

STAINLESS STEEL & BRONZE BRAIDED HOSES

60 years ago (when the writer started), braided stainless steel hose had been in use for quite some time. As I remember, there were only a few major manufacturers, such as Chicago Metal Hose and Anaconda. For the most part, the smaller assemblers did not invest in the expensive equipment that forms straight tubing into the helical and annular forms, and certainly not in the complex braiding equipment. Thus the standards in the industry were maintained by the major firms.

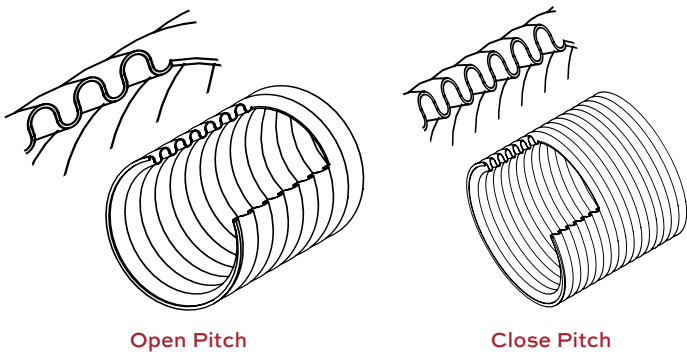
While helical hose (corrugations in a continuous helix) was still popular, the movement toward annular corrugations (each corrugation independent as in expansion joints) was moving along rapidly, because of lower stress and greater movement at a given pitch.

There were two broad descriptions of annular hose, "Open and Close Pitch", that described the spacing of the corrugations. In general, open pitch was used in low pressure applications where the braid was not required, and the hose might be used to take up some axial expansion as in diesel exhaust.

Close pitched hose was always used for transverse movement and applications where the stainless steel braid was required to control thrust.



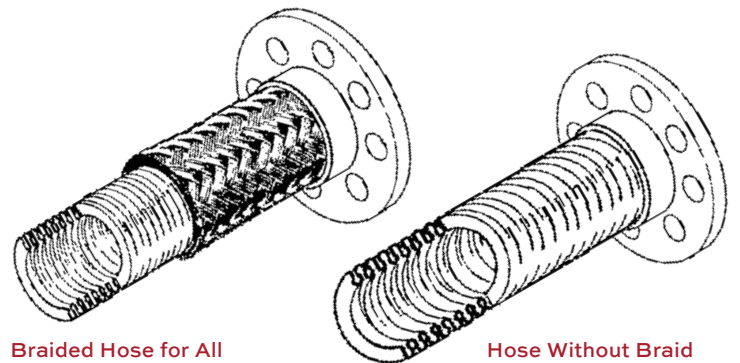
When fluid or gas pressure is applied to each corrugation, it tends to open axially, and this adds to the thrust of the pipe area multiplied by the line pressure. As the thrust pulls on the anchored braid ends, the interwoven bias weave applies inward radial pressure to the corrugations as well. Pressure capability is largely a function of the braid. When higher pressures are needed, it is seldom accomplished by thicker tubing as you would lose flexibility. It is most often accommodated by increasing the strength of the braid, using braid with heavier wire or tighter spacing described as "Double or Triple Braid" or just multiple braid layers. While braid angle is an influence, a quick comparison of braid strength is to multiply the wire area by the total number of wires around the circumference.



Open Pitch

Close Pitch

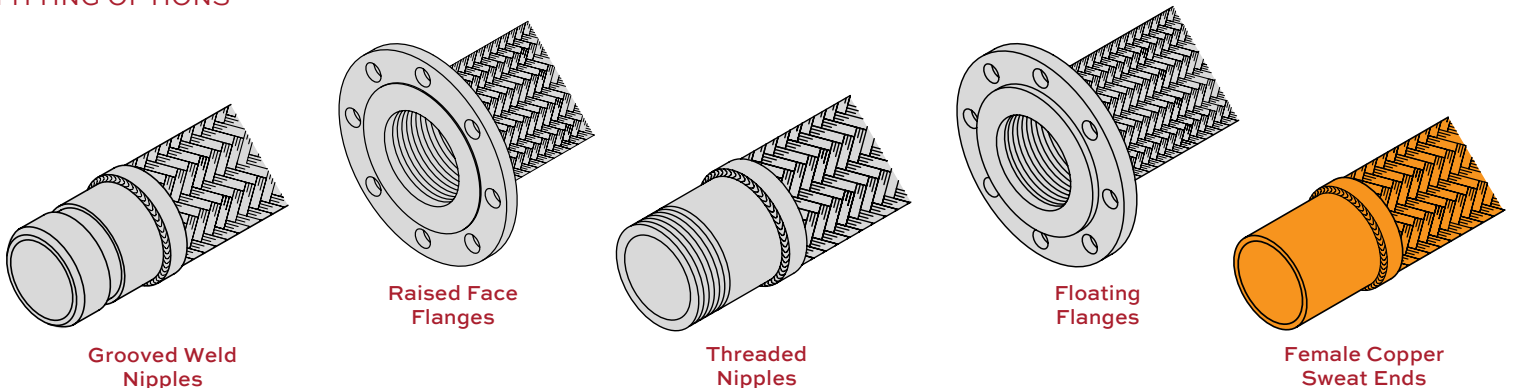
The corrugated hose provides flexibility and prevents leakage, but has virtually no resistance to pressure thrust. In a solid piping system, there is no external thrust, as the pressure on the projected area of the inside of the pipe is equalized by the two ends or bends in the pipe. The force is taken by the pipe wall. Once a flexible hose is inserted, that capability is gone.



Braided Hose for All Pressure Applications

Hose Without Braid for Diesel Exhaust and Similar Applications

FITTING OPTIONS



Grooved Weld Nipples

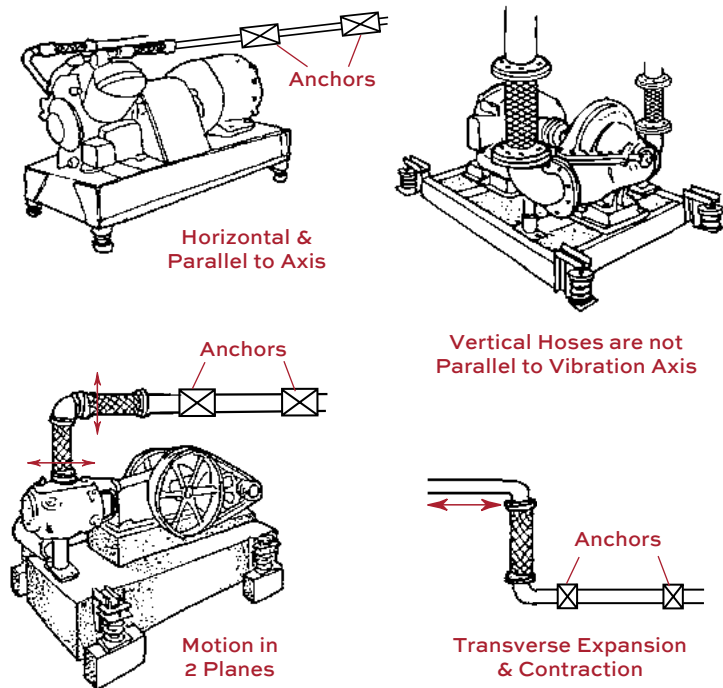
Raised Face Flanges

Threaded Nipples

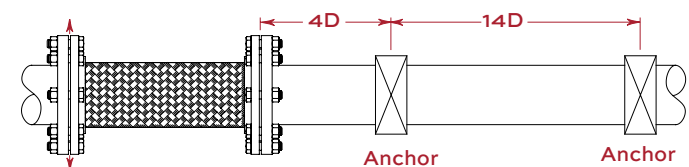
Floating Flanges

Female Copper Sweat Ends

Since the braid is stretched taut by the pressure in the axial direction and kept that way, hoses cannot accept axial motion. All flexibility is at right angles to the axis, so the hose flexes transversely. Most machinery vibrates in a radial direction from the main shaft. Therefore, the hose should be installed parallel to the shaft for best performance, although it seldom is. It must be installed at a 90° angle to the motion in expansion applications. When major motion occurs in two planes, two hoses at right angles to each other are one way to solve the problem.



A metallic hose offers more bend resistance as the pressure increases. The term "flexible" means flexure without fatigue rather than easy flexure. In many applications, the pipeline must be anchored right after the hose to force the hose to flex or the hose serves little purpose. For best results, one near the hose and the other some distance away provide a better solution, as pipe may pivot through one anchor. Spacing between anchors is a function of pipe diameter.



While we have influenced specifications over the years, our volume had always been very low, because we were not competitive. That has changed.

In setting standards for our new product range, we were dismayed to find that the term "Close Pitch" had almost become meaningless. Competitive literature does not include the number of corrugations per foot nor transverse stiffness. We are publishing pitch on all product pages and transverse stiffnesses on pages 10-12 & 10-13, so this bulletin begins to provide direction.

Do not be fooled by the salesman who bends a hose like a reed.

When most people visualize a hose flexing, the image is bending in an arc. Unfortunately, this is not true. When flanged hose is displaced, the rigid pipe flanges remain parallel. The hose remains relatively straight at both ends and takes an open "S" shape between the two ends, as shown below. Nippled hoses act the same way.



"S" SHAPED HOSE

Our hose has a safety factor of 4 times the rated pressure. When comparing allowable operating pressures with other manufacturers, ask for burst pressure. It may be they are working at a lower safety factor. We prefer not to.

All stainless steel hose loses strength at higher temperatures. In the interests of safety and good engineering, use the correction factors to lower ratings when lines are hot.

We arrived at our standards of corrugations per foot by buying samples from approximately six of the well known manufacturers. The variation was more than a factor of two. Our pitch matches the best of the competitors. Some other firms may have a tighter pitch, but our spacing ranks among the "quality suppliers" and makes the hose very flexible.

The question comes up as to why others do not use a tighter pitch. The answer is the fewer the corrugations, the shorter the length of the original tubing to arrive at a finished length, and the faster the forming process. This decreases cost in direct proportion to the shorter length of the original tubing. Flexibility suffers but the product is cheaper.

Our sales representatives already have a full sized photo comparing our braided copper sweat end hoses with a well known competitor's as shown on the next page.

Our 4" live length is 68% longer than their 23/8". We stripped the braid and counted the corrugations. Their product, sold as "close pitched", had 5 active corrugations. We have 22 or 4.4 times as many.

That is why specifications and published information are so important. It is the end user's only protection.

For the past 60 years, we have based our vibration control mountings, hanger, and pad recommendations on field experience. Rubber expansion joints have been tested acoustically and constantly improved for reliability. Since proper seismic restraint not only prevents property damage but more importantly saves lives, all of our seismic products are destruction tested for confirmation after design. We would not be living up to our self-imposed standards without the same intense engineering attention to Stainless Steel Hose.



Based on visits to job sites, we knew that very short hose lengths, the typical “plumbers helper”, did nothing but possibly reduce misalignment stress. Holding both ends of the hose provided a sense of equal vibration with no reduction from one end to the other. Even double lengths seemed to act about the same way.

Experience always provides background for the next step. In machinery vibration control, a theoretical isolator often failed to perform because the structure was not as stiff as the isolator. We solved the problem by producing isolators with lower stiffness than the structure.

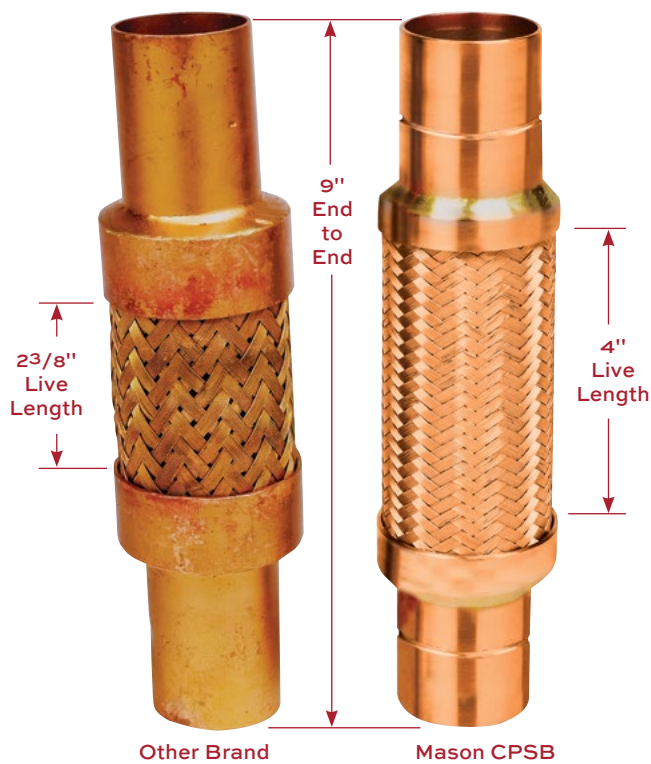
We started this study by calculating transverse schedule 40 pipe stiffness. This is important as the hose faces this resistance.

There are many manuals that provide hose designs for misalignment, misalignment and vibration amplitude or straight connectors for vibration only. However, we could find no

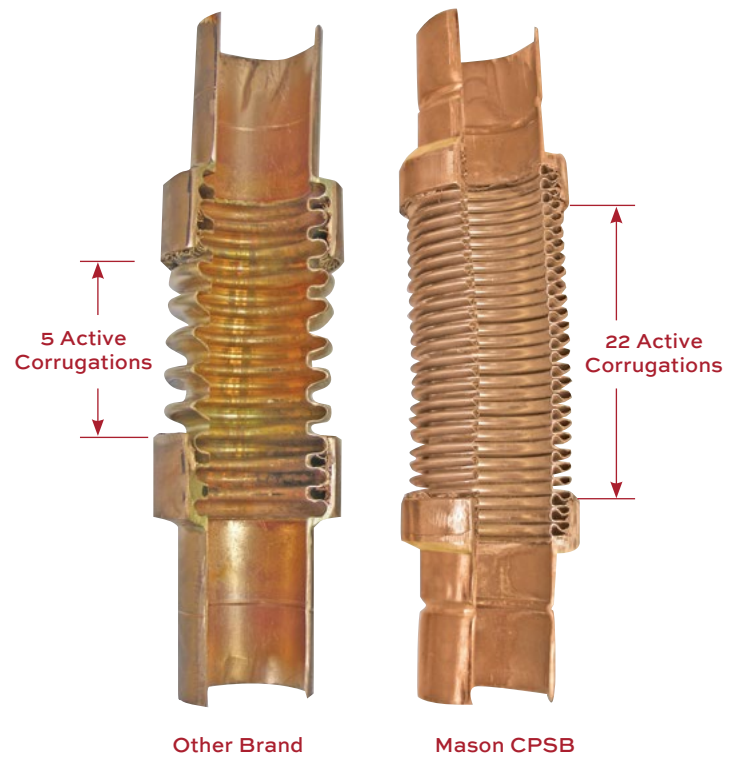
information on the force required to move a hose transversely—the key factor in selecting a hose to reduce vibration transmission.

Pipeline vibration reduction is based on hose length, pressure and the bending resistance of the steel piping it is attached to. While a vibration amplitude of $\pm 1/8$ " would be unacceptably high, our study is based on that displacement as $\pm 1/8$ " is the industries’ “Pump Connector” standard. When comparing the stiffnesses of straight pipe lengths versus flexible hoses, if the flexible hose has a transverse stiffness greater than the pipe it is connected to, there is no reason why it would reduce vibration transmission. There is the influence of the system’s inertia based on the mass provided by check and shutoff valves, strainers, etc., as well as the mass of the pipe filled with water directly after the flexible hose, but that is a variable. While it must help, it is an unknown.

1 1/2" X 9" COPPER FITTED HOSES



1 1/2" X 9" CROSS SECTION OF COPPER FITTED HOSES (Braid Removed to Reveal Active Corrugations)



Test Discussion

Our in-house capability does not include dynamic measurement. However, the following static data is the first publicized attempt to measure displacement forces as a basis for specifications. Despite recommendations to the contrary, the average pump installation has the hoses installed vertically.

The disturbing force is radial to the pump rotor. Since the hose is vertical, it is most effective when the unbalance is parallel to the floor and least when the force is vertical, as the hose is rigid in that direction. However, when the force is vertical, it is pushing or pulling the riser and in general, the riser and header are stiffer in that direction.

We continue to suggest two hoses at right angles to each other, or when only one hose is used, installed parallel to the axis of the pump, chiller, compressor, etc. While proper suggestions, we recognize piping restrictions often make it impossible.

The test results on pages 10•12 & 10•13 are the forces required to displace straight hose lengths 1/8" at three common pressures. These forces are compared to the resistance to 1/8" movement provided by 10 ft, 8 ft and 6 ft lengths of schedule 40 Steel Pipe.

We used our computerized Baldwin Universal Tester so we could test two hoses in parallel to prevent machine distortion. Long lengths of pipes were bolted to the flanges at each end and guided through rigid rollers, so the flanges were held parallel as in the field. Water pressure was introduced by a hydraulic pump and measurements taken at 0, 50, 100, 150, 200 and 250 psi. All readings were divided by 2 for single hose values. Since our hoses are all very close pitched and flexible, we believe competitive products would prove stiffer.

We tested a few hoses from the same lot and found variations. Therefore, our tabulations are only in the order of magnitude. We anticipated very large forces, but not as large as they turned out to be. Testing rig deflections lowered the 1/8" displacement values. 12" and larger data was not usable. 12", 14" and 16" numbers are extrapolations. We are rebuilding these jigs heavier and will publish corrected test information in the future. Similarly, very small sizes dropped below the testing machine's sensitivity, but they are in the proper direction.

In addition to corrugation count and configuration, live length rather than overall length is the stiffness control. All of our tables include this information. We have kept nipples as short as possible to maximize the flexible hose portion, but notice that a 1/2" x 61/2" MN has only 23/4" of live length, 11/4" x 81/2" only 31/4", 4" x 12" only 5". That is why the forces needed to move these "Pump Connector" lengths are so excessive. The live hose is so short that the connector has difficulty or finds it impossible to assume the shape shown in the bottom photograph on page 10•11.

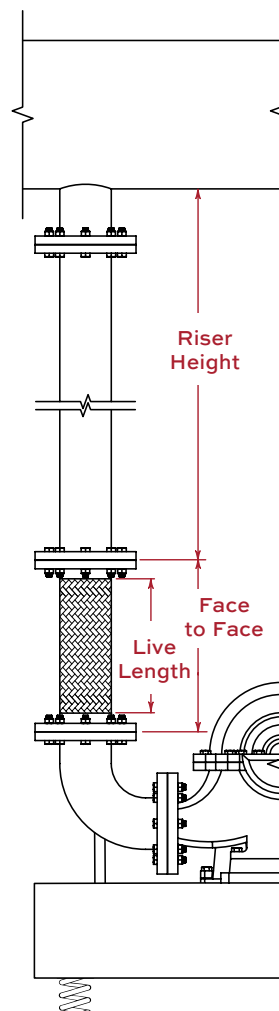
The lengths suggested in our specifications are based on experience. The height of equipment rooms controls the length of the risers. The pressure depends on the height of the building. It is hard to visualize 1/2" through 2" threaded hoses that would be connected to pumps or other equipment with long risers that go to the ceiling. They might not be connected to risers at all. Small lines seldom operate at more than 150 psi, because they service low buildings. Therefore, we are suggesting overall 24" lengths at 150 psi. These selections show the forces needed to

flex the hose are all below the stiffness of the pipe. The vibrating energy of small sized equipment is also lower and minimizes risk of serious transmission problems.

The same logic applies to the 2" through 4" sizes if we continue with the assumption that the pressure remains at 150 psi. However, at 250 psi, the hose stiffness increases dramatically. On virtually all major projects, the specifications allow for threaded nipples only through 2" diameter. So while we provide the force information for 2 1/2", 3" and 4" threaded nipple ends, our recommended lengths are based on flanged hoses in diameters of 2 1/2" and larger.

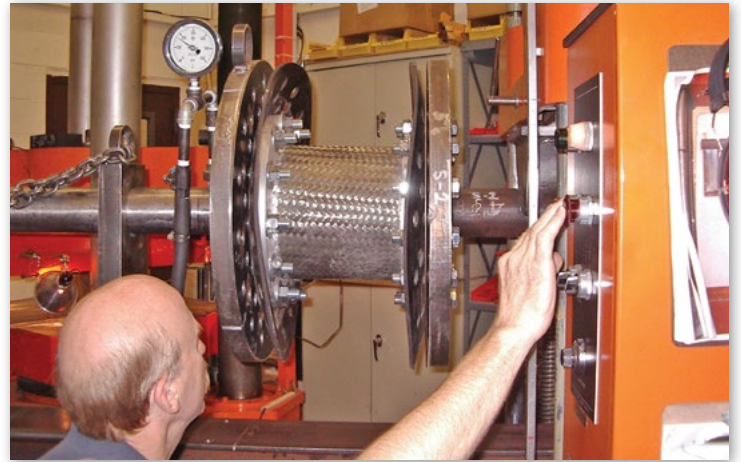
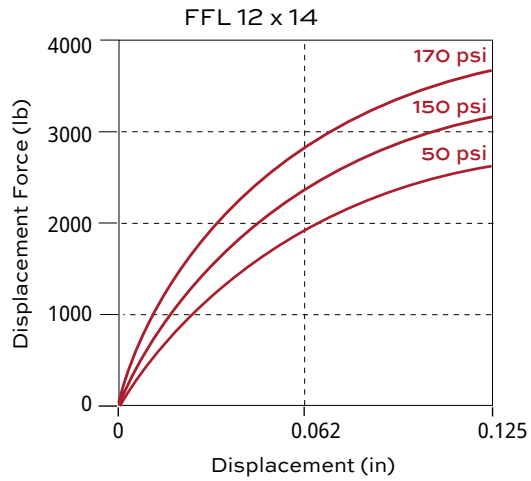
We have included copper pipe rather than ignoring it. However, copper tubing is both light and soft. Copper flexible hoses are better suited to allowing for thermal movement than reducing vibration.

Moving on to the larger diameter 2 1/2" through 16", we have to assume both higher pressures and longer risers. Typically a 4" pipe 8 ft long offers 90 lb resistance to 1/8" movement. A 4" x 24" flanged hose at 150 psi has a resistance of 105 lb, so it is too stiff. At 36" long, it drops to 50 lb and even at 250 psi, 80 lb, and still lower than the pipe stiffness. This sort of comparison is reasonable down through the study. A 36" FF length is about as long as practical because of valve heights and other problems. We are still synthesizing a great deal of information, so establishing one fixed length of 36" for 2 1/2" through 16" diameter appears to be a proper engineering choice at this time rather than an oversimplification.



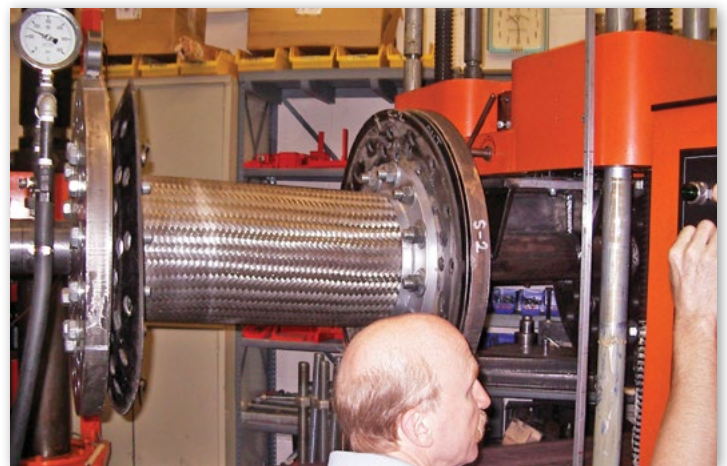
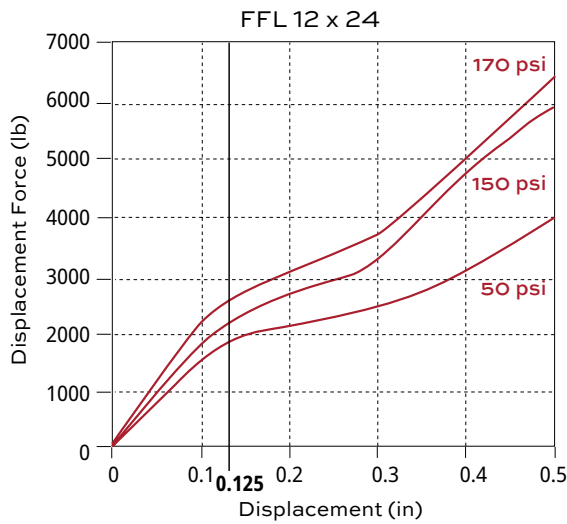
Typical vertical hose for purposes of illustration. Horizontal placement is preferable.

We do not recommend Industry Pump Connector Length. Displacement Force is 3690 lb/0.125" at 170 psi.



Typical Short Industry Pump Connector 12" x 14" at Maximum 0.125" Offset

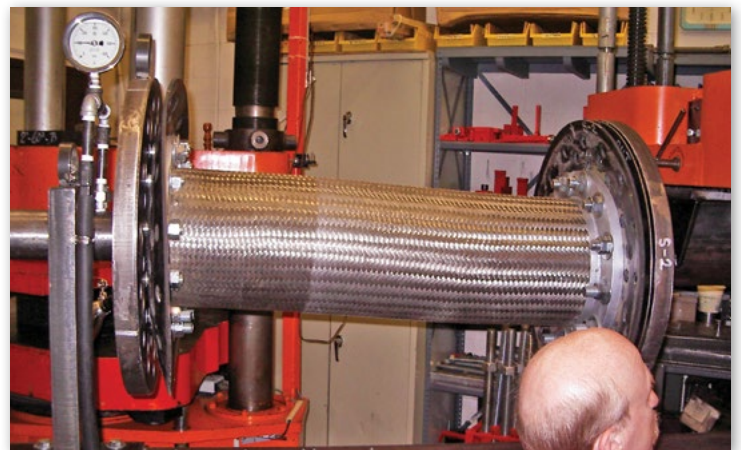
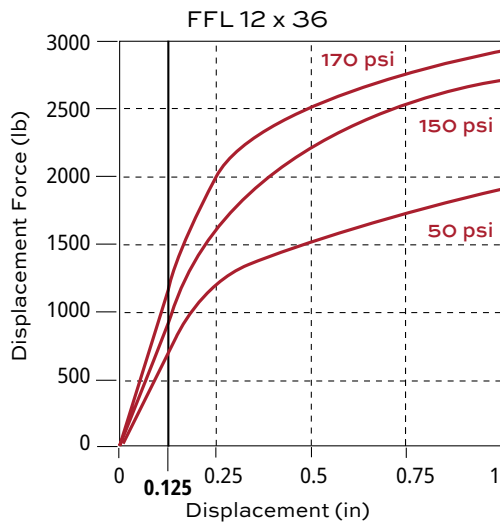
We also do not recommend 12 x 24 length. It is better than 12 x 14, but Displacement Force is still too high- 2650 lb/0.125" at 170 psi.



FFL 12 x 24 at 0.5" Offset

RECOMMENDED LENGTH

Displacement Force drops to 1150 lb/0.125" at 170 psi.



FFL 12 x 36 at 1" Offset

Baldwin Tester Report on Force Required to Displace 1/2" - 4" Nippled Hoses 1/8"
INFORMATION PROVIDED AS A GENERAL GUIDE TO MAGNITUDE

THREADED NIPPLE HOSES

MN Hose Dia. (in) (mm)		Length End to End (in) (mm)		Live Length (in) (mm)		Corrugations per (ft) (m)		Force Required for 1/8" (3mm) Displacement (lb (kg))											
								Hoses Water Pressure (psi (kg/cm ²))						Steel Pipe Schedule 40 Riser Length					
								(50 psi)	(3.4 kg)	(150 psi)	(10.3kg)	(250 psi)	(17.2kg)	(6 ft) (1.8m)	(8 ft) (2.4m)	(10ft) (3m)			
1/2	15	6 1/2	165	23/4	70	92	302	6.0	2.7	14.0	6.4	20.0	9.1						
1/2	15	12	305	8 1/4	210	92	302	0.8	0.4	0.8	0.4	1.0	0.5	0.5	.23	0.2	0.9	0.1	0.05
1/2	15	18	457	14 1/4	362	92	302	1.0	0.5	1.0	0.5	1.0	0.5	lb	kg	lb	kg	lb	kg
1/2	15	24	610	20 1/4	514	92	302	*0.3	*0.1	0.4	0.2	0.5	0.2						
3/4	20	7	178	3 1/4	83	80	262	10.0	4.5	18.0	8.2	25.0	11.3						
3/4	20	12	305	8 1/4	210	80	262	1.5	0.7	2.5	1.1	3.8	1.7	1.1	0.5	0.5	0.2	0.2	0.1
3/4	20	18	457	14 1/4	362	80	262	0.4	0.2	2.0	0.9	4.0	1.8	lb	kg	lb	kg	lb	kg
3/4	20	24	610	20 1/4	514	80	262	*—	*—	1.0	0.5	1.5	0.7						
1	25	8	203	3 3/4	95	72	236	13.0	5.9	30.0	13.6	50.0	22.7						
1	25	12	305	7 3/4	197	72	236	2.0	0.9	4.0	1.8	12.0	5.4	2.5	1.1	1.1	0.5	0.6	0.3
1	25	18	457	13 3/4	349	72	236	0.5	0.2	1.5	0.7	2.5	1.1	lb	kg	lb	kg	lb	kg
1	25	24	610	19 3/4	502	72	236	*0.5	*0.2	1.0	0.5	1.5	0.7						
1 1/4	32	8 1/2	216	3 1/4	83	67	220	50	23	110	50	180	82						
1 1/4	32	12	305	6 3/4	171	67	220	3.5	2	15	7	20	9	6	2.7	2.4	1.0	1.2	0.5
1 1/4	32	18	457	12 3/4	234	67	220	1.5	1	4	2	6.5	3	lb	kg	lb	kg	lb	kg
1 1/4	32	24	610	18 3/4	476	67	220	—	—	2.5	1	3.5	2						
1 1/2	40	9	229	3 3/4	95	63	207	120	54	250	113	310	141						
1 1/2	40	12	305	6 3/4	171	63	207	20	9	60	27	105	48	9	4	4	2	2	0.9
1 1/2	40	18	457	12 3/4	234	63	207	5	2	15	7	23	10	lb	kg	lb	kg	lb	kg
1 1/2	40	24	610	18 3/4	476	63	207	3	1	6	3	8	4						
2	50	10 1/2	267	4 1/2	114	58	190	180	82	360	163	460	209						
2	50	12	305	6	152	58	190	120	54	265	120	400	181	20	9	8	4	4	2
2	50	18	457	12	305	58	190	20	9	60	27	90	41	lb	kg	lb	kg	lb	kg
2	50	24	610	18	457	58	190	6	3	15	7	23	10						
2 1/2	65	12	305	5	127	48	157	220	100	360	163	475	216	45	20	20	9	10	4
2 1/2	65	18	457	11	279	48	157	30	14	80	36	120	54	lb	kg	lb	kg	lb	kg
2 1/2	65	24	610	17	432	48	157	10	5	25	11	40	18						
3	75	12	305	5	127	46	151	350	159	600	272	750	340	90	40	35	17	20	9
3	75	18	457	11	279	46	151	100	45	190	86	250	113	lb	kg	lb	kg	lb	kg
3	75	24	610	17	432	46	151	35	16	70	32	110	50						
4	100	12	305	5	127	32	105	500	227	825	374	900	408	210	96	90	40	45	21
4	100	18	457	11	279	32	105	150	68	305	138	400	181	lb	kg	lb	kg	lb	kg
4	100	24	610	17	432	32	105	110	50	175	79	260	118						

*Adjusted for testing sensitivity.



Baldwin Tester Report on Force Required to Displace 1 1/2" - 16" Flanged Hoses 1/8"

INFORMATION PROVIDED AS A GENERAL GUIDE TO MAGNITUDE

FLANGED END HOSES

FFL Hose Dia. (in) (mm)		Length Face to Face (in) (mm)		Live Length (in) (mm)		Corrugations per (ft) (m)		Force Required for 1/8" (3mm) Displacement (lb (kg))									
								Hoses Water Pressure (psi (kg/cm ²))				Steel Pipe Schedule 40 Riser Length					
								(50 psi)	(3.4 kg)	(150 psi) (10.3kg)	(250 psi) (17.2kg)	(6 ft) (1.8m)	(8 ft) (2.4m)	(10ft) (3m)			
11/2	40	9	229	67/8	175	63	207	20	9	55	25	85	39				
11/2	40	12	305	97/8	251	63	207	8	4	27	12	42	19	9	4	4	2
11/2	40	18	457	157/8	403	63	207	3	1	10	5	16	7	lb	kg	lb	kg
11/2	40	24	610	217/8	556	63	207	2	1	6	2	6	2			2	1
2	50	9	229	61/8	156	58	190	60	27	125	57	185	84				
2	50	12	305	91/8	232	58	190	22	10	57	26	95	43	20	9	8	4
2	50	18	457	151/8	384	58	190	6	3	18	8	29	13	lb	kg	lb	kg
2	50	24	610	211/8	537	58	190	3	1	10	5	15	7			4	2
2 1/2	65	9	229	61/8	156	48	157	145	66	275	125	380	173				
2 1/2	65	12	305	91/8	232	48	157	45	20	100	45	140	64	45	21	20	9
2 1/2	65	18	457	151/8	384	48	157	15	7	45	20	75	34	lb	kg	lb	kg
2 1/2	65	24	610	211/8	537	48	157	7	3	25	11	35	16			10	5
3	75	9	229	61/8	156	46	151	225	102	475	215	575	261				
3	75	12	305	91/8	232	46	151	105	48	245	111	320	145				
3	75	18	457	151/8	384	46	151	30	14	105	48	130	59	90	40	35	17
3	75	24	610	211/8	537	46	151	15	7	55	25	80	36	lb	kg	lb	kg
3	75	*36	*914	331/8	841	46	151	10	5	35	16	50	23			20	9
								(50 psi)	(3.4 kg)	(100 psi)	(6.9kg)	(200 psi)	(13.8kg)				
4	100	9	229	61/8	156	32	105	490	222	620	281	700	318				
4	100	12	305	91/8	232	32	105	220	100	385	175	505	229				
4	100	18	457	151/8	384	32	105	65	30	155	70	210	96	210	96	90	41
4	100	24	610	211/8	537	32	105	40	18	105	48	155	70	lb	kg	lb	kg
4	100	36	914	331/8	841	32	105	20	9	50	23	80	36			45	21
5	125	12	305	87/8	225	29	95	440	200	650	295	750	340				
5	125	18	457	147/8	378	29	95	190	86	355	161	420	191	440	201	190	85
5	125	24	610	207/8	530	29	95	85	39	195	89	225	102	lb	kg	lb	kg
5	125	36	914	327/8	835	29	95	65	30	135	61	150	68			95	44
6	150	12	305	87/8	225	25	82	675	306	950	431	1050	476				
6	150	18	457	147/8	378	25	82	445	202	670	304	750	340	820	371	350	157
6	150	24	610	207/8	530	25	82	170	76	450	204	505	229	lb	kg	lb	kg
6	150	36	914	327/8	835	25	82	70	32	155	70	180	82			180	81
								(50 psi)	(3.4 kg)	(150 psi)	(10.3kg)	(180 psi)	(12.4kg)				
8	200	12	305	85/8	219	23	75	1200	544	1450	658	1680	760				
8	200	18	457	145/8	371	23	75	710	322	1250	567	1290	585	2110	958	890	405
8	200	24	610	205/8	524	23	75	325	147	750	340	850	386	lb	kg	lb	kg
8	200	36	914	325/8	829	23	75	155	70	400	181	425	193			455	207
								(50 psi)	(3.4 kg)	(150 psi)	(10.3kg)	(170 psi)	(11.7kg)				
10	250	13	330	95/8	244	21	69	1870	848	2200	998	2590	1175				
10	250	18	457	145/8	371	21	69	1345	610	1580	717	1860	844	4690	2128	1980	898
10	250	24	610	205/8	524	21	69	900	408	1060	481	1250	567	lb	kg	lb	kg
10	250	36	914	325/8	829	21	69	570	259	680	308	800	363			1010	460
12	300	*14	*256	105/8	270	20	66	2670	1211	3140	1424	3690	1674				
12	300	*24	*610	205/8	524	20	66	1920	871	2250	1021	2650	1202	8130	3688	3430	1556
12	300	*36	*914	325/8	829	20	66	830	376	980	445	1150	522	lb	kg	lb	kg
14	350	*14	*256	105/8	270	18	59	3970	1801	4675	2121	5500	2495				
14	350	*36	*914	325/8	829	18	59	2370	1075	2780	1261	3270	1483	10900	4930	4600	2080
16	400	*16	*406	125/8	321	16	52	5200	2359	6120	2776	7200	3266				
16	400	*36	*914	325/8	829	16	52	2860	1297	3370	1529	3960	1796	16400	7430	6900	3134

*Not tested. Best estimates.

SPECIFICATION

Flexible stainless steel hoses with a safety factor of 4 shall be manufactured using Type 304 stainless steel braided hose with one fixed and one floating raised face carbon steel plate flange. Sizes 2 1/2" (65mm) and smaller may have threaded nipples. Copper sweat ends, 4" (100mm) and smaller, may have SS (gas service) or Bronze (water service) bodies. Grooved ends may be used in sizes 2" (50mm) through 12" (300mm). Welding is not acceptable. Minimum lengths, minimum live lengths and minimum number of convolutions per foot to assure flexibility are as tabulated. Shorter lengths are not acceptable.

Hoses shall be installed on the equipment side of the shut-off valves horizontal and parallel to the equipment shafts wherever possible.

Submittals shall include original test data showing force/displacement, fittings, material, live lengths, number of corrugations per foot, and safety factor at pressure ratings. Hoses shall be Type **BSS** or **CPSB** as manufactured by Mason Industries, Inc.

Pipe or Tubing Size (in) (mm)	Flanged		Threaded		Grooved Ends		Copper Sweat Bronze		Min. Convolutions per (ft) (m)			
	Face to Face (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	(ft)	(m)		
1/2 15	—	—	24	610	193/4	502	—	—	18	457	141/4 362	92 302
3/4 20	—	—	24	610	193/4	502	—	—	18	457	133/4 349	80 262
1 25	—	—	24	610	193/4	502	—	—	18	457	133/8 340	72 236
1 1/4 30	—	—	24	610	183/4	476	—	—	18	457	131/4 337	67 220
1 1/2 40	24	610	217/8	556	24	610	183/4	476	—	—	13 330	63 207
2 50	24	610	211/8	537	24	610	18	457	24	610	18 457	58 190
2 1/2 65	24	610	211/8	537	24	610	17	432	24	610	18 457	48 157
3 80	36	914	331/8	841	36	914	29	737	36	914	30 762	46 151
4 100	36	914	331/8	841	36	914	29	737	36	914	28 711	32 105
5 125	36	914	327/8	835	—	—	—	—	36	914	28 711	29 95
6 150	36	914	327/8	835	—	—	—	—	36	914	28 711	25 82
8 200	36	914	325/8	829	—	—	—	—	36	914	28 711	23 75
10 250	36	914	325/8	829	—	—	—	—	36	914	26 660	21 69
12 300	36	914	325/8	829	—	—	—	—	36	914	26 660	20 66
14 350	36	914	325/8	829	—	—	—	—	—	—	—	18 59
16 400	36	914	325/8	829	—	—	—	—	—	—	—	16 52

*Sweat ends on bronze hose have not been tested. We believe copper lines are so ductile and light, hoses only allow for offset, so longer than Pump Connector lengths are justified, but very long lengths would be overkill.

PRODUCT TABLES

The tables on the following pages cover stock lengths. We describe capability in terms of allowable offset and normal vibration. Normal vibration is the amplitude you would expect at pump, chiller, air compressor connections, etc. These lengths do not describe what is needed for seismic motion on isolated machinery. We would be more than pleased to design to requirements for any special lengths, but the basic rule is the longer the length, the lower the transmitted vibration.

Of all fittings used with stainless steel hoses, the most common are two threaded ends or two flanges. Flexibility depends not

on the overall length, but on the live length of hose between the braid rings. In terms of vibration transmission and allowable movement, flanged connectors of the same length are superior to nipple ends of one kind or another. The nipples are longer than the flanges are thick, and the same braid ring is used in both cases. So for a given length, flanged hose has longer live hose. It is important that you know the live length you are buying, so this information is included in all of our descriptive tables.

All ratings are extremely conservative. We sometimes allow more motion for a given length when we know specifics.



QUALITY CONTROL APPROVALS AS NOTED

Mason Hoses are also available with CSA approval for natural gas, UL approval for fire protection (UL) & potable water (NSF), and NFPA approval for medical gas (MG) as follows.

CSA Series– CSAMN, CSAWN & CSAFFL

Special Tested, Inspected and Tagged Gas Hoses

Everyone is concerned when installing flexible hose in flammable gas or liquid lines because of the risk of both asphyxiation and fire. Approved by the CSA, the successor to the American Gas Association, and complying with UL 536 provides that assurance. Tests include vibration 300 hours at 15 Hz, 90° bends at rated pressure @ 10 cpm for 20,000 cycles, elongation and tension, 450°F (232°C) for 100 hours as well as flame resistance. All of our standard hoses 1/2" through 4" diameter passed and can be used in straight, looped or Vee configurations. However, in addition to the general UL approval, all specific hoses must be rechecked with an approved thread gauge, if threaded, and retested to 50% above rated pressure using water or rated pressure using air. It must be clearly identified as a Mason product and tagged with maximum pressure rating and minimum bend radius.



These assemblies have been "CSA" approved for use on gas pipelines. "CSA" is the current certification agency for gas industry products, assuming the authority formerly associated with the American Gas Association (AGA).

Our Certification Report is #230720-1764990. This Certification meets all requirements of ANSI/UL #536- 1997 Standards for Flexible Metal Hose.

All dimensions are the same as standard products.
Rated Pressure @ 70°F (21°C) is 175 psi (12kg/cm²).

UL Series– MN-UL, FFL-UL, GWN-UL & CPSB-UL

Special Tested, Inspected and Tagged Hoses for Sprinkler and Fire Protection Systems

Mason Industries is proud to announce that our braided hoses have passed the stringent UL (Underwriters Laboratories) testing and are now certified for use for Wet & Dry Fire Protection Systems. To receive this prestigious certification our material was subjected to many tests including stress, flexing, low temperature and high pressure testing. We have also completed extensive in house testing on all our materials to determine safe working pressures as well as spring rates and allowable movements.

UL approved products are acceptable on all fire protection systems designed to the stringent NFPA 13 (National Fire Protection Agency) code requirements. We have included every possible attachment in the certification, including grooved, threaded, welded, and ASA 150 and 300 lb flanges, so you are covered regardless of how you decide to install your system.

All dimensions are the same as standard products.
Rated Pressure @ 70°F (21°C) is 175 psi (12kg/cm²).



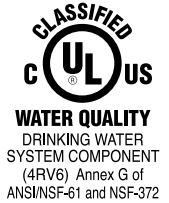
FLEXIBLE JOINT FITTINGS
3VX9

NSF Series– MNSS-NSF, FFLSS-NSF & CPSB-NSF

Special Tested, Inspected and Tagged Hoses for Low Lead Water Quality Annex G of ANSI/NSF-61 and NSF-372

Mason was the first company in the industry to be approved by UL (Underwriters Laboratory) as manufacturers of braided hoses with the new NSF/ANSI-372 low lead requirements for drinking water. We originally were listed to NSF/ANSI-61 which included the summation provision in Annex G. Then California added a new law, AB1953, which later became HB116875, which changed again the definition of low lead. Mason Hoses meet all of these listings.

LEAD FREE: The surface contacted by consumable water contains less than one quarter of one percent (0.25%) of lead by weight. These flexible joint fitting assemblies are UL Listed under File MH48651 and are intended for installation in accordance with the Mason installation instructions and the applicable requirements in Annex G of ANSI/NSF-61 and NSF-372.



WARNING! If disinfecting (chlorinating) is required per the International Plumbing Code, AWWA C651, and AWWA C652, then tablets and granular chlorine (calcium hypochlorite), and chlorine for swimming pool disinfection CANNOT be used on our products. We recommend chlorinating with diluted liquid chlorine (sodium hypochlorite) and immediately flushing thoroughly with potable water, as defined in the above Code. All traces of chlorine must be removed, since residual chlorine will cause corrosion and lead to premature failure of our products. Failure to do so will void our warranty. Mason recommends installing hoses vertically where feasible to promote drainage of chlorine.

All dimensions and pressures the same as standard products.

MG Series– CPSB-MG

Hoses Cleaned for Medical Gas

CPSB-MG hoses are cleaned and bagged for medical gas applications. Manufactured in accordance with NFPA99 Requirements.



MN- SS Braided Hose with Carbon Steel Threaded Nipples

Available in Stainless Steel, CSA, NSF, and UL (See page 10-15)

Our steam service ratings are very low in the interest of safety although our 70°F (21°C) pressure ratings are as high or higher than our competitors. All locations where failure could lead to personal injury or suffocation must be avoided. In dangerous locations we suggest housed expansion joints, solid loops, ball joints, packed devices, etc. rather than thin-walled flexible products regardless of manufacturer.

Consult factory with full location description as well as service conditions for higher pressure or temperature applications.

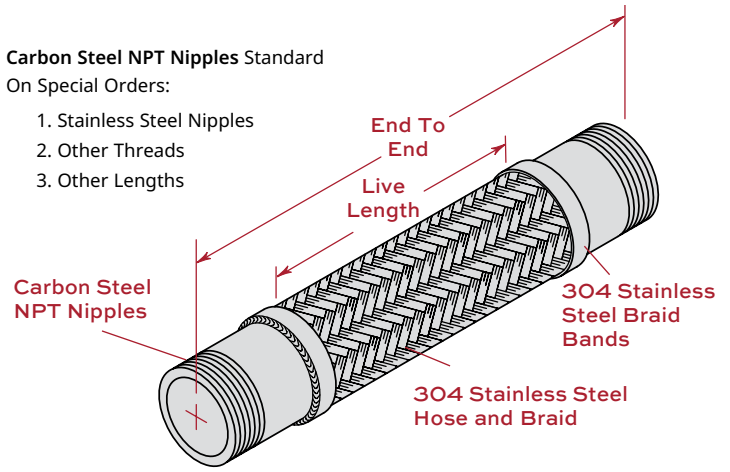
304 SS can be used up to 850°F (454°C) in applications such as engine exhaust.

When using these products in copper or brass water or steam systems, dielectric couplings must be used on each end to prevent leakage from galvanic action.

Carbon Steel NPT Nipples Standard

On Special Orders:

1. Stainless Steel Nipples
2. Other Threads
3. Other Lengths



STOCK SIZES & LENGTHS

TYPE MN DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & End to End		Live Length		Corrugations per		Maximum Lateral Offset		Force Req'd for Max. Offset at 250 psi (17kg/cm ²) or Lower Rated Pressure		Rated Pressure @70°F @21°C	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(lb)	(kg)	(psi)	(kg/cm ²)
MN-	1/2 x 61/2*	15 x 165*	25/8	67	92	302	1/8	3	20	9	1100	77
	1/2 x 12	15 x 305	81/8	207	92	302	11/4	32	9	4	1100	77
	1/2 x 18	15 x 457	141/8	359	92	302	4	102	7	3	1100	77
	1/2 x 24	15 x 610	201/8	512	92	302	71/2	191	6	3	1100	77
	1/2 x 36	15 x 914	321/8	816	92	302	16	406	0	3	1100	77
	3/4 x 7*	20 x 178*	31/8	80	80	262	1/8	3	25	11	700	49
	3/4 x 12	20 x 305	81/8	207	80	262	1	29	12	5	700	49
	3/4 x 18	20 x 457	141/8	359	80	262	21/4	89	9	4	700	49
	3/4 x 24	20 x 610	201/8	512	80	262	31/4	176	8	3	700	49
	3/4 x 36	20 x 914	321/8	816	80	262	14	356	0	0	700	49
	1 x 8*	25 x 203*	35/8	93	72	236	1/8	3	50	23	580	40
	1 x 12	25 x 305	75/8	194	72	236	1	25	25	11	580	40
	1 x 18	25 x 457	135/8	347	72	236	3	76	9	4	580	40
	1 x 24	25 x 610	195/8	499	72	236	61/2	165	8	3	580	40
	1 x 36	25 x 914	315/8	804	72	236	11	279	0	0	580	40
	11/4 x 81/2*	32 x 216*	35/8	94	67	220	1/8	3	180	82	480	33
	11/4 x 12	32 x 305	71/8	183	67	220	3/4	19	35	16	480	33
	11/4 x 18	32 x 457	131/8	335	67	220	21/4	57	18	8	480	33
	11/4 x 24	32 x 610	191/8	488	67	220	5	127	13	6	480	33
	11/4 x 36	32 x 914	311/8	792	67	220	10	254	0	6	480	33
	11/2 x 9*	40 x 229*	41/8	107	63	207	1/8	3	310	141	450	31
	11/2 x 12	40 x 305	71/8	183	63	207	5/8	16	170	77	450	31
	11/2 x 18	40 x 457	131/8	335	63	207	2	51	110	50	450	31
	11/2 x 24	40 x 610	191/8	488	63	207	41/2	214	30	14	450	31
	11/2 x 36	40 x 914	311/8	792	63	207	9	229	0	0	450	31
	2 x 101/2*	50 x 267*	51/4	135	58	190	1/8	3	460	209	360	25
	2 x 12	50 x 305	63/4	173	58	190	3/8	10	225	102	360	25
	2 x 18	50 x 457	123/4	325	58	190	11/2	38	125	57	360	25
	2 x 24	50 x 610	183/4	478	58	190	33/4	95	60	27	360	25
	2 x 36	50 x 914	303/4	782	58	190	8	203	0	0	360	25
	21/2 x 12*	65 x 305*	5	127	48	157	1/8	3	475	215	290	20
	21/2 x 18	65 x 457	11	279	48	157	11/4	32	325	147	290	20
	21/2 x 24	65 x 610	17	432	48	157	3	76	160	73	290	20
	21/2 x 36	65 x 914	29	737	48	157	7	178	0	0	290	20
	3 x 12*	80 x 305*	5	127	46	151	1/8	3	750	340	280	19
	3 x 18	80 x 457	11	279	46	151	1	25	600	272	280	19
	3 x 24	80 x 610	17	432	46	151	21/2	65	390	177	280	19
	3 x 36	80 x 914	29	737	46	151	6	152	0	41	280	19
	4 x 12*	100 x 305*	5	127	32	105	1/8	3	900	408	225	15
	4 x 18	100 x 457	11	279	32	105	1/2	19	800	363	225	15
4 x 24	100 x 610	17	432	32	105	3/4	44	450	204	225	15	
4 x 36	100 x 914	29	737	32	105	5	127	0	91	225	15	

RATED PRESSURES @ ELEVATED TEMPERATURES (psi) (kg/cm²)

Hose Size (in) (mm)	Factor 0.92 (250°F) (121°C)		Factor 0.86 (350°F) (176°C)		Factor 0.81 (450°F) (232°C)	
	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)
1/2 15	1010	69	950	65	890	61
3/4 20	640	44	600	41	570	39
1 25	530	36	500	34	470	32
11/4 32	460	32	430	30	400	28
11/2 40	400	28	370	26	350	24
2 50	330	23	310	21	290	20
21/2 65	270	19	250	17	235	16
3 80	260	18	240	16	230	16
4 100	210	15	200	14	190	12

SATURATED STEAM RECOMMENDED PRESSURE LIMITS

Size (in) (mm)	Max Gauge (psi) (kg/cm ²)		Temp Ref. (°F) (°C)	
	(psi)	(kg/cm ²)	(°F)	(°C)
1/2 15	200	14	387	197
3/4 20	200	14	387	197
1 25	150	11	362	183
11/4 32	150	11	362	183
11/2 40	150	11	362	183
2 50	150	11	362	183
21/2 65	125	9	355	179
3 80	125	9	355	179
4 100	125	9	355	179

Sizes in **Bold** are Minimum Recommended Lengths at Equipment Connections to Reduce Vibration Transmission. See discussion on pages 10-10 - 10-13.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application. Consult factory on all vacuum applications.

End to End Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

*Industry Pump Connector Lengths are not recommended, but supplied on demand.



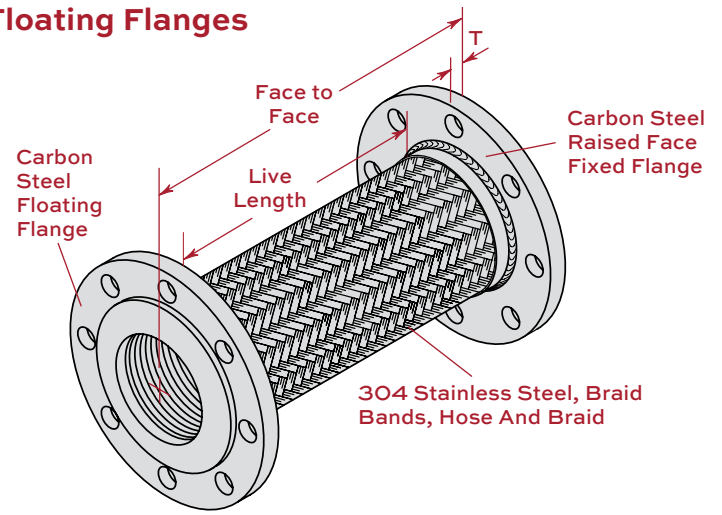
FFL- SS Braided Hose with Carbon Steel Fixed & Floating Flanges

Available in CSA, NSF, and UL (See page 10-15)

FFL Braided Stainless Steel Hose has fixed and floating raised face flanges. Years ago, almost all stainless steel hose was manufactured with a floating flange on one end. It is still important because it makes lining up the holes easier during installation, and eliminates the possibility of twisting the hose, when the holes do not line up. Twisting contributes to early failure.

Raised face flanges seal better. Most competitive plate flanges have flat faces to reduce machining costs, but the raised face is the better product as sealing pressure increases by factors of 2 & 3 because of the reduced gasket area.

All of our stocked flanged hoses have one floating flange.



STOCK SIZES & LENGTHS

TYPE FFL DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & Face to Face		Live Length		Corrugations per		Maximum Lateral Offset		Force Req'd for Max. Offset at 250 psi (17kg/cm ²) or Lower Rated Pressure		Rated Pressure @70°F @21°C	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(lb)	(kg)	(psi)	(kg/cm ²)
FFL-	11/2 x 9*	40 x 229*	63/4	171	63	207	1/8	3	83	38	450	31
	11/2 x 12	40 x 305	93/4	248	63	207	11/4	32	85	39	450	31
	11/2 x 18	40 x 457	153/4	400	63	207	31/2	89	40	18	450	31
	11/2 x 24	40 x 610	213/4	552	63	207	61/2	165	30	14	450	31
	2 x 9*	50 x 229*	63/4	171	58	190	1/8	3	185	84	360	25
	2 x 12	50 x 305	93/4	248	58	190	11/8	29	180	82	360	25
	2 x 18	50 x 457	153/4	400	58	190	21/2	64	80	36	360	25
	2 x 24	50 x 610	213/4	552	58	190	5	127	45	20	360	25
	2 1/2 x 9*	65 x 229*	6	152	48	157	1/8	3	380	171	290	20
	2 1/2 x 12	65 x 305	9	248	48	157	1	25	345	156	290	20
	2 1/2 x 18	65 x 457	15	400	48	157	21/4	57	215	98	290	20
	2 1/2 x 24	65 x 610	21	552	48	157	43/4	121	110	50	290	20
	3 x 9*	80 x 229*	6	152	46	151	1/8	3	575	259	280	19
	3 x 12	80 x 305	93/4	248	46	151	7/8	22	770	349	280	19
	3 x 18	80 x 457	153/4	400	46	151	2	51	335	152	280	19
	3 x 24	80 x 610	213/4	552	46	151	4	102	205	93	280	19
	3 x 36	80 x 914	333/4	857	46	151	8	203	100**	45**	280	19
	4 x 9*	100 x 229*	6	152	32	105	1/8	3	700	319	225	15
	4 x 12	100 x 305	93/4	248	32	105	3/4	19	1155	524	225	15
	4 x 18	100 x 457	153/4	400	32	105	11/2	38	525	238	225	15
	4 x 24	100 x 610	213/4	552	32	105	31/2	89	485	220	225	15
	4 x 36	100 x 914	333/4	857	32	105	7	178	220**	100**	225	15
	5 x 12*	125 x 305*	83/4	222	29	95	1/8	3	750	340	200	14
	5 x 18	125 x 457	143/4	375	29	95	11/4	32	710	322	200	14
	5 x 24	125 x 610	203/4	527	29	95	21/4	57	575	261	200	14
	5 x 36	125 x 914	323/4	832	29	95	51/2	140	430	195	200	14
	6 x 12*	150 x 305*	83/4	222	25	82	1/8	3	1050	476	200	14
	6 x 18	150 x 457	143/4	375	25	82	1	25	2175	987	200	14
	6 x 24	150 x 610	203/4	527	25	82	2	51	1485	674	200	14
	6 x 36	150 x 914	323/4	832	25	82	5	127	620	281	200	14
8 x 12*	200 x 305*	81/2	216	23	75	1/8	3	1680	762	200	14	
8 x 18	200 x 457	141/2	368	23	75	7/8	22	3280	1488	200	14	
8 x 24	200 x 610	201/2	521	23	75	11/2	32	3180	1442	200	14	
8 x 36	200 x 914	321/2	832	23	75	4	102	1405	637	200	14	
10 x 13*	250 x 330*	91/2	241	21	69	1/8	3	2590	1175	170	11	
10 x 18	250 x 457	141/2	368	21	69	3/4	19	3750	1701	170	11	
10 x 24	250 x 610	201/2	521	21	69	11/4	32	4020	1823	170	11	
10 x 36	250 x 914	321/2	826	21	69	3	76	2230	1012	170	11	
12 x 14*	300 x 356*	101/2	267	20	66	1/8	3	3690	1674	170	11	
12 x 24	300 x 610	201/2	521	20	66	1	25	4950	2245	170	11	
12 x 36	300 x 914	321/2	826	20	66	21/2	64	2960	1343	170	11	
14 x 14*	350 x 356*	101/2	267	18	59	1/8	3	5500	2495	170	11	
14 x 36	350 x 914	321/2	826	18	59	11/4	32	12000	5443	170	11	
16 x 16*	400 x 406*	121/2	318	16	52	1/8	3	7200	3266	170	11	
16 x 36	400 x 914	321/2	826	16	52	1	25	15000	6804	170	11	

CARBON STEEL PLATE FLANGE THICKNESS

Pipe Size		Flange Thickness T
(in)	(mm)	(in) (mm)
1 1/2 thru 4	40 thru 100	5/8 16
5 thru 6	125 thru 150	3/4 19
8 thru 16	200 thru 400	1 25

Carbon Steel Fixed and Floating Flanges ASA-150 Standard

On Special Orders:

1. Other Drillings
2. Other Lengths

For Rated Pressures @ Elevated Temperatures and Saturated Steam Recommended Pressure Limits, see page 10-18.

Sizes in **Bold** are Minimum Recommended Lengths at Equipment Connections to Reduce Vibration Transmission. See discussion on pages 10-10 - 10-13.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application. Consult factory on all vacuum applications.

Face to Face Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

Sizes 12" - 16" (300 - 400mm) have double braid.

*Industry Pump Connector Lengths are not recommended, but supplied on demand.

**Estimated.

FFLSS- SS Braided Hose with Stainless Steel Fixed & Floating Flanges

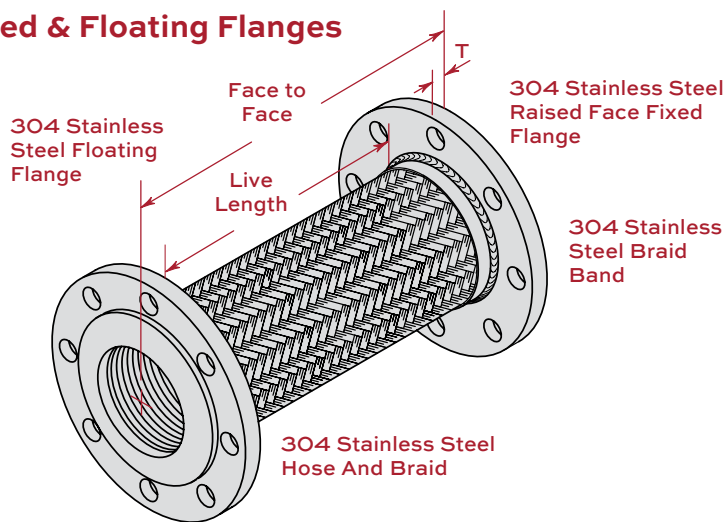
Available in NSF (See page 10-15)

Our steam service ratings are very low in the interest of safety although our 70°F (21°C) pressure ratings are as high, or higher, than our competitors. All locations where failure could lead to personal injury or suffocation must be avoided. In dangerous locations we suggest housed expansion joints, solid loops, ball joints, packed devices, etc. rather than thin-walled flexible products regardless of manufacturer.

Consult factory with full location description as well as service conditions for higher pressure or temperature applications.

304 SS can be used up to 850°F (454°C) in applications such as engine exhaust with minor pressure.

When using these products in copper or brass water or steam systems, dielectric flanges must be used on each end to prevent leakage from galvanic action.



STOCK SIZES & LENGTHS

TYPE FFLSS DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & Face to Face		Live Length		Corrugations per		Maximum Lateral Offset		Force Req'd for Max. Offset at 250 psi (17kg/cm ²) or Lower Rated Pressure		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(lb)	(kg)	@70°F (psi)	@21°C (kg/cm ²)
FFLSS-	2 x 12	50 x 305	9 3/4	248	58	190	1 1/8	29	180	82	360	25
	2 1/2 x 12	65 x 305	9	229	48	157	1	25	345	156	290	20
	3 x 12	80 x 305	9	229	46	151	7/8	22	770	349	280	19
	4 x 12	100 x 305	9	229	32	105	3/4	19	1155	524	225	15
	4 x 18	100 x 457	15	381	32	105	1 1/2	38	525	238	225	15
	5 x 18	125 x 457	14 3/4	375	29	95	1 1/8	29	710	322	200	14
	6 x 18	150 x 457	14 3/4	375	25	82	1	25	2175	987	200	14
	8 x 24	200 x 610	19 7/8	521	23	75	1 1/2	38	3180	1488	200	14
	10 x 24	250 x 610	19 7/8	521	21	69	1 1/4	32	4020	1175	170	11
	12 x 24	300 x 610	19 7/8	521	20	66	1	25	4950	1674	170	11

STAINLESS STEEL PLATE FLANGE THICKNESS

Pipe Size		Flange Thickness T	
(in)	(mm)	(in)	(mm)
2 thru 4	50 thru 100	5/8	16
5 thru 6	125 thru 150	3/4	19
8 thru 12	200 thru 300	1	25

Stainless Steel Fixed and Floating Flanges ASA-150 Drilling Standard

On Special Orders:

1. Other Drillings
2. Other Lengths

Face to Face Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%. Sizes 12" (300mm) have double braid.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application. Consult factory on all vacuum applications.

NOTE: In applications calling for stainless flanges and meeting special overall vibration reduction lengths, order to specified lengths.

RATED PRESSURE @ ELEVATED TEMPERATURES FOR FFL & FFLSS

RATED PRESSURES @ ELEVATED TEMPERATURES (psi) (kg/cm²)

Hose Size (in) (mm)	Factor 0.92 (250°F) (121°C)		Factor 0.86 (350°F) (176°C)		Factor 0.81 (450°F) (232°C)	
	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)
1 1/2	40	400	28	370	26	350
2	50	330	23	310	21	290
2 1/2	65	270	19	250	17	235
3	80	260	18	240	16	230
4	100	210	15	200	14	190
5	125	190	13	180	12	170
6	150	190	13	180	12	170
8	200	190	13	180	12	170
10	250	160	11	150	10	140
12	300	160	11	150	10	140
14	350	160	11	150	10	140
16	400	160	11	150	10	140

SATURATED STEAM RECOMMENDED PRESSURE LIMITS

Size (in) (mm)	Max Gauge (psi) (kg/cm ²)		Temp Ref. (°F) (°C)	
	(psi)	(kg/cm ²)	(°F)	(°C)
1 1/2	40	150	11	362
2	50	150	11	362
2 1/2	65	125	9	355
3	80	125	9	355
4	100	125	9	355
5	125	100	7	337
6	150	100	7	337
8	200	75	5	320
10	250	60	4	307
12	300	60	4	307
14	350	60	4	307
16	400	60	4	307

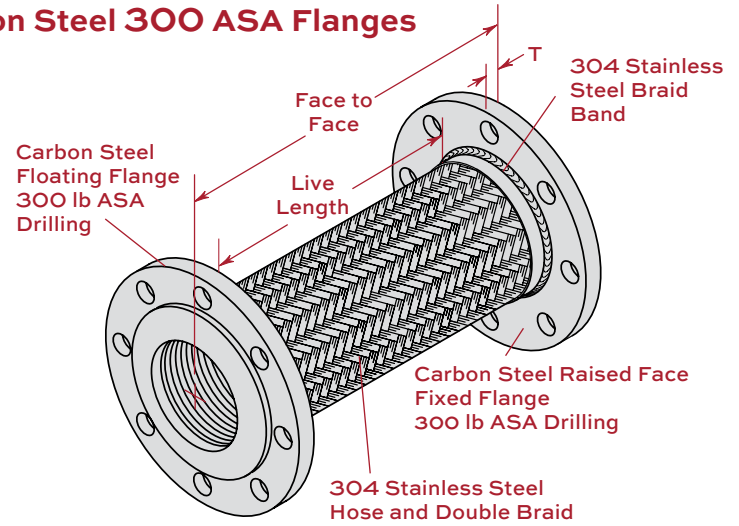
FFL2B300– SS Double Braided Hose with Carbon Steel 300 ASA Flanges

Our steam service ratings are very low in the interest of safety although our 70°F (21°C) pressure ratings are as high, or higher, than our competitors. All locations where failure could lead to personal injury or suffocation must be avoided. In dangerous locations we suggest housed expansion joints, solid loops, ball joints, packed devices, etc. rather than thin-walled flexible products regardless of manufacturer.

Consult factory with full location description as well as service conditions for higher pressure or temperature applications.

304 SS can be used up to 850°F (454°C) in applications such as engine exhaust with minor pressure.

When using these products in copper or brass water or steam systems, dielectric flanges must be used on each end to prevent leakage from galvanic action.



STOCK SIZES & LENGTHS

TYPE FFL2B300 DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & Face to Face		Live Length		Corrugations per		Maximum Permanent Lateral Offset		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	@70°F (psi)	@21°C (kg/cm ²)
FFL2B300-	2 x 12	50 x 305	93/8	238	58	190	1	25	500	35
	2 1/2 x 12	65 x 305	87/8	225	48	157	7/8	22	500	35
	3 x 12	80 x 305	87/8	225	46	151	3/4	19	375	26
	4 x 12	100 x 305	87/8	225	32	105	5/8	16	375	26
	4 x 18	100 x 457	147/8	378	32	105	1 1/4	32	375	26
	5 x 18	125 x 457	141/4	362	29	95	1 1/8	29	375	26
	6 x 18	150 x 457	141/4	362	25	82	7/8	22	375	26
	8 x 24	200 x 610	191/2	495	23	75	1 1/4	32	235	16
	10 x 24	250 x 610	191/2	495	21	69	1 1/8	29	210	14
	12 x 24	300 x 610	191/2	495	20	66	7/8	22	170	11

CARBON STEEL PLATE FLANGE THICKNESS

Pipe Size		Flange Thickness T	
(in)	(mm)	(in)	(mm)
2 thru 4	50 thru 100	3/4	19
5 thru 6	125 thru 150	1	25
8 thru 12	200 thru 300	1 1/4	32

Carbon Steel Fixed and Floating Flanges ASA-300 Standard

On Special Orders:

1. Stainless Steel Flanges
2. Other Lengths

Face to Face Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration.

If intermittent in both directions, reduce by 50%.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application.

Consult factory on all vacuum applications.

RATED PRESSURES @ ELEVATED TEMPERATURES (psi) (kg/cm²)

Hose Size (in) (mm)	Factor 0.92 (250°F) (121°C)		Factor 0.86 (350°F) (176°C)		Factor 0.81 (450°F) (232°C)	
	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)
2 50	460	31	430	29	405	28
2 1/2 65	460	31	430	29	405	28
3 80	345	24	323	22	304	21
4 100	345	24	323	22	304	21
5 125	345	24	323	22	304	21
6 150	345	24	323	22	304	21
8 200	216	15	202	14	190	13
10 250	193	13	181	12	170	11
12 300	156	11	146	10	138	9

SATURATED STEAM RECOMMENDED PRESSURE LIMITS

Size (in) (mm)		Max Gauge (psi) (kg/cm ²)		Temp Ref. (°F) (°C)	
2	50	200	14	388	198
2 1/2	65	150	10	362	183
3	80	150	10	362	183
4	100	150	10	362	183
5	125	125	9	355	179
6	150	125	9	355	179
8	200	90	6	330	166
10	250	75	5	307	153
12	300	60	4	307	153

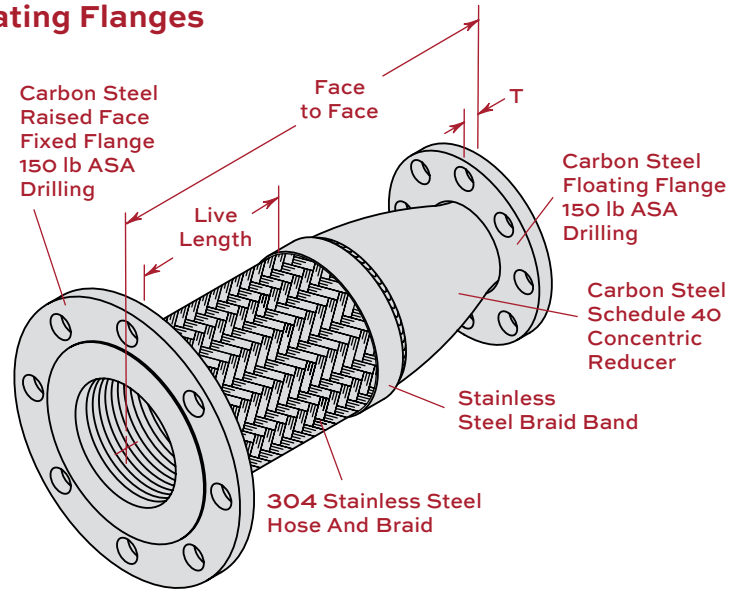
RFFL- SS Reducer with Carbon Steel Fixed & Floating Flanges

Our steam service ratings are very low in the interest of safety although our 70°F (21°C) pressure ratings are as high, or higher, than our competitors. All locations where failure could lead to personal injury or suffocation must be avoided. In dangerous locations we suggest housed expansion joints, solid loops, ball joints, packed devices, etc. rather than thin-walled flexible products regardless of manufacturer.

Consult factory with full location description as well as service conditions for higher pressure or temperature applications.

304 SS can be used up to 850°F (454°C) in applications such as engine exhaust with minor pressure.

When using these products in copper or brass water or steam systems, dielectric flanges and/or couplings must be used on each end to prevent leakage from galvanic action.



STOCK SIZES & LENGTHS

TYPE RFFL DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size		Face to Face		Live Length		Corrugations per		Maximum Permanent Lateral Offset		Rated Pressure			
	Large End (in)	Small End (mm)	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	@70°F (psi)	@21°C (kg/cm²)		
RFFL-	2 1/2	2	65	51	14	356	7 3/4	197	48	157	1/8	3	290	20
	3	2	80	51	14	356	7 3/4	197	46	151	1/8	3	280	19
	3	2 1/2	80	64	14	356	7 3/4	197	46	151	1/8	3	280	19
	4	2	100	51	14	356	7 1/4	184	32	105	1/8	3	225	15
	4	2 1/2	100	64	14	356	7 1/4	184	32	105	1/8	3	225	15
	4	3	100	76	14	356	7 1/4	184	32	105	1/8	3	225	15
	5	3	125	76	17	432	9 1/8	232	29	95	1/8	3	200	14
	5	4	125	102	17	432	9 1/8	232	29	95	1/8	3	200	14
	6	3	150	76	18	475	9 5/8	244	25	82	1/8	3	200	14
	6	4	150	102	18	475	9 5/8	244	25	82	1/8	3	200	14
	6	5	150	127	18	475	9 5/8	244	25	82	1/8	3	200	14
	8	4	200	102	18	475	8 7/8	225	23	75	1/8	3	200	14
	8	5	200	127	18	475	8 7/8	225	23	75	1/8	3	200	14
	8	6	200	152	18	475	8 7/8	225	23	75	1/8	3	200	14

Carbon Steel Fixed and Floating Flanges ASA-150 Standard

On Special Orders:

1. Stainless Steel Flanges
2. Other Drillings
3. Other Lengths
4. Other Reductions

Face to Face Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration.

If intermittent in both directions, reduce by 50%.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application.

Consult factory on all vacuum applications.

RATED PRESSURE @ ELEVATED TEMPERATURES RFFL & GWN

RATED PRESSURES @ ELEVATED TEMPERATURES (psi) (kg/cm²)

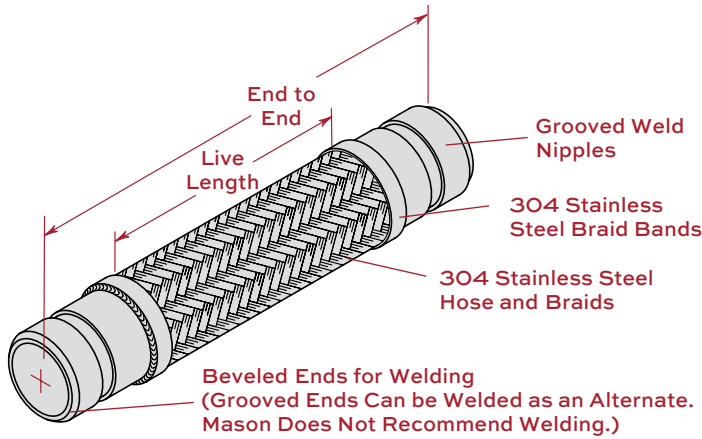
Hose Size (in)	(mm)	Factor 0.92 (250°F) (121°C)		Factor 0.86 (350°F) (176°C)		Factor 0.81 (450°F) (232°C)	
		(psi)	(kg/cm²)	(psi)	(kg/cm²)	(psi)	(kg/cm²)
2	50	330	23	310	21	290	20
2 1/2	65	270	19	250	17	235	16
3	80	260	18	240	16	230	16
4	100	210	15	200	14	190	13
5	125	190	13	180	12	170	11
6	150	190	13	180	12	170	11
8	200	190	13	180	12	170	11
10	250	160	11	150	10	140	9
12	300	160	11	150	10	140	9

SATURATED STEAM RECOMMENDED PRESSURE LIMITS

Size (in)	(mm)	Max Gauge (psi) (kg/cm²)		Temp Ref. (°F) (°C)	
		(psi)	(kg/cm²)	(°F)	(°C)
2	50	150	11	362	183
2 1/2	65	125	9	355	179
3	80	125	9	355	179
4	100	125	9	355	179
5	125	100	7	337	169
6	150	100	7	337	169
8	200	75	5	320	160
10	250	60	4	307	153
12	300	60	4	307	153

GWN- SS Braided Hose with Carbon Steel Weld Grooved Nipples

Available in Stainless Steel and UL (See page 10*15)



STOCK SIZES & LENGTHS

TYPE GWN DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & End to End		Live Length		Corrugations per		Maximum Permanent Lateral Offset		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(psi)	(kg/cm ²)
GWN-	2 x 14	50 x 356	83/4	222	58	190	1	25	360	25
	2 x 24	50 x 610	183/4	476	58	190	33/4	95	360	25
	2 x 36	50 x 914	303/4	781	58	190	8	203	360	25
	2 1/2 x 14	65 x 356	8	203	48	157	7/8	22	290	20
	2 1/2 x 24	65 x 610	18	457	48	157	3	76	290	20
	2 1/2 x 36	65 x 914	30	762	48	157	7	178	290	20
	3 x 14	80 x 356	8	203	46	151	3/4	19	280	19
	3 x 36	80 x 900	30	762	46	151	6	152	280	19
	4 x 18	100 x 457	10	254	32	105	3/4	19	225	15
	4 x 36	100 x 914	28	711	32	105	5	127	225	15
	5 x 20	125 x 508	12	305	29	95	3/4	19	200	14
	5 x 36	125 x 914	28	711	29	95	4	102	200	14
6 x 22	150 x 559	14	356	25	82	3/4	19	200	14	
6 x 36	150 x 914	28	711	25	82	3 1/2	89	200	14	
8 x 24	200 x 610	16	406	23	75	3/4	19	200	14	
8 x 36	200 x 914	28	711	23	75	3	76	200	14	
10 x 28	250 x 711	18	457	21	69	3/4	19	170	12	
10 x 36	250 x 914	26	660	21	69	2	51	170	12	
12 x 30	300 x 762	20	508	20	66	3/4	19	170	11	
12 x 36	300 x 914	26	660	20	66	1 3/4	44	170	11	

Carbon Steel Weld Grooved Nipples Standard On Special Orders:

1. Stainless Steel Grooves
2. Copper Grooves
3. Other Lengths

Sizes in **Bold** are Minimum Recommended Lengths at Equipment Connections to Reduce Vibration Transmission. See discussion on pages 10-10 - 10-13.

End to End Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

Size 12" (300mm) has double braid.

Safety Factor is 4X Rated Pressure. Vacuum rating varies with size and application.

Consult factory on all vacuum applications.

CPSB- Braided Bronze Hose with Copper Sweat Ends

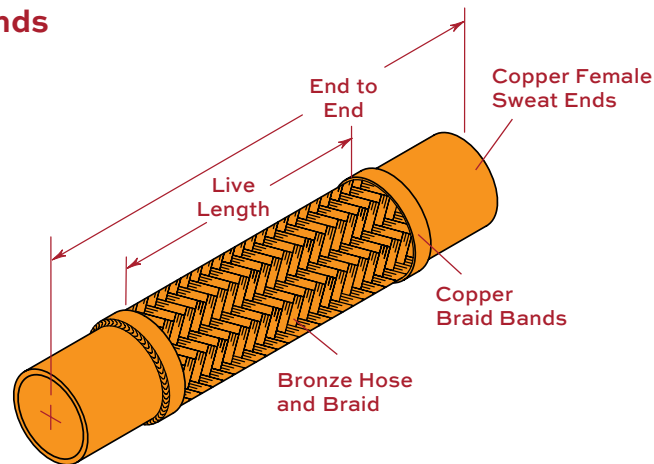
Available in CSA, MG, NSF and UL (See page 10-15)

All Services **Except Refrigerant**

Copper Lines have virtually no stiffness or mass. We are recommending our longest standard lengths primarily for offset, not vibration reduction. See specifications on page 10-14.

Consult factory with full location description as well as service conditions for higher pressure or temperature applications.

Not suitable for steam.



STOCK SIZES & LENGTHS

TYPE CPSB DIMENSIONS & PRESSURE RATINGS

Type	Tubing Size & End to End		Live Length		Corrugations per		Maximum Permanent Lateral Offset		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	@70°F (psi)	@21°C (kg/cm ²)
CPSB-	1/2 x 6 1/2*	15 x 165*	23/4	70	73	240	1/8	3	500	35
	1/2 x 12	15 x 305	8 1/4	210	73	240	1	25	500	35
	1/2 x 18	15 x 457	14 1/4	362	73	240	3	76	500	35
	1/2 x 24	15 x 610	20 1/4	514	73	240	6	152	500	35
	1/2 x 36	15 x 915	32 1/4	819	73	240	12 1/2	318	500	35
	3/4 x 7*	20 x 178*	23/4	70	67	220	1/8	3	470	32
	3/4 x 12	20 x 305	7 3/4	197	67	220	3/4	19	470	32
	3/4 x 18	20 x 457	13 3/4	349	67	220	2 1/2	64	470	32
	3/4 x 24	20 x 610	19 3/4	502	67	220	5 1/2	140	470	32
	3/4 x 36	20 x 915	31 3/4	806	67	220	11	279	470	32
	1 x 8*	25 x 203*	3 3/8	86	58	190	1/8	3	450	31
	1 x 12	25 x 305	7 3/8	187	58	190	5/8	16	450	31
	1 x 18	25 x 457	13 3/8	340	58	190	2 1/4	57	450	31
	1 x 24	25 x 610	19 3/8	492	58	190	5	127	450	31
	1 x 36	25 x 915	31 3/8	797	58	190	8 1/2	216	450	31
	1 1/4 x 8 1/2*	32 x 216*	3 3/4	95	55	180	1/8	3	400	28
	1 1/4 x 12	32 x 305	7 1/4	184	55	180	1/2	13	400	28
	1 1/4 x 18	32 x 457	13 1/4	337	55	180	1 3/4	44	400	28
	1 1/4 x 24	32 x 610	19 1/4	489	55	180	4	102	400	28
	1 1/4 x 36	32 x 915	31 1/4	793	55	180	8	203	400	28
	1 1/2 x 9*	40 x 229*	4	102	53	174	1/8	3	335	23
	1 1/2 x 12	40 x 305	7	178	53	174	1/2	13	335	23
	1 1/2 x 18	40 x 457	13	330	53	174	1 1/2	38	335	23
	1 1/2 x 24	40 x 610	19	483	53	174	3 1/2	89	335	23
	1 1/2 x 36	40 x 915	31	787	53	174	7 1/2	191	335	23
	2 x 12*	50 x 305*	6 1/2	165	51	167	1/4	6	235	16
	2 x 18	50 x 457	12 1/2	318	51	167	1 3/8	35	235	16
	2 x 24	50 x 610	18 1/2	470	51	167	3 1/4	83	235	16
	2 x 36	50 x 915	30 1/2	775	51	167	7	178	235	16
	2 1/2 x 12*	65 x 305*	4 3/4	121	34	112	1/8	3	230	16
	2 1/2 x 18	65 x 457	10 3/4	273	34	112	7/8	22	230	16
	2 1/2 x 24	65 x 610	16 3/4	425	34	112	2	51	230	16
	2 1/2 x 36	65 x 915	28 3/4	730	34	112	4 1/2	114	230	16
	3 x 12*	80 x 305*	4 1/2	114	30	98	1/8	3	225	15
	3 x 18	80 x 457	10 1/2	267	30	98	3/4	19	225	15
	3 x 24	80 x 610	16 1/2	419	30	98	1 1/2	38	225	15
	3 x 36	80 x 915	28 1/2	724	30	98	4 1/4	108	225	15
	4 x 18*	100 x 457*	9 1/2	241	28	92	1/2	13	220	15
	4 x 24	100 x 610	15 1/2	394	28	92	1 1/4	32	220	15
	4 x 36	100 x 915	27 1/2	699	28	92	4	102	220	15

*Industry Pump Connector Lengths are not recommended, but supplied on demand.

Sizes in **Bold** are Minimum Recommended Lengths at Equipment Connections to Reduce Vibration Transmission. See discussion on pages 10-10 - 10-13.

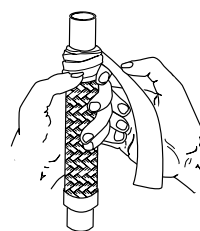
End to End Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

Female end fits over copper tubing, e.g. 1/2 x 12 (15 x 305mm) fits over 1/2" (15mm) tubing.

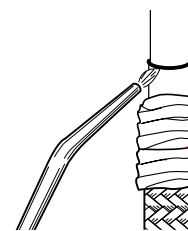
Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

INSTALLATION PROCEDURES

1. Thoroughly clean male and female ends using steel wool and steel brushes.
2. Apply flux.
3. Wrap base of copper fitting on connector and 2" (50mm) of the braid with a wet cloth to prevent overheating during soldering.
4. Direct the torch away from the base of the copper fitting and braided section. Avoid contact of the flame with the base of the copper fitting and braid. Heat end of copper fitting for proper flow of silver solder. Silver solder flows at approximately 430°F (221°C).
5. Use caution with brazing rod or other higher temperature techniques. Overheating will cause leaks.
6. Remove wet cloth and remove all soldering flux immediately after installation. Flux chlorides will cause premature failure of joint.



Step 3

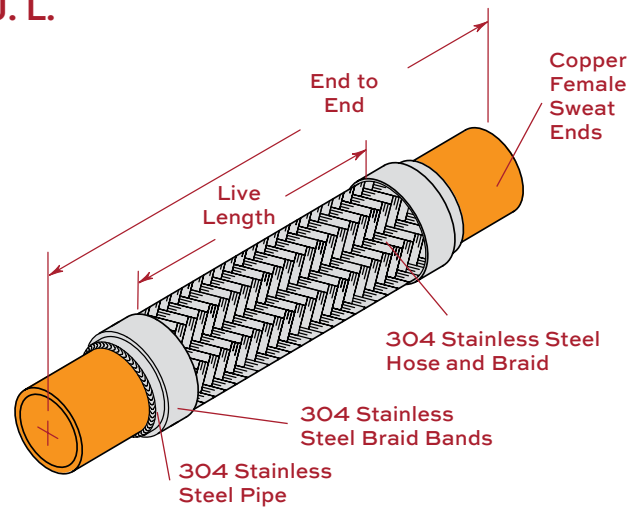


Step 4

ULCPS- SS Braided Hose with Copper Sweat Ends U. L.

Approved for Refrigerant Services

U.L. approved flexible hose are cleaned and bagged for refrigeration service. Do not use for water service.



STOCK SIZES & LENGTHS

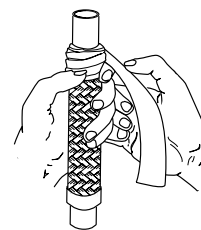
TYPE ULCPS DIMENSIONS & PRESSURE RATINGS

Stamped Code	Size & End to End		Fits Over Tubing Size		Tubing OD		Live Length		Maximum Permanent Lateral Offset		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(psi)	(kg/cm ²)
NF1	1/4 x 8 1/2	6 x 216	1/4	6	3/8	10	6	152	1/8	3	650	45
NF2	3/8 x 9	10 x 229	3/8	10	1/2	15	6 1/4	159	1/8	3	650	45
NF3	1/2 x 9 3/4	15 x 248	1/2	15	5/8	17	6 5/8	168	1/8	3	650	45
NF4	5/8 x 10 1/2	17 x 267	5/8	17	3/4	19	6 3/4	171	1/8	3	650	45
NF5	3/4 x 12	20 x 305	3/4	20	7/8	22	7 1/2	191	1/8	3	650	45
NF6	1 x 13	25 x 330	1	25	1 1/8	28	7 7/8	200	1/8	3	600	41
NF7	1 1/4 x 15 1/2	32 x 394	1 1/4	32	1 3/8	35	9 3/4	248	1/8	3	550	38
NF8	1 1/2 x 17	40 x 432	1 1/2	40	1 5/8	41	10 1/2	267	1/8	3	510	35
NF9	2 x 20 1/2	50 x 521	2	50	2 1/8	54	13 1/4	337	1/8	3	400	28
NF10	2 1/2 x 24 1/4	65 x 616	2 1/2	65	2 5/8	68	15 1/2	394	1/8	3	350	24
NF11	3 x 27	80 x 686	3	80	3 1/8	78	17	432	1/8	3	320	22
NF12	4 x 33	100 x 838	4	100	4 1/8	105	21	533	1/8	3	190	13

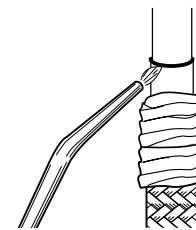
End to End Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 5.
 Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.
 These meet or exceed the higher pressure requirements of R410A, R717 (NH₃) and R744 (CO₂).
 Safety Factor is 5X Rated Pressure. Full Vacuum Rating— 30" Hg (762mm)
 Lengths are industry standard always ordered for this service.

INSTALLATION

1. Thoroughly clean male and female ends.
2. Wrap base of copper fitting on connector and 2" (50mm) of the braid with a wet cloth to prevent overheating during brazing.
3. Direct the torch away from the base of the copper fitting and braided section. Avoid contact of the flame with the base of the copper fitting and braid. Heat end of copper fitting for proper flow of brazing filler material.
4. Use caution with brazing rod or other higher temperature techniques. Overheating will cause leaks.
5. Remove wet cloth.



Step 2



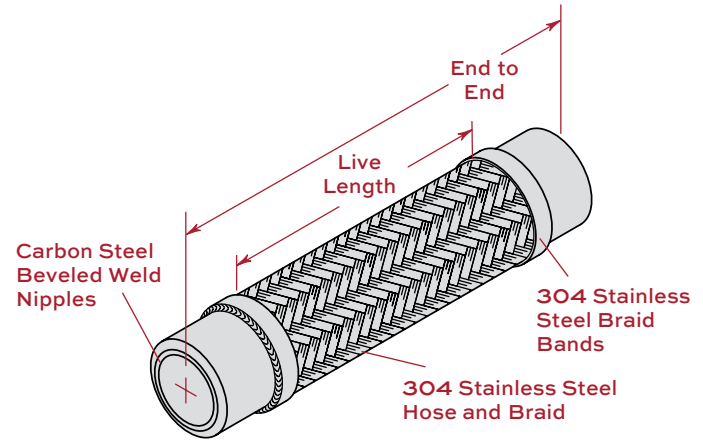
Step 3

CSAWN- SS Braided Hose with Carbon Steel Weld Nipples



These assemblies have been "CSA" approved for use on gas pipelines. "CSA" is the current certification agency for gas industry products, assuming the authority formerly associated with the American Gas Association (AGA).

Our Certification Report is #230720-1764990. This Certification meets all requirements of ANSI/UL #536- 1997 Standards for Flexible Metal Hose.



CSAMN and CSAFFL are also available. (See page 10-15)

See Standard MN (See page 10-16) and FFL (See page 10-17) for dimensions.

Rated Pressure @ 70°F (21°C) is 175 psi (12kg/cm2).

Max. Vacuum— 30" (762mm) Hg

Carbon Steel NPT Nipples Standard

On Special Orders:

1. Stainless Steel Nipples
2. Other Lengths

STOCK SIZES & LENGTHS

TYPE CSAWN DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size		MN		WN		Live Length		Corru-gations per		Maximum Permanent Lateral Offset		Rated Pressure @70°F @21°C		Min. Burst Pressure		Safety Factor
	(in)	(mm)	End to End (in)	End to End (mm)	End to End (in)	End to End (mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(psi)	(kg/cm ²)	(psi)	(kg/cm ²)	
CSAWN-	1/2	15	12	305	11	279	8 1/4	210	112	367	1 1/4	32	175	12	4300	302	25
	1/2	15	18	457	17	432	14 1/4	362	112	367	2 1/2	63	175	12	4300	302	25
	1/2	15	24	610	23	584	20 1/4	514	112	367	3 1/2	88	175	12	4300	302	25
	3/4	20	12	305	10 1/2	267	8 1/4	210	90	295	1	25	175	12	3168	222	18
	3/4	20	18	457	16 1/2	419	14 1/4	362	90	295	2 1/4	57	175	12	3168	222	18
	3/4	20	24	610	22 1/2	572	20 1/4	514	90	295	3 1/4	82	175	12	3168	222	18
	1	25	12	305	10	254	7 3/4	197	56	184	3/4	19	175	12	3132	220	18
	1	25	18	457	16	406	13 3/4	349	56	184	2	50	175	12	3132	220	18
	1	25	24	610	22	559	19 3/4	502	56	184	3	76	175	12	3132	220	18
	1 1/4	32	12	305	10	254	6 3/4	171	52	171	5/8	15	175	12	2656	186	15
	1 1/4	32	18	457	16	406	12 3/4	324	52	171	1 3/4	43	175	12	2656	186	15
	1 1/4	32	24	610	22	559	18 3/4	610	52	171	2 3/4	69	175	12	2656	186	15
	1 1/2	40	12	305	10	254	6 3/4	171	46	151	1/2	12	175	12	2284	160	13
	1 1/2	40	18	457	16	406	12 3/4	324	46	151	1 1/2	38	175	12	2284	160	13
	1 1/2	40	24	610	22	559	18 3/4	610	46	151	2 1/2	63	175	12	2284	160	13
	2	50	12	305	10	254	6	152	67	220	1/4	6	175	12	2120	149	12
	2	50	18	457	16	406	12	305	67	220	13/8	34	175	12	2120	149	12
	2	50	24	610	22	559	18	457	67	220	2 3/8	60	175	12	2120	149	12
	2 1/2	65	18	457	15 1/2	394	11	279	55	180	1 1/4	32	175	12	1724	121	10
	2 1/2	65	24	610	21 1/2	546	17	432	55	180	2	50	175	12	1724	121	10
	3	80	18	457	15 1/2	394	11	279	29	95	1	25	175	12	1564	109	9
	3	80	24	610	21 1/2	546	17	432	29	95	1 3/4	43	175	12	1564	109	9
	3	80	36	914	33 1/2	851	29	737	29	95	3 3/4	95	175	12	1564	109	9
	4	100	18	457	15 1/2	394	11	279	28	92	1/2	12	175	12	1160	81	7
4	100	24	610	21 1/2	546	17	432	28	92	3/4	19	175	12	1160	81	7	
4	100	36	914	33 1/2	851	29	737	28	92	3 1/4	82	175	12	1160	81	7	

Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

End to End Tolerance: minus 1% plus 3%.

