISING OUT OF OR IN CONNECTION WITH DEFECTS IN MATERIALS, WORKMANSHIP OR SERVICES, WHICH ARE BASED ON WARRANTY, CONTRACT NEGLIGENCE, STRICT LIABILITY OR OTHERWISE, SHALL BE THOSE STATED IN THIS SECTION. The Purchaser acknowledges that any affirmation of fact or promise made by GRAYLOC shall not be deemed to create an express warranty, that Purchaser is not relying on GRAYLOC's skill or judgment in selecting or furnishing a system suitable for any particular purpose, and there are no warranties which extend beyond the description on the face hereof.

3. Liability

3.1 Mutual Indemnities. GRAYLOC agrees to defend, indemnify, release and hold Purchaser Group harmless from and against all costs, damages, losses, fines, penalties, expenses (including court costs and reasonable attorney's fees) and liabilities (except for Environmental Liabilities) arising out of claims, demands, or causes of action brought by any person or entity for bodily injury to or death of, any employee of GRAYLOC or contractor, subcontractor, agent, invitee, parent, co-owner, co-venturer, co-lessor, partner, subsidiary, or affiliate of GRAYLOC, or for damage to or loss of property owned or leased (except property leased to Purchaser) by GRAYLOC ("Grayloc Group"), which injury, death, damage, liability, claim, demand or loss arises out of or is incidental to the performance of this Agreement, REGARDLESS OF WHETHER CAUSED BY THE NEGLIGENCE, IN ANY FORM, OR FAULT, OR STRICT LIABILITY OF ANY MEMBER OF PURCHASER GROUP, OR ANY OTHER PERSON NATURAL OR OTHERWISE, AND/OR THE UNSEAWORTHINESS OF ANY VESSEL, ANY DEFECT IN ANY PREMISES OR VESSEL WHETHER PRE-EXISTING THIS CONTRACT OR NOT AND WHETHER SUCH DAMAGES, LOSSES, INJURIES, LIABILITIES, CLAIMS OR DEMANDS ARISE FROM TORT, CONTRACT, QUASI-CONTRACT OR OTHERWISE. Purchaser agrees to defend, indemnify, release and hold GRAYLOC Group, harmless from and against all costs, damages, losses, fines, penalties, expenses (including court costs and reasonable attorney's fees) and liabilities arising out of claims, demands, fines, penalties or causes of action brought by any person or entity for bodily injury to or death of, any employee of Purchaser, contractor (other than GRAYLOC), subcontractor, agent, invitee, parent, co-owner, co-venturer, colessor, partner, subsidiary or affiliate of Purchaser ("Purchaser Group"), or for damage to or loss of property owned or leased by Purchaser Group, which injury, death, damage, liability, claim, demand or loss arises out of or is incidental to the performance of this Agreement, REGARDLESS OF WHETHER CAUSED BY THE NEGLIGENCE, IN ANY FORM, OR FAULT, OR STRICT LIABILITY OF ANY MEMBER OF GRAYLOC, OR ANY OTHER PERSON NATURAL OR OTHERWISE AND/OR THE UNSEAWORTHINESS OF ANY VESSEL, ANY DEFECT IN ANY PREMISES OR VESSEL WHETHER PRE-EXISTING THIS CONTRACT OR NOT AND WHETHER SUCH DAMAGES, LOSSES, INJURIES, LIABILITIES, CLAIMS OR DEMANDS ARISE FROM TORT, CONTRACT, QUASI-CONTRACT OR OTHERWISE. To the extent that the laws of the State of Texas are applied to this Agreement, the parties agree that the foregoing indemnity obligations shall be supported by equal amounts of insurance, or qualified self-insurance maintained by GRAYLOC and Purchaser, respectively, which shall be greater than the amounts of insurance set forth in Article 4.

The indemnification provided hereunder shall be effective to the maximum extent permitted by applicable law. The parties agree that in the event any law is enacted **in any state,** the laws of which are applied to this Agreement that limits in a120

way the extent to which indemnification may be provided to an indemnitee, then this Agreement shall automatically be amended to provide that the indemnification provided hereunder shall extend to the maximum extent permitted by applicable law.

3.2 Environmental Liability. Notwithstanding any other provision(s) contained in this Agreement and specifically in this Article 3, Purchaser assumes sole responsibility for and shall defend, indemnify and hold GRAYLOC harmless from and against any and all claims, demands, suits, judgments, damages, losses, fines, penalties and causes of action of every nature, kind and character for damage to or loss of the hole, including the casing and all pipe and tubulars and equipment and tools therein, loss of or impairment of any property right in and to any oil, gas, water or other mineral substance, for all spills, leakage, blowouts, above or below ground, or uncontrolled flow(s) of oil, gas and water and all other substances, including the damages caused by said leakage or uncontrolled flow(s) of oil, gas, water and all other substances, including the control and removal thereof, pollution and/or contamination, costs of removal of debris or damage to or loss of the well, damage to or loss of the reservoir, damage to or loss of the production and/or formations (the " Environmental Liabilities") REGARDLESS 6F WHETHER CAUSED BY THE NEGLIGENCE, IN ANY FORM, OR FAULT, OR STRICT LIABILITY OR ABSOLUTE LIABILITY OF ANY MEMBER OF GRAYLOC GR OUP, OR ANY OTHER PERSON NATURAL OR OTHERWISE AND/OR THE UNSEAWORTHINESS OF ANY VESSEL, ANY DEFECT IN ANY PREMISES OR VESSEL WHETHER PRE-EXISTING THIS CONTRACT OR NOT AND WHETHER SUCH DAMAGES, LOSSES, LIABILITIES, CLAIMS OR DEMANDS ARISE FROM TORT, CONTRACT, QUASI-CONTRACT OR OTHERWISE.

3.3 Incidental and Consequential Damages. Notwithstanding anything to the contrary in this Agreement, in no event shall either party hereto be liable for any liquidated, special, incidental or consequential damages of any type, including, but not limited to, loss of business, loss of profits, costs of capital or costs connected with interruption of operation, loss of use or loss of production, including, but not limited to delayed production, from any cause whatsoever.

3.4 Limitation of Liability. Notwithstanding anything to the contrary in this Agreement, except for liabilities governed by the laws of the State of Texas arising from the mutual Indemnity obligations of the parties under Article 3.1 hereinabove, GRAYLOC's total liability, in tort, contract or otherwise, to Purchaser Group, under or relating in any way to this Agreement or to any materials, equipment or services provided hereunder shall in no event exceed a single aggregate limit equal to the Agreement price.

4 . Insurance

Purchaser agrees to procure and maintain, at their sole expense, policies of insurance, or qualified self- insurance, no less than the following minimum limits:

Workers Compensation	Statutory
Employer's Liability	$1,000,000 per occurrence
Comprehensive General Liability	Combined Single Limit for Bodily Injury and Property Damage of $1,000,000 per occurrence.
Automobile Liability	Combined Single Limit for Bodily Injury and Property Damage of $1,000,000 per occurrence
Umbrella Coverage	$3,000,000 limit per occurrence

All such policies shall name GRAYLOC as additional insured, excepting Workers' Compensation.. Purchaser, on request, shall furnish GRAYLOC insurance certificates evidencing the aforementioned minimum limits of insurance and additional insured status of Grayloc. Such insurance certificates shall state that insurers shall give GRAYLOC thirty (30) days' written notice in the event of cancellation of the aforementioned insurance policies. Purchaser shall arrange for any insurance covering the liabilities under Section 3 to be extended to include waivers of subrogation.

5. Price and Payment

5.1 All products are priced in U.S. dollars, unless otherwise stated, and will be invoiced upon shipment. Net payment is due within thirty (30) days after invoice date. Interest charges at eighteen percent (18%) per annum (or at maximum lawful rate) will be applicable to delinquent accounts unpaid after due date. Prices quoted are subject to change without notice If not accepted within thirty (30) days, unless specifically stated otherwise.

5.2 Unless otherwise quoted, Purchaser will pay, in addition to the purchase price of the products, all charges for export, packing and processing, insurance and transportation, and the price of products does not include personnel or equipment required to Install the products.

6. Transportation

Unless otherwise specified in GRAYLOC's sales quotation, transportation charges, including transportation documents and contracts with carriers, shall be based upon the point of manufacture and shall be paid by Purchaser.

7. Delivery and Title

7.1 Point of Delivery. GRAYLOC agrees to deliver the equipment to Purchaser ex-works (GRAYLOC manufacturing facility) unless otherwise agreed in writing for an order. Risk of loss of the equipment shall pass to Purchaser upon delivery. Title to the equipment shall pass when the full purchase price for the equipment has been received by GRAYLOC. GRAYLOC shall maintain a purchase money security interest in the equipment for any portion of the purchase price not paid at the time of delivery and shall retain this interest until GRAYLOC has received the full purchase price for the equipment.

7.2 Delivery Dates. Delivery dates shall be interpreted as estimates. Delivery commitments are given as accurately as information permits, and reasonable efforts will be made to make deliveries as scheduled. All shipping dates are based upon receipt of complete orders, performance of routine quality control and Purchaser's inspection/testing requirements which, if the normal production sequence is affected, will be considered as extending shipping dates appropriately. GRAYLOC assumes no liability for damage arising out of failure to deliver materials as scheduled.

8. Cancellation or Rescheduling of Orders

8.1 Orders once placed and accepted, may be canceled only with GRAYLOC's written consent and upon terms which will save GRAYLOC from loss. No products may be returned for credit, warranty claim or adjustment without the written consent of authorized GRAYLOC employees.

8.2 GRAYLOC may, but is not obligated to, accept a written request by Purchaser to delay shipment of the products. If rescheduling is accepted by GRAYLOC, Purchaser shall pay any additional costs incurred by the delay and the price for the balance of the order shall be adjusted to reflect prices and costs in effect at time of actual shipment.

9. Taxes, Licenses or Other Charges

9.1 All taxes or other charges imposed by law on the sale or production of goods or the performance of services under this Agreement, including, but not limited to, those from all governmental authorities, as well as all foreign taxes, surcharges, customs duties, consular fees, assessments or other applicable charges, if any, shall be borne by the Purchaser, unless the law specifically provides that such payment must be borne by GRAYLOC. Purchaser shall pay for and hold GRAYLOC harmless from all such governmental charges.

9.2 Purchaser shall, at its own expense, obtain all licenses, permissions or authorizations to use, purchase, export or import the products, as may be required by any governmental authority. The procurement of consular fees for legalizing invoices, stamping Bills of Lading or other such documents and declarations required by the law of any country or destination, are not included in quotations or selling prices. Although It is not GRAYLOC's policy to make such arrangements, if instructed by the Purchaser and agreed to in writing by GRAYLOC, GRAYLOC will make arrangements for any consular documents and declarations needed, as agents of the Purchaser. GRAYLOC assumes no liability whatsoever as a result of making such arrangements and all costs and liability shall be borne by the Purchaser.

10. Services

Upon the request of the Purchaser, GRAYLOC will provide appropriate services and/or technical information, as available, regarding the products and their uses, and will use reasonable efforts to provide personnel to assist the Purchaser in effecting field installations. The Purchaser acknowledges that any such information, service or assistance so provided, whether with or without charge, shall be in an advisory capacity only. The Purchaser further agrees that GRAYLOC assumes no liability for any damage or loss at any location arising out of, resulting from or caused, In whole or in part, by any information, service, advice or assistance provided by GRAYLOC, its agents, assigns, employees or subcontractors,

11. Packaging/Insurance

11.1 When obligated to do so in the specifications, GRAYLOC shall attempt to pack and prepare all shipments in such a manner as to prevent breakage, rust or deterioration in transit. GRAYLOC does not, however, guarantee against such damage and the risk of any damage to the products in transit shall be borne by the Purchaser at all times.

11.2 Unless requested by the Purchaser and agreed to in writing by GRAYLOC, no shipments are insured by GRAYLOC against damage or loss in transit andGRAYLOC assumes no liability whatsoever in regard to the obtaining of such insurance.

12. Changes and Modifications in Design

GRAYLOC hereby reserves the right to change or modify the specification and construction of any of its products without incurring any obligation to furnish or install such changes or modifications on products previously or subsequently sold.

11.1 When obligated to do so in the specifications, GRAYLOC shall attempt to pack and prepare all shipments in such a manner as to prevent breakage, rust or deterioration In transit. GRAYLOC does not, however, guarantee against such damage and the risk of any damage to the products in transit shall be borne by the Purchaser at all times.

11.2 Unless requested by the Purchaser and agreed to in writing by GRAYLOC, no shipments are insured by GRAYLOC against damage or loss in transit and GRAYLOC assumes no liability whatsoever in regard to the obtaining of such insurance.

13. Patent Warranties

The Purchaser acknowledges that GRAYLOC does not warrant that any of the materials, equipment or apparatus sold by it, if used or sold in combination with any other equipment, or used in Purchaser's methods or processes, will not, by virtue of such combination or use, infringe patents of others, and GRAYLOC shall not be liable for any patent infringement arising from or by reason of any such use or sale. On any item sold by GRAYLOC, but specified or designed and/or manufactured by others, GRAYLOC shall endeavor, for protection of Purchaser, to obtain the most advantageous patent guarantee, which shall run directly to Purchaser, with GRAYLOC's liability limited to rendering to Purchaser reasonable assistance in enforcing such guarantees. Further, GRAYLOC shall not be liable for the use or sale of any material, equipment or apparatus specially made, in whole or in part, to the Purchaser's design specifications and, in such instances, all patent liabilities shall be borne by the Purchaser, If an injunction is issued enjoining use of products designed by GRAYLOC, GRAYLOC, at its own expense, shall either procure for Purchaser the right to continue to use such products, design and specify non-infringing products, or design and specify modifications so that the product becomes non-Infringing, as GRAYLOC's sole and limited obligation for patent infringement.

14. Shortages

Subject to Paragraphs 7.1, 11,1 and 11.2, all claims regarding shortages in any shipment must be made within thirty (30)days from the receipt of such shipment, and must be accompanied by the packing list or lists covering the shipment.

15. Force Majeure

Neither GRAYLOC nor Purchaser shall be liable for any delay or inability in performing obligations hereunder, or interfering with production or receipt of goods as herein contemplated, if the delay, inability or interference is due to causes (such as acts of God, war, resurrection, riot, blockade, earthquake, fire, cyclone, flood, storm of unusual severity, strike,,delay of carrier, interruption in utilities, fuel shortage, embargo, walkout or other labor disturbance, interference of civil or military authority, governmental orders or regulations, or other cause, whether similar or dissimilar) beyond the reasonable control of the party affected, exercising ordinary diligence. The party so delayed, prevented or interfered with shall be excused from making or taking deliveries to the extent of such delay, pre-¨Qntfon or interference (excluding the obligation to pay monies owed), provided prompt written notice is given to the other party.

16. Governing Law

16.1 This Agreement shall be governed and construed (n accordance with the General Maritime Law of the United States of America, not including however any of its conflicts of law rules or other provisions which would direct the application of or refer to any other body of law(s), or the law of any other jurisdiction, or the laws of any state of the United States. Alternatively, and only in the event that the General Maritime Law of the United States of America is deemed to not apply, this Agreement, shall be construed in accordance with the laws of the State of Texas.

16.2 The parties agree that, if the United Nations Convention on International Sale of Goods 1988 (CISG), as amended from time to time, is applicable to this Agreement, the utilization of the CISG is excluded.

16.3 The Invalidity, in whole or in part, of the Terms, or any provision or any part thereof, shall not affect the validity or enforceability of any other terms or provisions.

16.4 The right of GRAYLOC to require strict performance of the Terms shall not be affected by any prior waiver or course of dealing.

16.5 Should any governmental law, regulation, ruling and/or policy (including, but not limited to, import/export restrictions, license requests, exchange controls or requirements, or any document for certifications or information which may tend to discriminate or favor GRAYLOC's customers) effectively prohibit or restrict GRAYLOC or its affiliates from delivering products or services, or restrict GRAYLOC or its affiliates from receiving or remitting currency payments or the equivalent thereof, in full payment for products/services, then GRAYLOC or its affiliates shall not be liable for any damages. GRAYLOC shall endeavor to promptly notify Purchaser of any known restrictions or prohibitions.

16.6 In the event of termination, cancellation or avoidance of this Agreement, the terms and conditions pertaining to warranty limitations and disclaimers, indemnities, environmental liability, disclaimer of consequential damages, and limitations of liability, shall remain in full force and effect.