

Grayloc[®] Connector

The Ultimate Connection

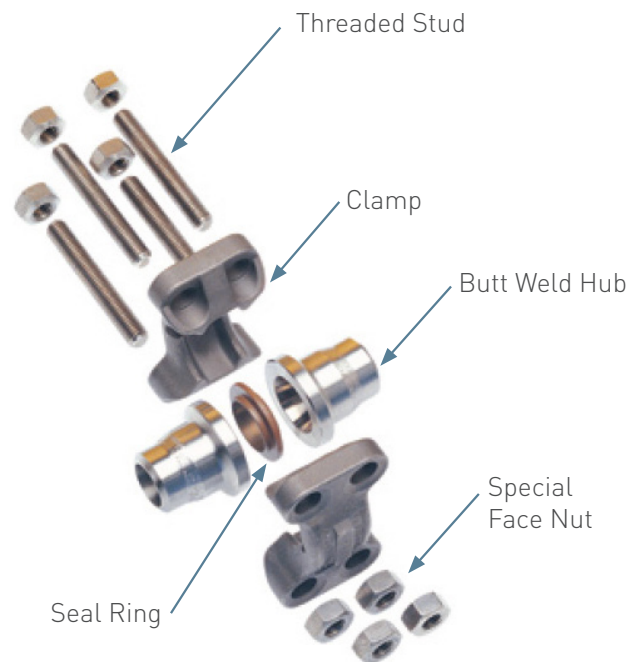
The Grayloc[®] Connector has been a field-proven and reliable mechanical connector for over 50 years. This connector features a metal-to-metal bore seal that is recognized as the standard for critical service piping and vessel connections. Grayloc[®] connectors save weight, space, and fabrication time. Long after installation, ongoing advantages include lowered maintenance costs, reduced inventories, and increased performance.



The Ultimate Connection

Grayloc® connectors have applications in a wide range of industries:

- » Oil and gas production
- » Petroleum refining
- » Chemical processing
- » Fossil and nuclear power generation
- » Aerospace manufacturing
- » Synthetic fuels processing
- » Coal gasification and liquefaction
- » Industrial gas manufacturing
- » Food processing
- » Environmental



The Grayloc® Metal-to-Metal Seal

Grayloc® connectors have three components:

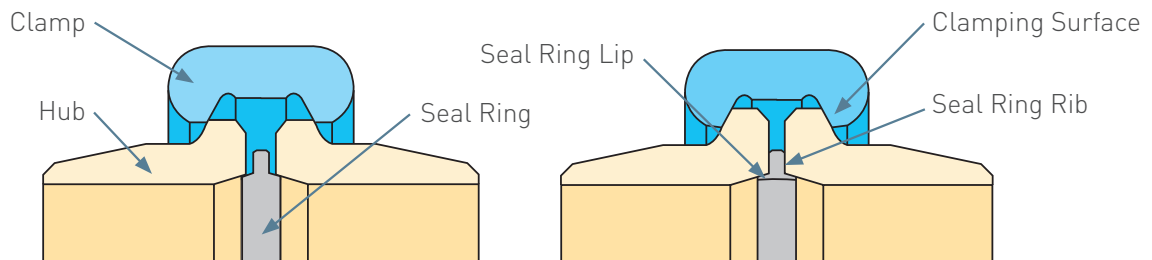
Metal Seal Ring—The Grayloc® seal ring achieves a self-energized and pressure-energized bore seal that will hold vacuum or external pressures. The metal Grayloc® seal ring consists of a rib and two lips. During makeup, the seal ring lips deflect inward as the connector is assembled. This deflection is controlled and is within the elastic limits of the seal ring material.

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.

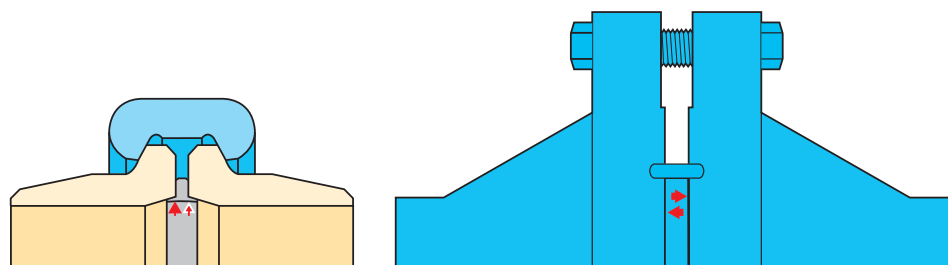
Clamp Assembly—The clamp is the primary pressure-retaining member of the Grayloc® connector, not the bolting. The two-piece clamp configuration ensures equal loading around the entire connector. The clamp carries all of the internal pressure loads, as well as axial and bending loads transmitted by the pipe. No specific orientation is required when the clamps are installed around the hubs.

How the Grayloc® Connector Seals



Rib of the seal ring is clamped between hub faces. Lips of the seal ring engage inner hub surfaces in an interference fit that 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

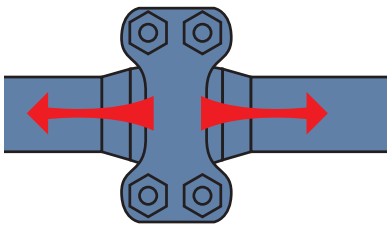
Tension, Compression, Bending

Sealing integrity

In most cases, the Grayloc® connector surpasses the strength of the pipe and that of most other components that may also be connected.

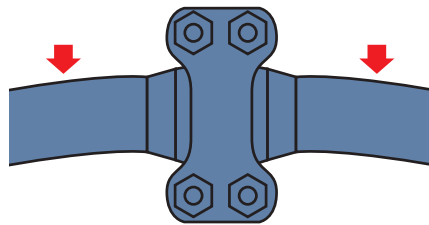
The rib of the seal ring prevents the seal lip from being crushed by over-tightening. While it acts as a

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.



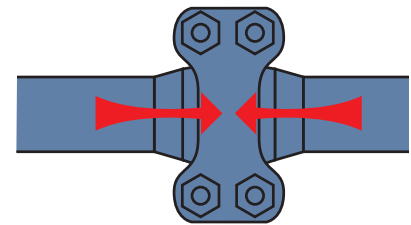
Tension

- » The Grayloc® connector withstands greater tension loads than conventional ANSI flanges.
- » In most cases, it 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

- » Independent tests have shown that the Grayloc® connector can withstand severe bending loads without leaking or loosening.
- » In one test, a 2 1/2 GR20 Grayloc® connector was welded to a 2.5-inch Sch. XX pipe and subjected to a 2-inch cold bend, 36 inches on center. The connector did not leak and the 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 of 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 / 45.5 MPa	Thermal shock	Routine service with temperature changes up to 300°F / 167°C per hour
High temperature	Service experience to 1,700°F / 927°C	Corrosion	Liquid sodium service at 1,200°F / 649°C
Low temperature	Routine liquefied gas service, including liquid hydrogen and nitrogen to -425°F / -254°C	Zero leak rate	10 ⁻⁶ atm cc/s helium
		Pressure	Full vacuum to 60,000 psi / 413.68 MPa

Service extremes

Vibration, heat, cold, and thermal shock often accompany service where Grayloc® connectors are heavily loaded. These connectors consistently withstand severe situations without routine maintenance. Grayloc® connectors permit maintenance-free service, even under the extreme conditions shown above.

Lighter and Smaller Option

Saving weight and space

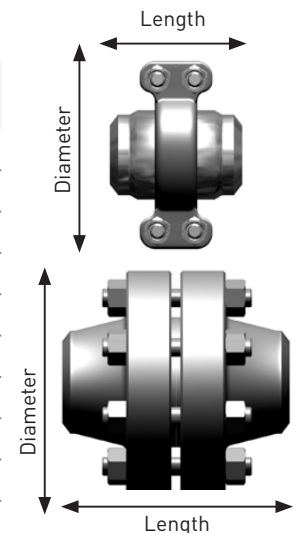
Compared to conventional ANSI or API ring joint flanges, the Grayloc® connector is significantly lighter and smaller. The diameter of the clamp is less than that of a flange. The length of the weld neck is also shorter than that of a comparable flange, further reducing weight and space. The Grayloc® connector allows components, such as valves, to be installed without regard to bolt hole alignment. The clamp may be rotated a full 360° around the hub to orient the bolts so the connectors can be assembled and disassembled in confined spaces with minimal clearance.

Four factors—smaller diameter, shorter length, freedom to rotate the clamp, and no bolt hole alignment constraint—provide an opportunity to design lightweight compact systems. An example of such a design is 12 dual completions through a single 120-inch offshore platform leg. Another is the reduction of more than 15 inches in length and 11 tons of weight saved in the production unit for an offshore platform in the Gulf of Mexico. In the end, lighter, smaller Grayloc®-fitted structures can be supported by lighter, smaller platforms and supporting structures.



Comparison of Grayloc® Connectors and Conventional Flanges

Size, in	Connection	W.P., psi	Diameter, in	Length, in	Weight, lb
3	Grayloc® Connector	6,593	6.9	6.75	37
	ANSI 1500 Flange	3,705	10.5	9.25	121
	API 5000 Flange	5,000	10.5	8.62	92
6	Grayloc® Connector	6,359	12.0	9.50	144
	ANSI 1500 Flange	3,705	15.5	13.50	407
	API 5000 Flange	5,000	15.5	14.25	365
10	Grayloc® Connector	5,368	17.6	12.32	415
	ANSI 1500 Flange	3,705	23.0	20.00	1,100
	API 5000 Flange	5,000	23.0	20.87	1,032



Construction

Save time and money—initially and continuously

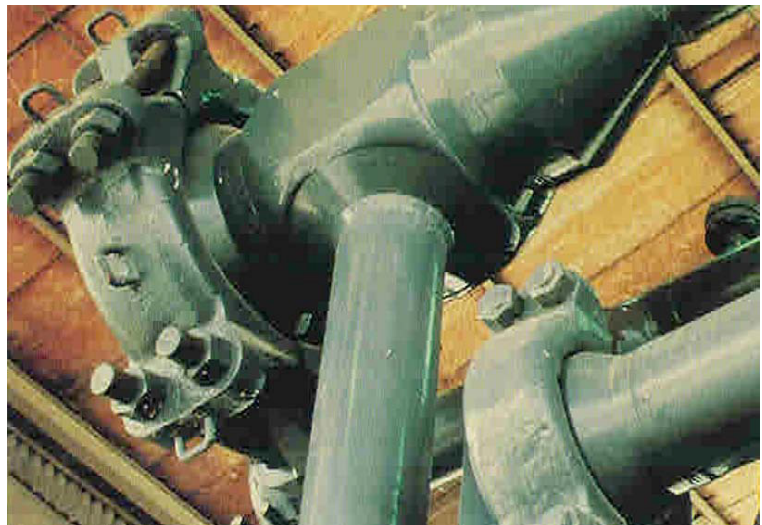
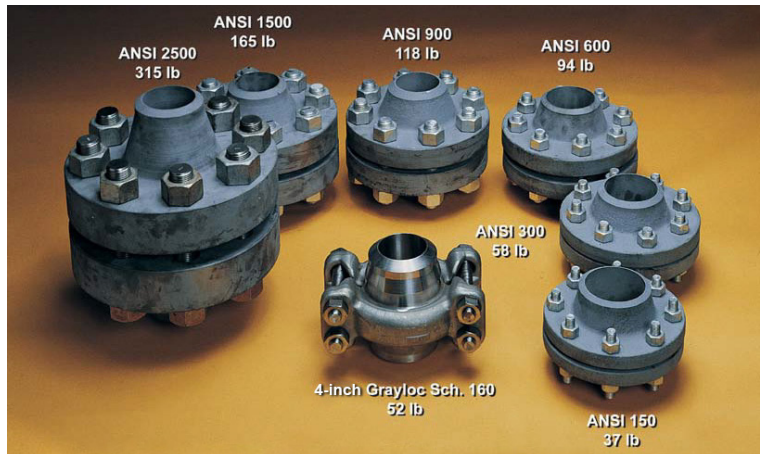
In the fabrication of piping systems, less time is required to weld Grayloc® hubs to the pipe, since there are no bolt holes to align.

There are only four bolts to tighten, rather than eight to 24 bolts as on a conventional flange. The torque required to make up a Grayloc® connector is less than that of a ring joint flange—as much as 75% less.

Removing the four bolts frees the connector, making maintenance considerably simpler. Make and break times are much shorter, usually in the

range of three to eight Grayloc® connectors in the same time as one flanged connection. No periodic retightening of bolting is required once the connector is in service. Seal rings can be reused when service conditions allow.

The Grayloc® connector is sized according to pipe size and schedule. As a result, one Grayloc® connector can be used for all piping of the same size, regardless of pressure, as shown below. This significantly reduces the necessary inventory of spare parts.

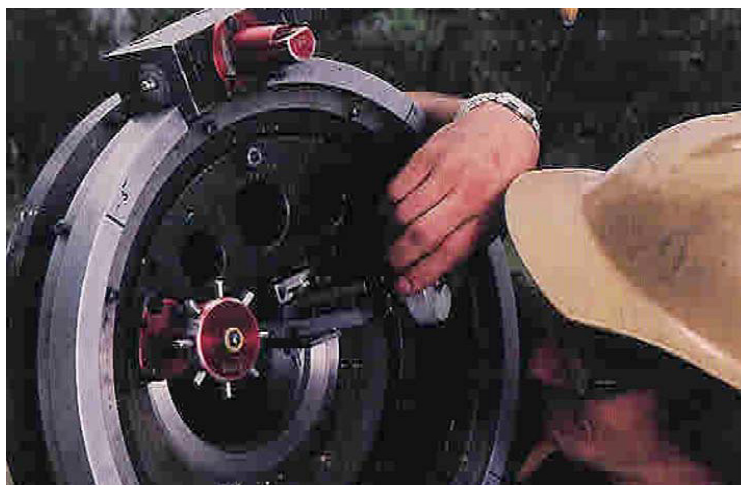


Service and Product Support

Complete piping system support

A complete range of Grayloc® components is available to help reduce space requirements and to make complicated piping and vessel assemblies easier to install and maintain.

Onsite services (including inspection, repair, and maintenance of Grayloc® connectors) are also offered as an option.





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