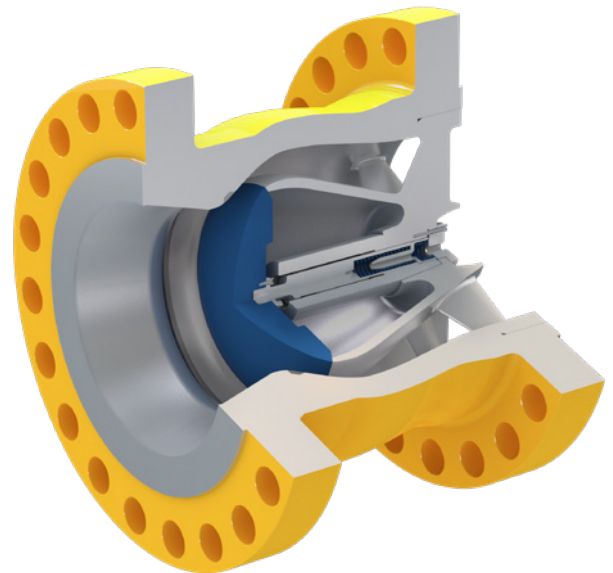# Nozzle Check Valve

High-performance check valves

Innovative and unique check valve design with superior performance and reliability

FEATURES

Low pressure loss

Unique dual-spring design for fast, dynamic, non-slam response

Reliable, maintenance-free operation

GRAYLOC® PRODUCTS
A Division of Oceaneering International, Inc.

Nozzle Check Valve

Proven reliability since 2008, our non-slam nozzle check valve*, characterized by an optimized flow profile and unique dual-spring design, solves common check valve operational issues while improving on the dynamic response and pressure loss of existing nozzle check valve designs. Low friction movement, low part weight, and short disc stoke ensure stable, maintenance-free operation, even in low flow applications. The simplified, one-piece valve body with an integral valve seat is inherently fire-safe, and is customizable to meet internal coating, length, and end-connection requirements.

Our innovative valve design includes a separate diffuser body, which is inserted from the valve's downstream end. This greatly simplifies the body shape and enables the valve to be offered with a cast or forged body, and supports the offering of options such as custom lengths, weld overlay, and internal coatings such as fusion-bonded epoxy (FBE). This innovation alone can substantially reduce the delivery time and cost of procuring valves for your next project.
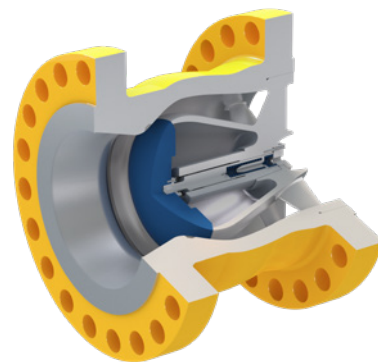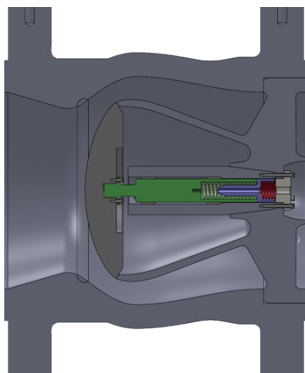
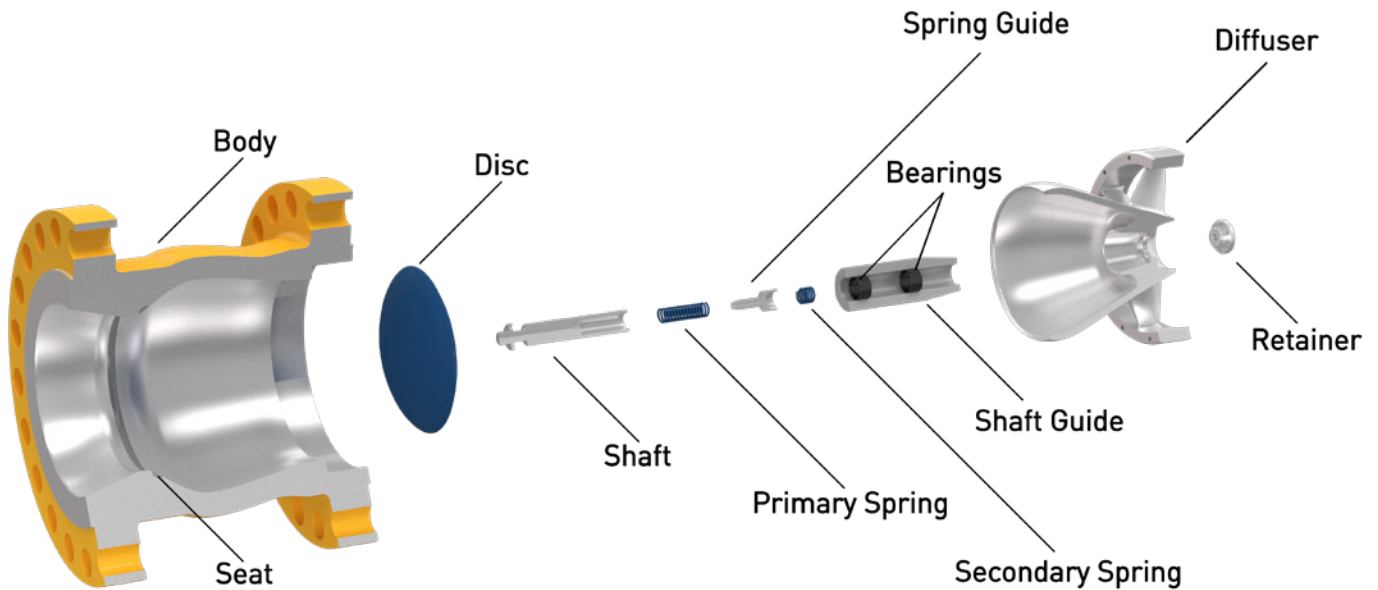*Formerly the SMX International non-slam nozzle check valve

Features

» Low pressure loss

» Unique dual-spring design for fast, dynamic, non-slam response

» Reliable, maintenance-free operation

» One-piece, all-metal valve body—fire safe and no fugitive emissions

» Reliable, leak-free, and integral metal-to-metal seat

» Suitable for low and high flow rates

» Springs replaceable without major valve disassembly

» Lightweight moving parts and minimized disc stroke to optimize the closing time

» Low friction bearings

Flexible design

» Sizes from 1 in to 72 in (25.4 mm to 1828.8 mm)

» Pressure ratings up to API 10,000 psi (69 MPa)

» Available with any end connection: Grayloc® clamp connectors and compact flanges, ASME B16.5 flanges, ASME B16.47 flanges, ASME B16.25 weld ends, NORSOK L-005, AS4087 flanges, and API 6A flanges (other end connections available upon request)

» API and custom trims available

» Available with weld overlay and internal coatings such as fusion bonded epoxy

» Available in short pattern, long pattern, and custom lengths

» Designed and manufactured to comply with applicable international or local standards

Body · Disc · Spring Guide · Diffuser · Bearings · Retainer · Shaft · Primary Spring · Secondary Spring · Shaft Guide · Seat

How it works

1. When closed, the valve disc is held against the seat by the primary spring and the back pressure. The disc lifts off the seat when the static pressure exceeds the force of the pre-loaded springs.

2. As the flow rate increases, the disc moves toward the open position.

3. As the disc moves toward the diffuser, the Venturi effect adds an additional opening force (low pressure behind the disc) and the secondary (significantly stronger) spring is engaged.

   » The valve is fully open at the opening velocity and the disc will sit stable against the diffuser when the velocity increases (no disc chatter).

4. When the flow decelerates below the opening velocity, the dual springs provide a powerful closing force.

5. The valve closes just before the return flow starts (non-slam closure).
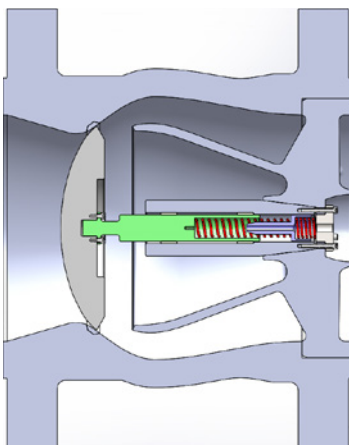
Primary Spring Engaged
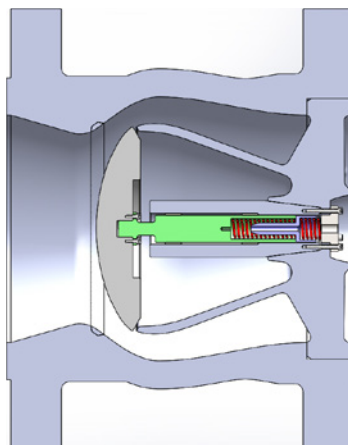
Primary Spring Compressed, Secondary Spring Engaged
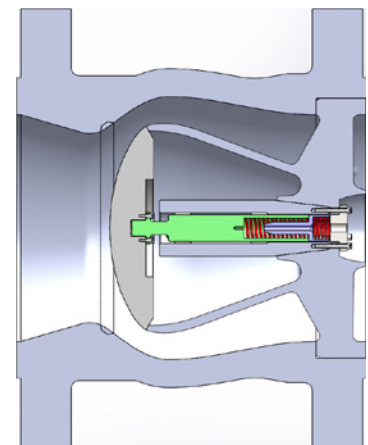
Full Open, Primary and Secondary springs compressed

OCEANEERING®

Valve Performance Characteristics

Comparison of dynamic performance

The dynamic performance of the non-slam Nozzle Check Valve is attributed to its short valve stroke, low moving mass, and strong dual-spring low-friction closing action. Only the more complex and expensive ring disc valve is faster due to its inherently shorter stroke.

Comparison of the dynamic characteristics of various check valves. Non-slam Nozzle Check Valve data superimposed on data presented by Thorley [Thorley, A. R. (2004). Fluid Transients in Pipeline Systems: A Guide to the Control and Suppression of Fluid Transients in Liquids in Closed Conduits (2nd ed.). New York: D. & L. George Ltd.]

Avoiding check valve slam

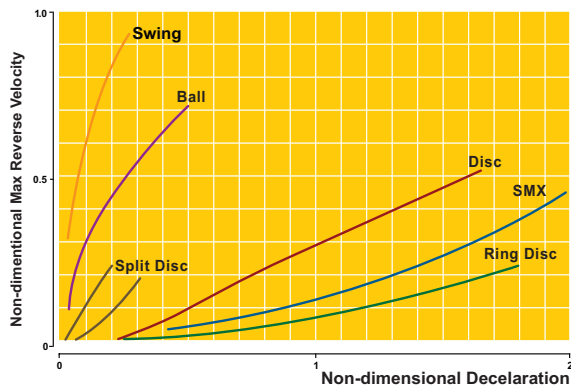Replacing an unsuitable check valve with the non-slam Nozzle Check Valve can significantly reduce pressure transient following a pump trip.
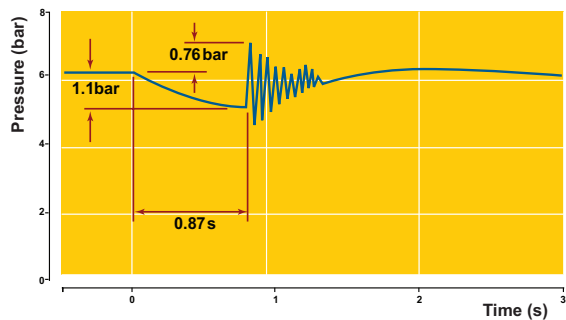
The phenomenon of check valve slam is caused by installing valves that are not matched to the system of which they are a part. Systems that are most at risk are high head installations and systems with parallel pumps (Thorley).

Comparison of loss coefficients

The low loss coefficient of the non-slam Nozzle Check Valve can be attributed to the excellent pressure recovery of its high-efficiency diffuser.

Comparison of the loss coefficients of various types of check valves. Non-slam Nozzle Check Valve data superimposed on data (Thorley).
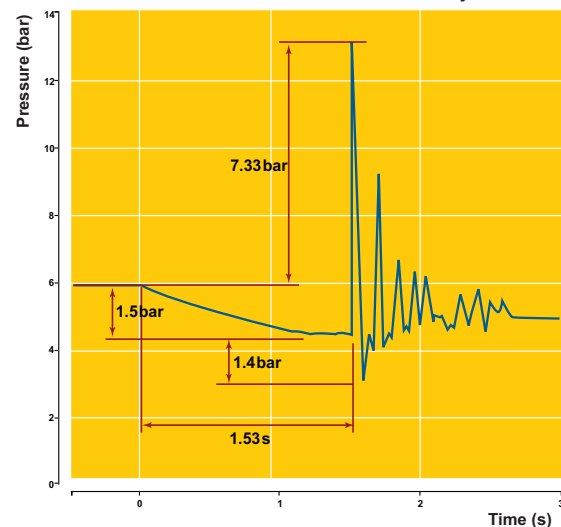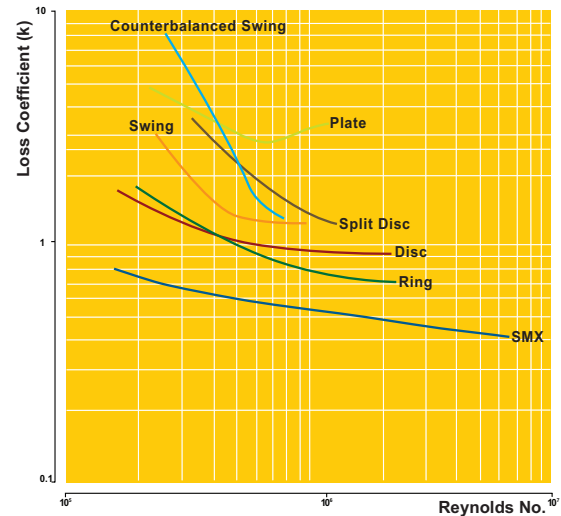
Valve Sizing

The prime operating function of a check valve is to close quickly at flow reversals to prevent damage to upstream piping and piping components. While performing this function, the valve should have minimum pressure loss during normal operation.

We use valve sizing calculations based on theoretic fluid dynamic considerations that are validated by testing. The valve springs are sized to result in a stable opening and quick closing valve under normal flow conditions.

Spring sizing

Correct valve sizing is important to ensure full opening of the valve at the specified flow rate (v_0). Only a fully opened valve will have very low pressure loss. At the same time, it is important to have a quick closing valve and to select the strongest spring possible at the specified v_0.

The basis for sizing the springs for the non-slam Nozzle Check Valve is included in the chart below. The red line represents the opening (differential) force on the valve disc at various opening positions.

Following the red line from left to right, the force on the valve disc increases with increasing flow velocity. The valve disc lifts from the valve seat and moves toward the fully open position. During the initial stage of opening, from 0–85%, the opening force is delivered by the dynamic force ($Fd = \rho v^2$) on the front of the disc. From 85–100%, the opening force increases dramatically as a result of a large suction force behind the disc. This suction force is a result of the Venturi effect. The flow contour of the valve body is designed to maximize the Venturi effect.
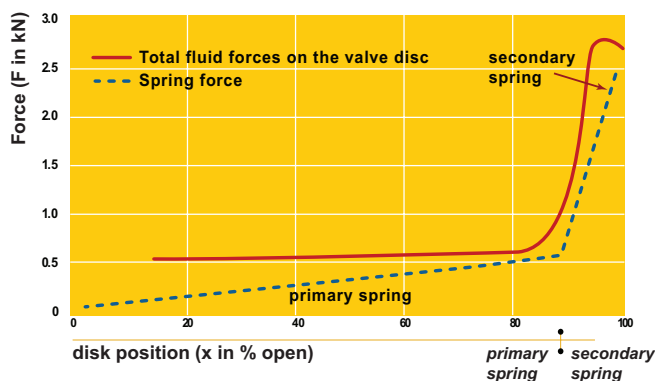
The blue line represents the spring force. The shallow slope represents the force of the primary spring. The steep slope represents the force of the optional secondary spring. The secondary spring takes advantage of the Venturi effect.

Pressure loss coefficient

The pressure loss coefficient K in the relationship $\Delta p = \frac{1}{2}K\rho v^2$ is the key characteristic used to calculate the pressure loss across a fully open valve (K = pressure loss coefficient, ρ = fluid density, and v = flow velocity). In the chart below, the loss coefficient characteristic of the non-slam Nozzle Check Valve is presented as a function of the Reynolds number. To make this chart easier to interpret, two axes are added that equate the Reynolds number to the valve size at a water flow rate of 6.6 ft/sec (2 m/s).
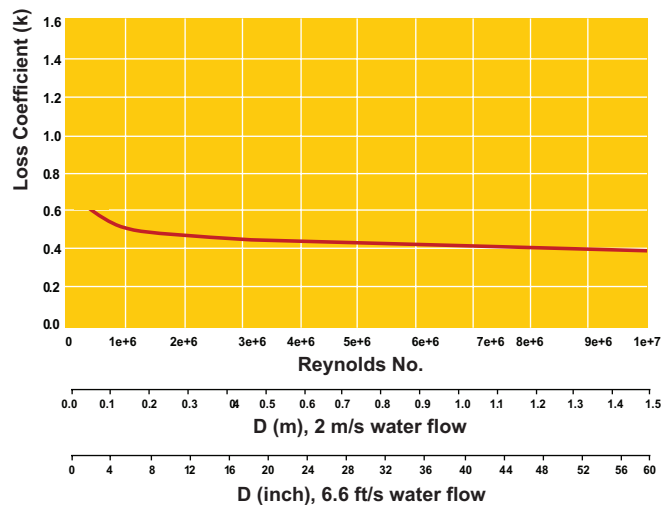
Pressure loss characteristic

The graph below shows the complete pressure loss characteristic typical for the non-slam Nozzle Check Valve. As the flow rate increases, the valve opens. Initially, the pressure loss increases as the disc is lifted from the valve seat. Then, as the flow increases, the valve disc moves toward the fully open position in which the disc and diffuser form an aerodynamic shape. In this graph, the valve is fully open at approximately 8.2 ft/s (2.5 m/s), and this velocity is called v_0. The spring force shall be selected such that v_0 is lower than the normal operating flow velocity to ensure that the valve is fully open at normal flow conditions.
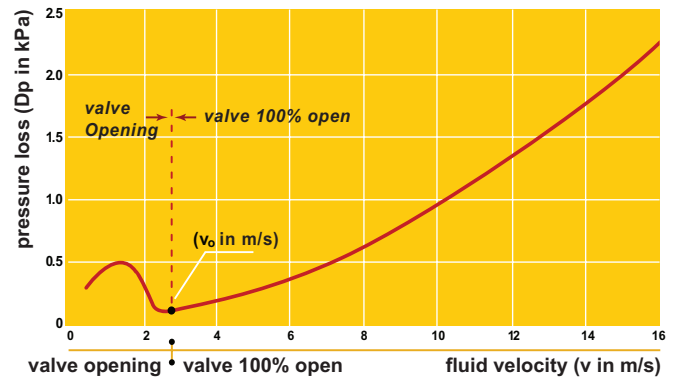
Check Valve Components

A variety of body and trim materials are available: carbon steel, low-alloy steel, stainless steel, duplex, aluminium bronzes, nickel alloys, and titanium.

The valve can be provided with an internal coating or a weld overlay based on application requirements.
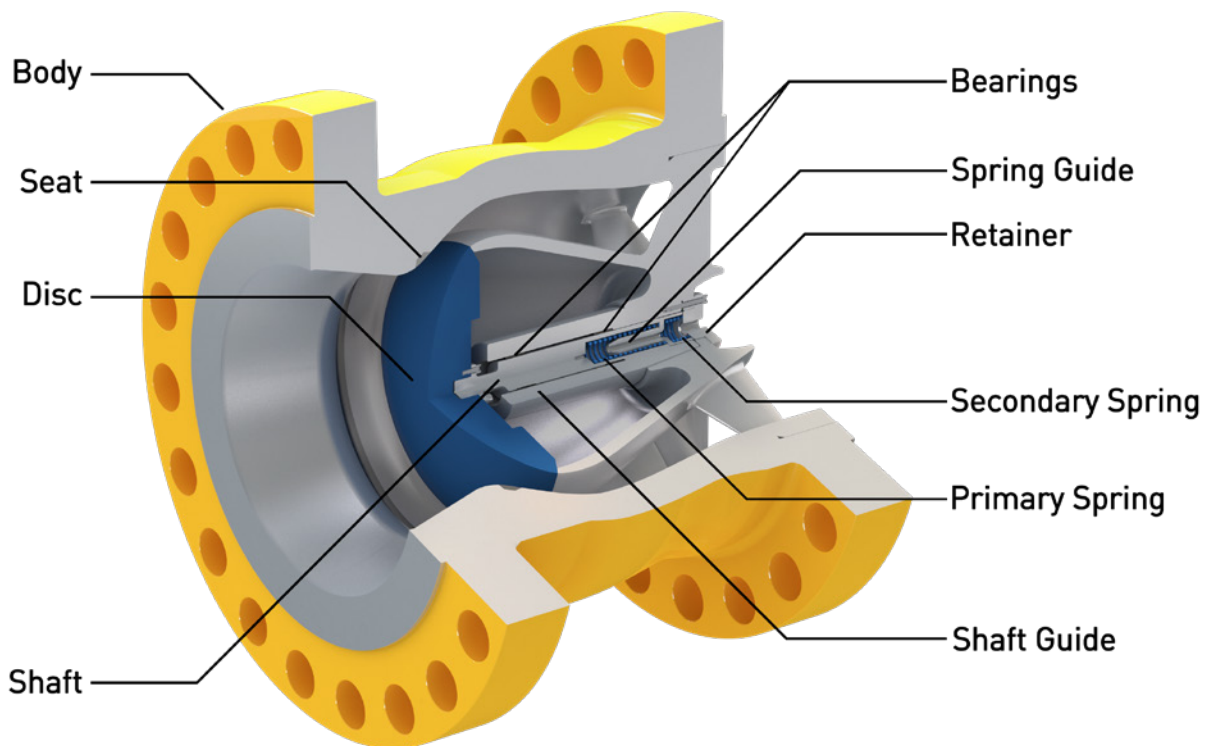
Dimensions

ASME Class 150														
Size		Short Pattern Length						ASME B16.10 Length						
DN	NPS	End Connection												
		RTJ		RF		WE		RTJ		RF		WE		
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	89	3.50	89	3.50			140	5.50	127	5.00	127	5.00
40	1.5	95	3.75	95	3.75			178	7.00	165	6.50	165	6.50
50	2	152	6.00	152	6.00			216	8.50	203	8.00	203	8.00
65	2.5	152	6.00	152	6.00			229	9.00	216	8.50	216	8.50
80	3	165	6.50	165	6.50			254	10.00	241	9.50	241	9.50
100	4	177	6.96	177	6.96			305	12.00	292	11.50	292	11.50
150	6	266	10.47	253	9.96	265	10.43	368	14.50	356	14.00	356	14.00
200	8	308	12.12	295	11.61	305	12.00	508	20.00	495	19.50	495	19.50
250	10	378	14.88	365	14.37	380	14.96	635	25.00	622	24.50	622	24.50
300	12	448	17.63	435	17.12	450	17.71	711	28.00	698	27.50	698	27.50
350	14	488	19.21	475	18.70	490	19.29	800	31.50	787	31.00	787	31.00
400	16	558	21.96	545	21.45	560	22.04	876	34.50	864	34.00	864	34.00
450	18	623	24.52	610	24.01	630	24.80	991	39.00	978	38.50	978	38.50
500	20	688	27.08	675	26.57	700	27.55	991	39.00	978	38.50	978	38.50
600	24	823	32.40	810	31.88	835	32.87	1308	51.50	1295	51.00	1295	51.00
700	28			945	37.20	975	38.38			1448	57.00	1448	57.00
750	30			1010	39.76	1045	41.14			1524	60.00	1524	60.00
800	32			1080	42.51	1115	43.89						
900	36			1215	47.83	1250	49.21			1956	77.00	1956	77.00
1000	40			1350	53.14	1390	54.72						
1050	42			1415	55.70	1460	57.48						
1200	48			1615	63.58	1650	64.96						
1400	56			1725	67.91								

Special sizes and lengths are available on request.

ASME Class 300													
Size		Short Pattern Length						ASME B16.10 Length					
DN	NPS	End Connection											
		RTJ		RF		WE		RTJ		RF		WE	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	102	4.00	102	4.00			228	9.00	215	8.50	215	8.50
40	1.5	114	4.50	114	4.50			254	10.00	241	9.50	241	9.50
50	2	152	6.00	152	6.00			283	11.12	267	10.50	267	10.50
65	2.5	152	6.00	152	6.00			308	12.12	292	11.50	292	11.50
80	3	165	6.50	165	6.50			333	13.12	318	12.50	318	12.50
100	4	177	6.96	177	6.96			371	14.63	356	14.00	356	14.00
150	6	269	10.59	253	9.96	265	10.43	460	18.12	444	17.50	444	17.50
200	8	311	12.24	295	11.61	305	12.00	549	21.63	533	21.00	533	21.00
250	10	381	15.00	365	14.37	380	14.96	638	25.12	622	24.50	622	24.50
300	12	451	17.75	435	17.12	450	17.71	727	28.63	711	28.00	711	28.00
350	14	491	19.33	475	18.70	490	19.29	854	33.63	838	33.00	838	33.00
400	16	561	22.08	545	21.45	560	22.04	879	34.63	864	34.00	864	34.00
450	18	626	24.64	610	24.01	630	24.80	994	39.12	978	38.50	978	38.50
500	20	694	27.32	675	26.57	700	27.55	1035	40.75	1016	40.00	1016	40.00
600	24	832	32.75	810	31.88	835	32.87	1368	53.88	1346	52.99	1346	52.99
700	28	970	38.18	945	37.20	975	38.38	1524	60.00	1499	59.01	1499	59.01
750	30	1035	40.74	1010	39.76	1045	41.14	1619	63.75	1594	62.75	1594	62.75
800	32	1109	43.66	1080	42.51	1115	43.89						
900	36	1244	48.97	1215	47.83	1250	49.21	2112	83.14	2083	82.00	2083	82.00
1000	40			1350	53.14	1390	54.72						
1050	42			1415	55.70	1460	57.48						
1200	48			1615	63.58	1650	64.96						

Special sizes and lengths are available on request.

ASME Class 600													
Size		Short Pattern Length						ASME B16.10 Length					
DN	NPS	End Connection											
		RTJ		RF		WE		RTJ		RF		WE	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	102	4.00	102	4.00			216	8.50	216	8.50	216	8.50
40	1.5	121	4.75	121	4.75			241	9.50	241	9.50	241	9.50
50	2	152	6.00	152	6.00			295	11.63	292	11.50	292	11.50
65	2.5	152	6.00	152	6.00			333	13.12	330	13.00	330	13.00
80	3	165	6.50	165	6.50			359	14.12	356	14.00	356	14.00
100	4	178	6.96	178	6.96			435	17.12	432	17.00	432	17.00
150	6	256	10.07	253	9.96	265	10.43	562	22.12	559	22.00	559	22.00
200	8	298	11.73	295	11.61	305	12.00	664	26.14	660	26.00	660	26.00
250	10	368	14.48	365	14.37	380	14.96	791	31.12	787	31.00	787	31.00
300	12	438	17.24	435	17.12	450	17.71	841	33.12	838	33.00	838	33.00
350	14	478	18.81	475	18.70	490	19.29	892	35.12	889	35.00	889	35.00
400	16	548	21.57	545	21.45	560	22.04	994	39.12	991	39.00	991	39.00
450	18	613	24.13	610	24.01	630	24.80	1095	43.12	1092	43.00	1092	43.00
500	20	681	26.81	675	26.57	700	27.55	1200	47.25	1194	47.00	1194	47.00
600	24	819	32.24	810	31.88	835	32.87	1407	55.38	1397	55.00	1397	55.00
700	28	958	37.71	945	37.20	975	38.38	1613	63.50	1600	63.00	1600	63.00
750	30	1023	40.27	1010	39.76	1045	41.14	1664	65.50	1651	65.00	1651	65.00
800	32	1096	43.14	1080	42.51	1115	43.89						
900	36	1231	48.46	1215	47.83	1250	49.21	2099	82.63	2083	82.00	2083	82.00
1000	40			1350	53.14	1390	54.72						
1050	42			1415	55.70	1460	57.48						

Special sizes and lengths are available on request.

OCEANEERING®

ASME Class 900													
Size		Short Pattern Length						ASME B16.10 Length					
DN	NPS	End Connection											
		RTJ		RF		WE		RTJ		RF		WE	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	140	5.50	140	5.50			254	10.00	254	10.00	254	10.00
40	1.5	152	6.00	152	6.00			305	12.00	305	12.00	305	12.00
50	2	152	6.00	152	6.00			371	14.62	368	14.50	368	14.50
65	2.5	184	7.25	184	7.25			422	16.62	419	16.50	419	16.50
80	3	203	8.00	203	8.00			384	15.12	381	15.00	381	15.00
100	4	238	9.37	235	9.25	238.0	9.37	460	18.12	457	18.00	457	18.00
150	6	306	12.04	303	11.92	306.0	12.04	613	24.12	610	24.00	610	24.00
200	8	344	13.54	341	13.42	344.0	13.54	740	29.12	737	29.00	737	29.00
250	10	394	15.51	391	15.39	394.0	15.51	841	33.12	838	33.00	838	33.00
300	12	451	17.75	448	17.63	451.0	17.75	968	38.12	965	38.00	965	38.00
350	14	494	19.44	485	19.09	494.0	19.44	1038	40.88	1029	40.50	1029	40.50
400	16	610	24.01	558	21.96	610.0	24.01	1140	44.88	1130	44.50	1130	44.50
450	18	632	24.88	619	24.37	632.0	24.88	1232	48.50	1219	48.00	1219	48.00
500	20	697	27.44	684	26.92	697.0	27.44	1334	52.50	1321	52.00	1321	52.00
600	24	838	32.99	819	32.24	838.0	32.99	1568	61.75	1549	61.00	1549	61.00

Special sizes and lengths are available on request.

ASME Class 1500													
Size		Short Pattern Length						ASME B16.10 Length					
DN	NPS	End Connection											
		RTJ		RF		WE		RTJ		RF		WE	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	140	5.50	140	5.50			254	10.00	254	10.00	254	10.00
40	1.5	180	6.00	180	6.00			305	12.00	305	12.00	305	12.00
50	2	152	6.00	152	6.00			371	14.62	368	14.50	368	14.50
65	2.5	184	7.25	184	7.25			425	16.62	419	16.50	419	16.50
80	3	203	8.00	203	8.00			473	18.62	470	18.50	470	18.50
100	4	238	9.37	235	9.25	238	9.37	549	21.62	546	21.50	546	21.50
150	6	306	12.04	300	11.81	306	12.04	711	28.00	705	27.75	705	27.75
200	8	344	13.54	335	13.18	344	13.54	841	33.13	832	32.75	832	32.75
250	10	394	15.51	385	15.15	394	15.51	1000	39.38	991	39.00	991	39.00
300	12	451	17.75	435	17.12	451	17.75	1146	45.12	1130	44.50	1130	44.50
350	14	494	19.44	475	18.70	494	19.44	1276	50.25	1257	49.50	1257	49.50
400	16	567	22.32	545	21.45	567	22.32	1407	55.38	1384	54.50	1384	54.50
450	18	632	24.88	610	24.01	632	24.88	1559	61.38	1537	60.50	1537	60.50
500	20	697	27.44	675	26.57	697	27.44	1686	66.38	1664	65.50	1664	65.50
600	24	838	32.99	810	31.88	838	32.99	1972	77.62	1943	76.50	1943	76.50

ASME Class 2500													
Size		Short Pattern Length						ASME B16.10 Length					
DN	NPS	End Connection											
		RTJ		RF		WE		RTJ		RF		WE	
mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
25	1	152	6.00	152	6.00			308	12.12	308	12.12	308	12.12
40	1.5	184	7.25	184	7.25			387	15.24	384	15.12	384	15.12
50	2	203	8.00	203	8.00			454	17.87	451	17.75	451	17.75
65	2.5	229	9.00	229	9.00			514	20.25	508	20.00	508	20.00
80	3	254	10.00	254	10.00			584	23.00	578	22.75	578	22.75
100	4	304	11.96	295	11.61	253	9.96	683	26.88	673	26.50	673	26.50
150	6	403	15.86	390	15.35	324	12.75	927	36.50	914	36.00	914	36.00
200	8	446	17.55	430	16.92	367	14.44	1038	40.87	1022	40.25	1022	40.25
250	10	562	22.12	540	21.25	424	16.69	1292	50.88	1270	50.00	1270	50.00
300	12	617	24.29	595	23.42	486	19.13	1445	56.88	1422	56.00	1422	56.00

Special sizes and lengths are available on request.

Grayloc® Products
9342 Telge Road
Houston, Texas
77095
U.S.A.
Telephone: +1 713.466.8853
Fax: +1 713.937.2335

Grayloc® Products
Site 39 Silverburn Place, Bridge of
Don Industrial Estate
Aberdeen, Scotland
AB23 8EG
Telephone: +44 1224.222790
Fax: +44 1224.222780

Grayloc® Products Canada Ltd.
1129 Northside Road, Unit 1
Burlington, Ontario
L7M 1H5
Canada
Telephone: +1 905.842.3150
Fax: +1 905.842.1785

**Oceaneering Grayloc® Connection
Systems Sdn. Bhd.**
Unit 2, Jalan Sungai Kayu Ara 32/31
Berjaya Industrial Park
Section 32
40460 Shah Alam
Selangor Darul Ehsan
Malaysia
Telephone: +60 3.5870.1200

OCEANEERING®

oceaneering.com