

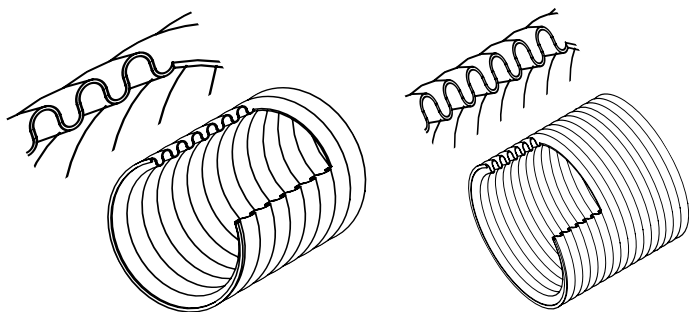
STAINLESS STEEL & BRONZE BRAIDED HOSES

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.



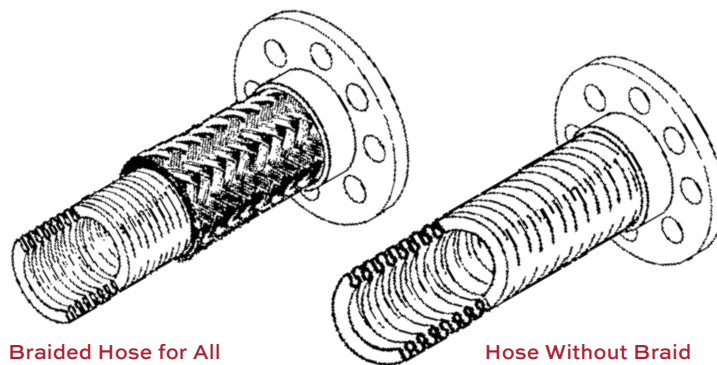
Open Pitch

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.



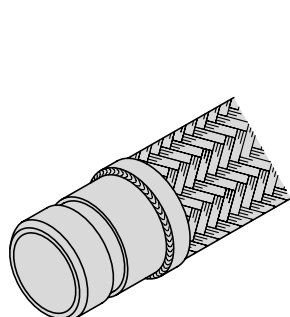
When fluid or gas pressure is applied to each corrugation, it tends to open axially, and this adds to the thrust of the pipe area multiplied by the line pressure. As the thrust pulls on the anchored braid ends, the interwoven bias weave applies inward radial pressure to the corrugations as well. Pressure 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.



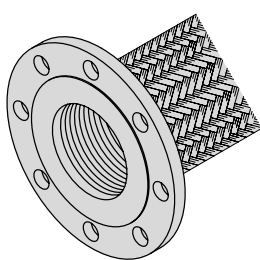
Braided Hose for All Pressure Applications

Hose Without Braid for Diesel Exhaust and Similar Applications

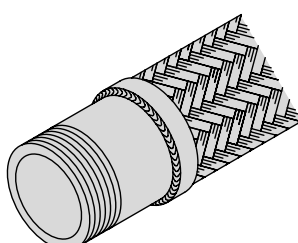
FITTING OPTIONS



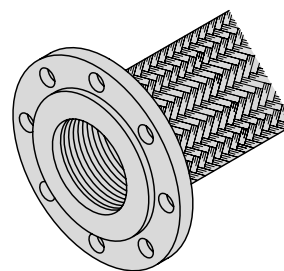
Grooved Weld Nipples



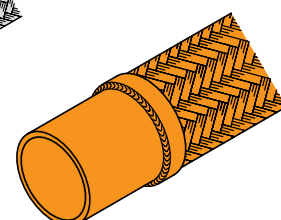
Raised Face Flanges



Threaded Nipples

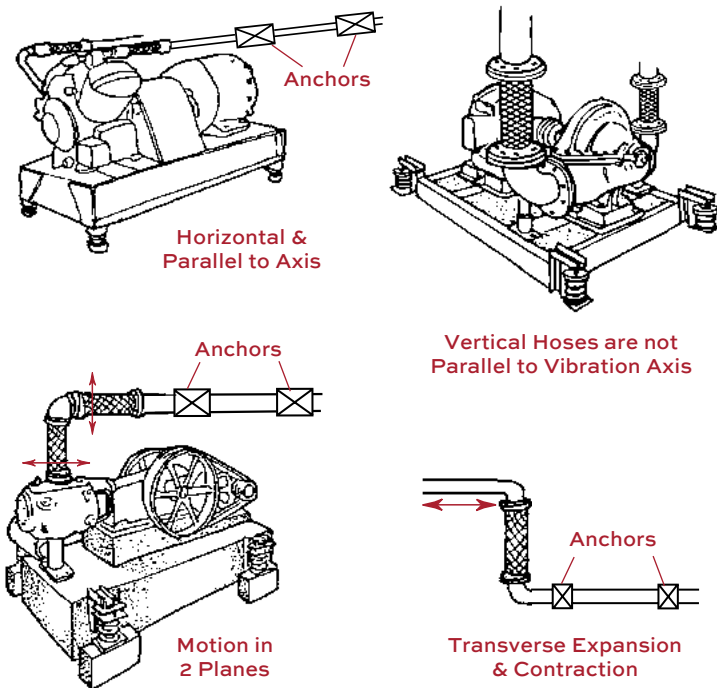


Floating Flanges

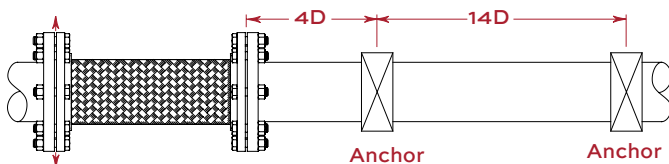


Female Copper Sweat Ends

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 8-12 & 8-13, 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.

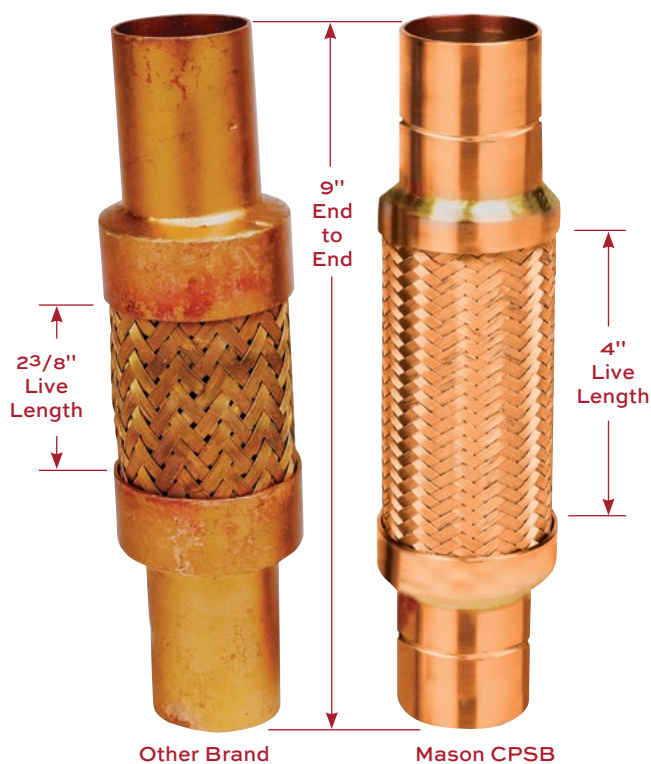
We started this study by calculating transverse schedule 40 pipe stiffness. This is important as the hose faces this resistance.

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

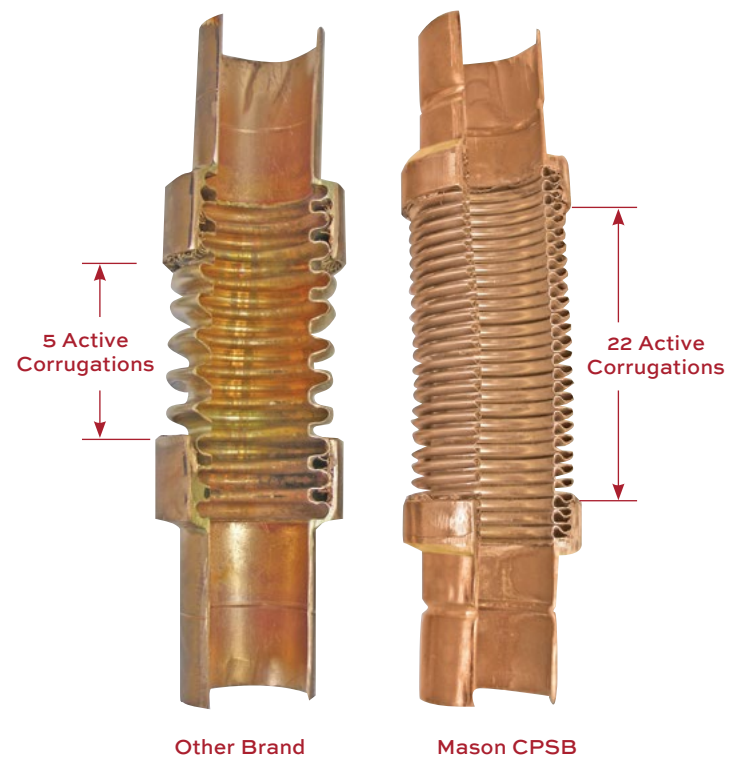
information on the force required to move a hose transversely—the key factor in selecting a hose to reduce vibration transmission.

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 8•12 & 8•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 8•11.

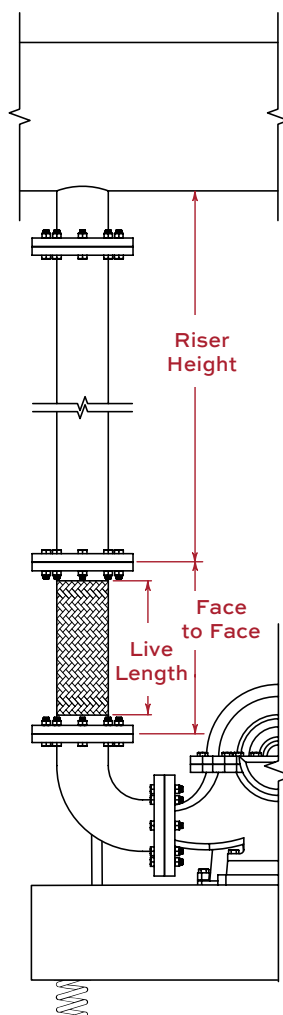
The lengths suggested in our specifications are based on experience. The height of equipment rooms controls the length of the risers. The pressure depends on the height of the building. It is hard to visualize 1/2" through 2" threaded hoses that would be connected to pumps or other equipment with long 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.

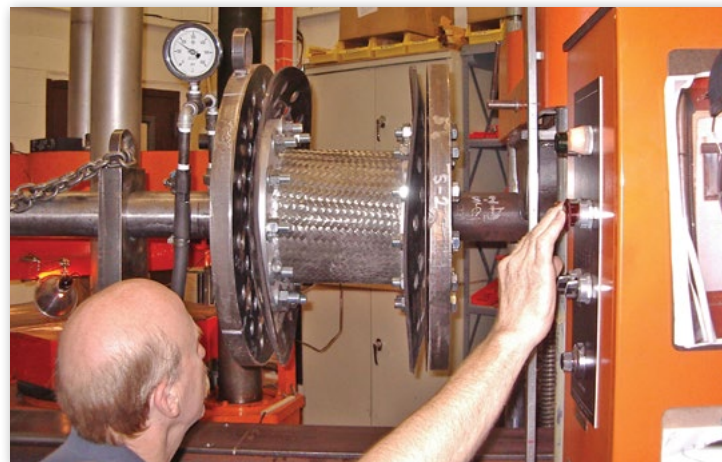
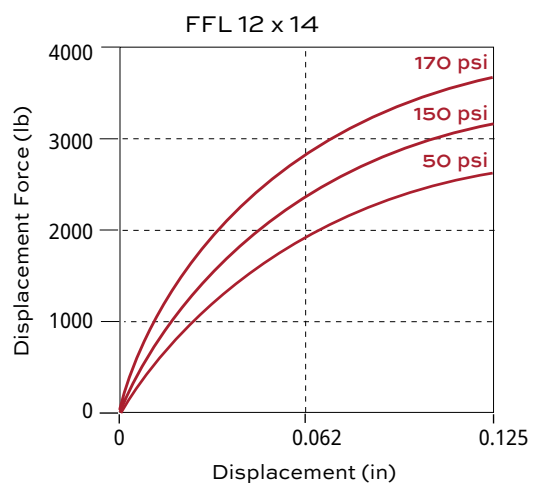
We have included copper pipe rather than ignoring it. However, copper tubing is both light and soft. Copper flexible hoses are better suited to allowing for thermal movement than reducing vibration.

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.



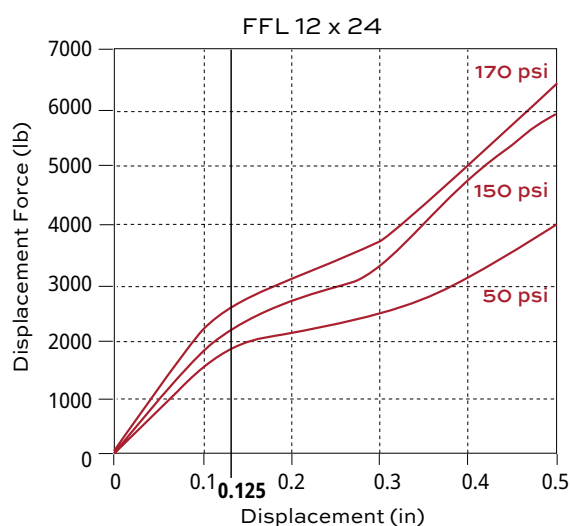
Typical vertical hose for purposes of illustration. Horizontal placement is preferable.

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

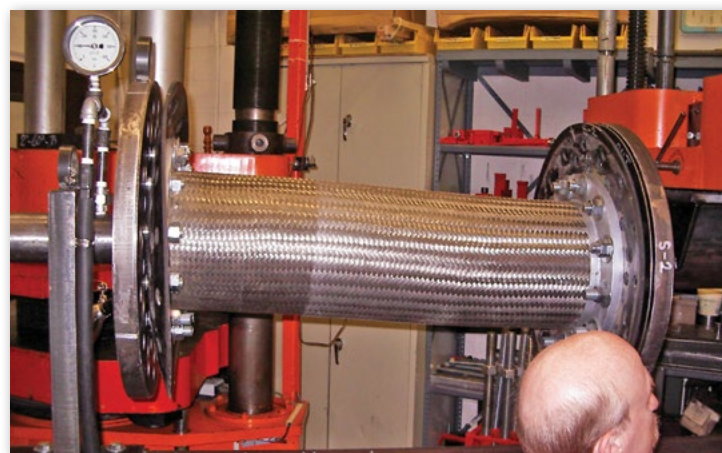
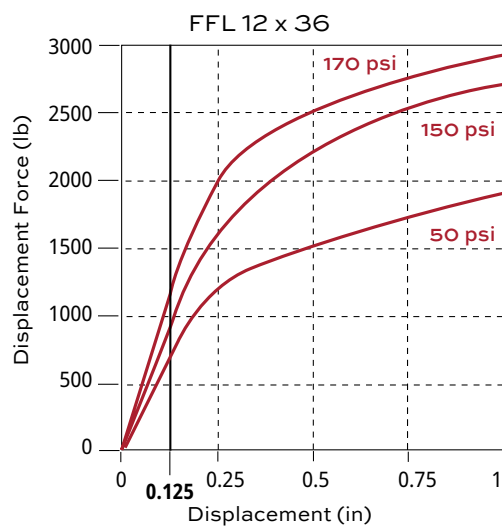
We also do not recommend 12 x 24 length. It is better than 12 x 14, but Displacement Force is still too high- 2650 lb/0.125" at 170 psi.



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	61/2 165	23/4 70	92 302	6.0	2.7	14.0	6.4	20.0	9.1						
1/2 15	12 305	81/4 210	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	141/4 362	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	201/4 514	92 302	*0.3	*0.1	0.4	0.2	0.5	0.2						
3/4 20	7 178	31/4 83	80 262	10.0	4.5	18.0	8.2	25.0	11.3						
3/4 20	12 305	81/4 210	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	141/4 362	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	201/4 514	80 262	*—	*—	1.0	0.5	1.5	0.7						
1 25	8 203	33/4 95	72 236	13.0	5.9	30.0	13.6	50.0	22.7						
1 25	12 305	73/4 197	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	133/4 349	72 236	0.5	0.2	1.5	0.7	2.5	1.1	lb	kg	lb	kg	lb	kg
1 25	24 610	193/4 502	72 236	*0.5	*0.2	1.0	0.5	1.5	0.7						
1 1/4 32	8 1/2 216	31/4 83	67 220	50	23	110	50	180	82						
1 1/4 32	12 305	63/4 171	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	123/4 234	67 220	1.5	1	4	2	6.5	3	lb	kg	lb	kg	lb	kg
1 1/4 32	24 610	183/4 476	67 220	—	—	2.5	1	3.5	2						
1 1/2 40	9 229	33/4 95	63 207	120	54	250	113	310	141						
1 1/2 40	12 305	63/4 171	63 207	20	9	60	27	105	48	9	4	4	2	2	0.9
1 1/2 40	18 457	123/4 234	63 207	5	2	15	7	23	10	lb	kg	lb	kg	lb	kg
1 1/2 40	24 610	183/4 476	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						
2 1/2 65	18 457	11 279	48 157	30	14	80	36	120	54	45	20	20	9	10	4
2 1/2 65	24 610	17 432	48 157	10	5	25	11	40	18	lb	kg	lb	kg	lb	kg
3 75	12 305	5 127	46 151	350	159	600	272	750	340						
3 75	18 457	11 279	46 151	100	45	190	86	250	113	90	40	35	17	20	9
3 75	24 610	17 432	46 151	35	16	70	32	110	50	lb	kg	lb	kg	lb	kg
4 100	12 305	5 127	32 105	500	227	825	374	900	408						
4 100	18 457	11 279	32 105	150	68	305	138	400	181	210	96	90	40	45	21
4 100	24 610	17 432	32 105	110	50	175	79	260	118	lb	kg	lb	kg	lb	kg

*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)
1 1/2 40	9 229	67/8 175	63 207	20	9	55	25	85	39						
1 1/2 40	12 305	97/8 251	63 207	8	4	27	12	42	19	9	4	4	2	2	1
1 1/2 40	18 457	157/8 403	63 207	3	1	10	5	16	7	lb	kg	lb	kg	lb	kg
1 1/2 40	24 610	217/8 556	63 207	2	1	6	2	6	2						
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	4	2
2 50	18 457	151/8 384	58 190	6	3	18	8	29	13	lb	kg	lb	kg	lb	kg
2 50	24 610	211/8 537	58 190	3	1	10	5	15	7						
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	10	5
2 1/2 65	18 457	151/8 384	48 157	15	7	45	20	75	34	lb	kg	lb	kg	lb	kg
2 1/2 65	24 610	211/8 537	48 157	7	3	25	11	35	16						
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	90	40	35	17	20	9
3 75	18 457	151/8 384	46 151	30	14	105	48	130	59	lb	kg	lb	kg	lb	kg
3 75	24 610	211/8 537	46 151	15	7	55	25	80	36						
3 75	*36 *914	331/8 841	46 151	10	5	35	16	50	23						
				(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	210	96	90	41	45	21
4 100	18 457	151/8 384	32 105	65	30	155	70	210	96	lb	kg	lb	kg	lb	kg
4 100	24 610	211/8 537	32 105	40	18	105	48	155	70						
4 100	36 914	331/8 841	32 105	20	9	50	23	80	36						
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	95	44
5 125	24 610	207/8 530	29 95	85	39	195	89	225	102	lb	kg	lb	kg	lb	kg
5 125	36 914	327/8 835	29 95	65	30	135	61	150	68						
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	180	81
6 150	24 610	207/8 530	25 82	170	76	450	204	505	229	lb	kg	lb	kg	lb	kg
6 150	36 914	327/8 835	25 82	70	32	155	70	180	82						
				(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	455	207
8 200	24 610	205/8 524	23 75	325	147	750	340	850	386	lb	kg	lb	kg	lb	kg
8 200	36 914	325/8 829	23 75	155	70	400	181	425	193						
				(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	1010	460
10 250	24 610	205/8 524	21 69	900	408	1060	481	1250	567	lb	kg	lb	kg	lb	kg
10 250	36 914	325/8 829	21 69	570	259	680	308	800	363						
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	1755	797
12 300	*36 *914	325/8 829	20 66	830	376	980	445	1150	522	lb	kg	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	2300	1065
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	3500	1605

*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. Convol- utions 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)		
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	—	—	—	—	18 457	13 330	63 207						
2 50	24 610	211/8 537	24 610	18 457	24 610	18 457	18 457	18 457	12 1/2 318	58 190							
2 1/2 65	24 610	211/8 537	24 610	17 432	24 610	18 457	18 457	18 457	10 3/4 273	48 157							
3 80	36 914	331/8 841	36 914	29 737	36 914	30 762	18 457	10 1/2 267	46 151								
4 100	36 914	331/8 841	36 914	29 737	36 914	28 711	24 610	15 1/2 394	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

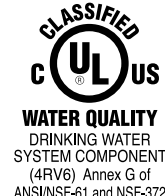


NSF Series– MNSS-NSF, FFLSS-NSF & CPSB-NSF

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 8-15)

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.

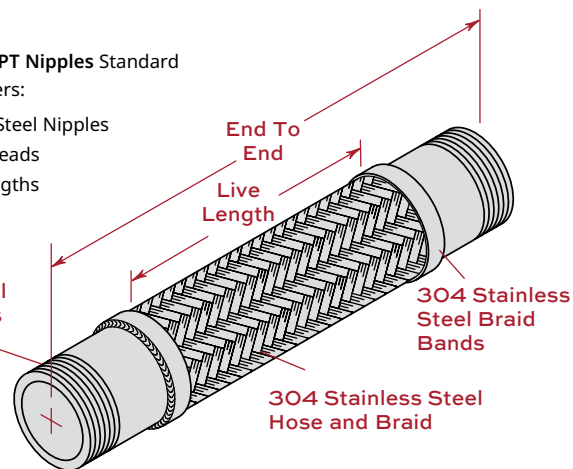
When using these products in copper or brass water or steam systems, dielectric couplings must be used on each end to prevent leakage from galvanic action.

Carbon Steel NPT Nipples Standard

On Special Orders:

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

Carbon Steel
NPT Nipples



STOCK SIZES & LENGTHS

TYPE MN DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & End to End (in) (mm)	Live Length (in) (mm)	Corrugations per (ft) (m)	Maximum Lateral Offset (in) (mm)	Force Req'd for Max. Offset at 250 psi (17kg/cm²) or Lower Rated Pressure (lb) (kg)	Rated Pressure @70°F @21°C (psi) (kg/cm²)
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)
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/cm²)	Temp Ref. (°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 8-10 - 8-13.

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.

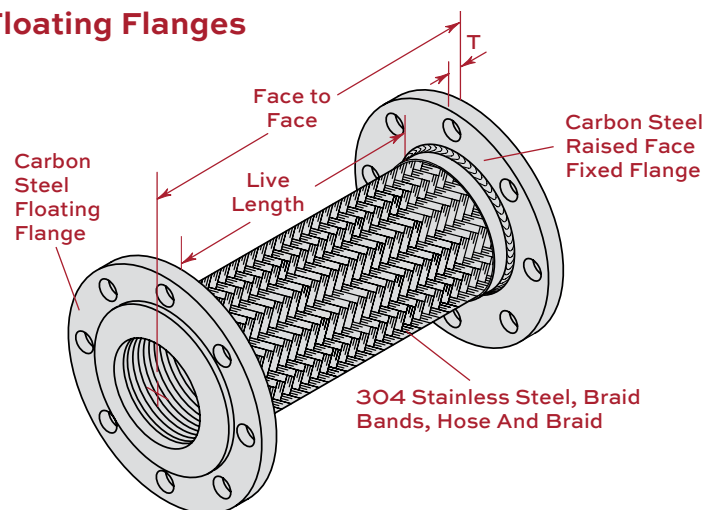
FFL- SS Braided Hose with Carbon Steel Fixed & Floating Flanges

Available in CSA, NSF, and UL (See page 8-15)

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/cm²) or Lower Rated Pressure		Rated Pressure @70°F @21°C	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(lb)	(kg)	(psi)	(kg/cm²)
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	2 1/4	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	1 1/2	38	525	238	225	15
	4 x 24	100 x 610	213/4	552	32	105	3 1/2	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	1 1/4	32	710	322	200	14
	5 x 24	125 x 610	203/4	527	29	95	2 1/4	57	575	261	200	14
	5 x 36	125 x 914	323/4	832	29	95	5 1/2	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*	8 1/2	216	23	75	1/8	3	1680	762	200	14
	8 x 18	200 x 457	14 1/2	368	23	75	7/8	22	3280	1488	200	14
	8 x 24	200 x 610	20 1/2	521	23	75	1 1/2	32	3180	1442	200	14
	8 x 36	200 x 914	32 1/2	832	23	75	4	102	1405	637	200	14
	10 x 13*	250 x 330*	9 1/2	241	21	69	1/8	3	2590	1175	170	11
	10 x 18	250 x 457	14 1/2	368	21	69	3/4	19	3750	1701	170	11
	10 x 24	250 x 610	20 1/2	521	21	69	1 1/4	32	4020	1823	170	11
	10 x 36	250 x 914	32 1/2	826	21	69	3	76	2230	1012	170	11
	12 x 14*	300 x 356*	10 1/2	267	20	66	1/8	3	3690	1674	170	11
	12 x 24	300 x 610	20 1/2	521	20	66	1	25	4950	2245	170	11
	12 x 36	300 x 914	32 1/2	826	20	66	2 1/2	64	2960	1343	170	11
	14 x 14*	350 x 356*	10 1/2	267	18	59	1/8	3	5500	2495	170	11
	14 x 36	350 x 914	32 1/2	826	18	59	1 1/4	32	12000	5443	170	11
	16 x 16*	400 x 406*	12 1/2	318	16	52	1/8	3	7200	3266	170	11
	16 x 36	400 x 914	32 1/2	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 8-18.

Sizes in **Bold** are Minimum Recommended Lengths at Equipment Connections to Reduce Vibration Transmission. See discussion on pages 8-10 - 8-13.

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

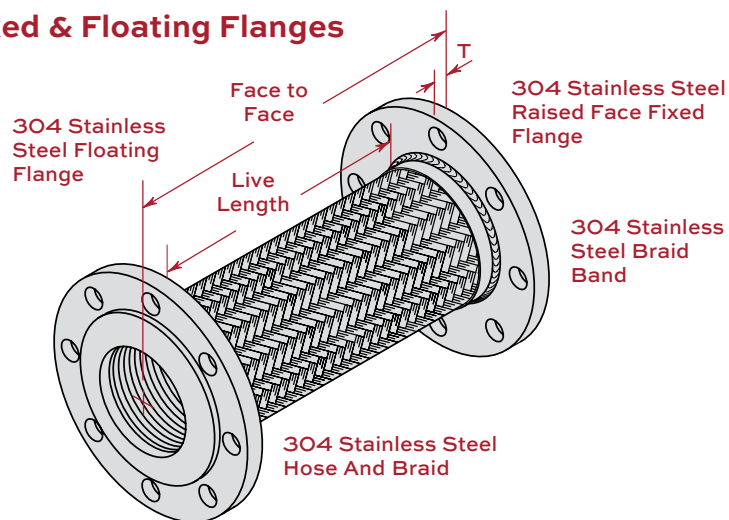
Available in NSF (See page 8-15)

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/cm²) or Lower Rated Pressure		Rated Pressure	
	(in)	(mm)	(in)	(mm)	(ft)	(m)	(in)	(mm)	(lb)	(kg)	@70°F (psi)	@21°C (kg/cm²)
FFLSS-	2 x 12	50 x 305	9 3/4	248	58	190	11/8	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	Factor 0.92	Factor 0.86	Factor 0.81
(in) (mm)	(250°F) (121°C)	(350°F) (176°C)	(450°F) (232°C)
1 1/2 40	400 28	370 26	350 24
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
14 350	160 11	150 10	140 9
16 400	160 11	150 10	140 9

SATURATED STEAM**RECOMMENDED PRESSURE LIMITS**

Size	Max Gauge	Temp Ref.
(in) (mm)	(psi) (kg/cm²)	(°F) (°C)
1 1/2 40	150 11	362 183
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
14 350	60 4	307 153
16 400	60 4	307 153

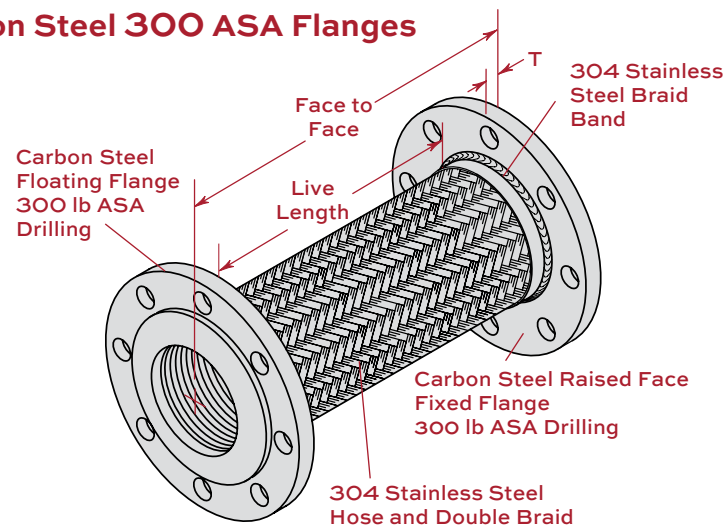
FFL2B300- SS Double Braided Hose with Carbon Steel 300 ASA Flanges

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/cm²)
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	Factor 0.92	Factor 0.86	Factor 0.81
(in) (mm)	(250°F) (121°C)	(350°F) (176°C)	(450°F) (232°C)
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	Max Gauge	Temp Ref.
(in) (mm)	(psi) (kg/cm²)	(°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

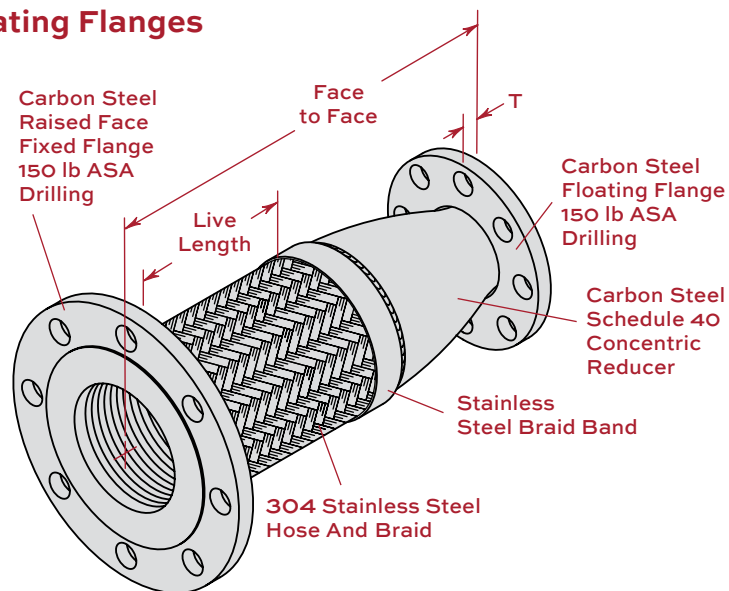
RFFL- SS Reducer with Carbon Steel Fixed & Floating Flanges

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

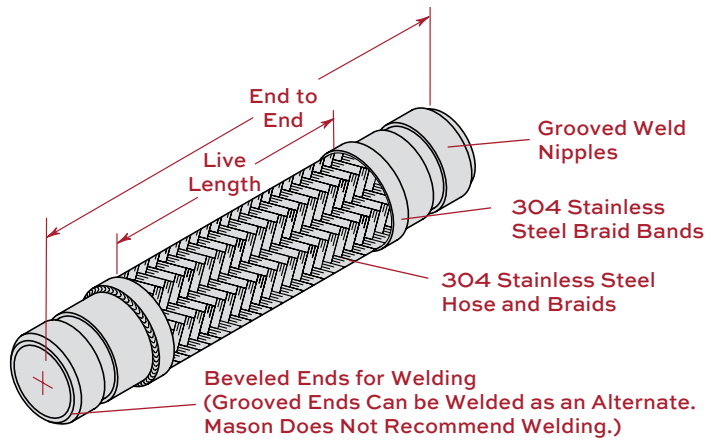
SATURATED STEAM

RECOMMENDED PRESSURE LIMITS

Size (in) (mm)	Max Gauge (psi) (kg/cm²)	Temp Ref. (°F) (°C)
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 8*15)



STOCK SIZES & LENGTHS

TYPE GWN DIMENSIONS & PRESSURE RATINGS

Type	Pipe Size & End to End (in) (mm)		Live Length (in) (mm)		Corrugations per (ft) (m)		Maximum Permanent Lateral Offset (in) (mm)		Rated Pressure @70°F @21°C (psi) (kg/cm²)	
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 8*10 - 8*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

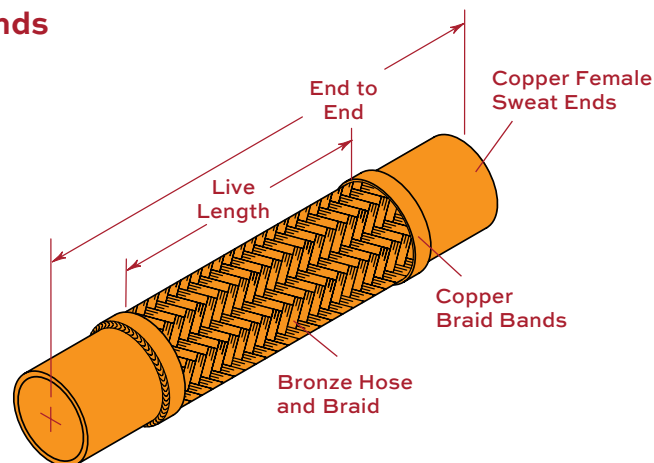
Available in CSA, MG, NSF and UL (See page 8-15)

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 8-14.

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/cm²)
CPSB-	1/2 x 61/2*	15 x 165*	23/4	70	73	240	1/8	3	500	35
	1/2 x 12	15 x 305	81/4	210	73	240	1	25	500	35
	1/2 x 18	15 x 457	141/4	362	73	240	3	76	500	35
	1/2 x 24	15 x 610	201/4	514	73	240	6	152	500	35
	1/2 x 36	15 x 915	321/4	819	73	240	121/2	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	73/4	197	67	220	3/4	19	470	32
	3/4 x 18	20 x 457	133/4	349	67	220	21/2	64	470	32
	3/4 x 24	20 x 610	193/4	502	67	220	51/2	140	470	32
	3/4 x 36	20 x 915	313/4	806	67	220	11	279	470	32
	1 x 8*	25 x 203*	33/8	86	58	190	1/8	3	450	31
	1 x 12	25 x 305	73/8	187	58	190	5/8	16	450	31
	1 x 18	25 x 457	133/8	340	58	190	21/4	57	450	31
	1 x 24	25 x 610	193/8	492	58	190	5	127	450	31
	1 x 36	25 x 915	313/8	797	58	190	81/2	216	450	31
	1 1/4 x 81/2*	32 x 216*	33/4	95	55	180	1/8	3	400	28
	1 1/4 x 12	32 x 305	71/4	184	55	180	1/2	13	400	28
	1 1/4 x 18	32 x 457	131/4	337	55	180	13/4	44	400	28
	1 1/4 x 24	32 x 610	191/4	489	55	180	4	102	400	28
	1 1/4 x 36	32 x 915	311/4	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	11/2	38	335	23
	1 1/2 x 24	40 x 610	19	483	53	174	31/2	89	335	23
	1 1/2 x 36	40 x 915	31	787	53	174	71/2	191	335	23
	2 x 12*	50 x 305*	61/2	165	51	167	1/4	6	235	16
	2 x 18	50 x 457	121/2	318	51	167	13/8	35	235	16
	2 x 24	50 x 610	181/2	470	51	167	31/4	83	235	16
	2 x 36	50 x 915	301/2	775	51	167	7	178	235	16
	2 1/2 x 12*	65 x 305*	43/4	121	34	112	1/8	3	230	16
	2 1/2 x 18	65 x 457	103/4	273	34	112	7/8	22	230	16
	2 1/2 x 24	65 x 610	163/4	425	34	112	2	51	230	16
	2 1/2 x 36	65 x 915	283/4	730	34	112	41/2	114	230	16
	3 x 12*	80 x 305*	41/2	114	30	98	1/8	3	225	15
	3 x 18	80 x 457	101/2	267	30	98	3/4	19	225	15
	3 x 24	80 x 610	161/2	419	30	98	11/2	38	225	15
	3 x 36	80 x 915	281/2	724	30	98	41/4	108	225	15
	4 x 18*	100 x 457*	91/2	241	28	92	1/2	13	220	15
	4 x 24	100 x 610	151/2	394	28	92	11/4	32	220	15
	4 x 36	100 x 915	271/2	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 8-10 - 8-13.

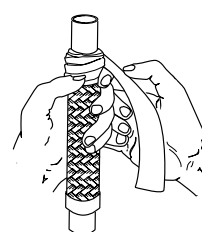
End to End Tolerance: minus 1% plus 3%. Minimum Burst is four times the Rated Pressure. Safety factor of 4.

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

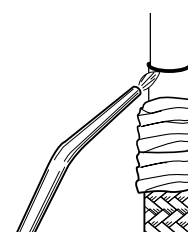
Lateral Offset one side of centerline and normal machinery vibration. If intermittent in both directions, reduce by 50%.

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

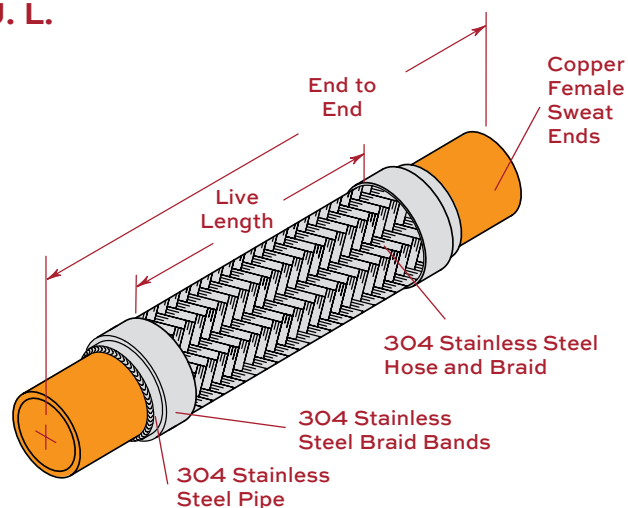


Step 4

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 (in) (mm)		Fits Over Tubing Size (in) (mm)		Tubing OD (in) (mm)		Live Length (in) (mm)		Maximum Permanent Lateral Offset (in) (mm)		Rated Pressure @70°F @21°C (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%.

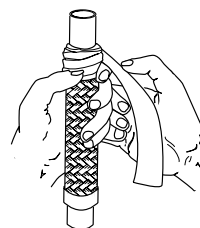
These meet or exceed the higher pressure requirements of R410A, R717 (NH₃) and R744 (CO₂).

Safety Factor is 5X Rated Pressure. Full Vacuum Rating— 30" Hg (762mm)

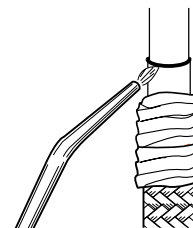
Lengths are industry standard always ordered for this service.

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



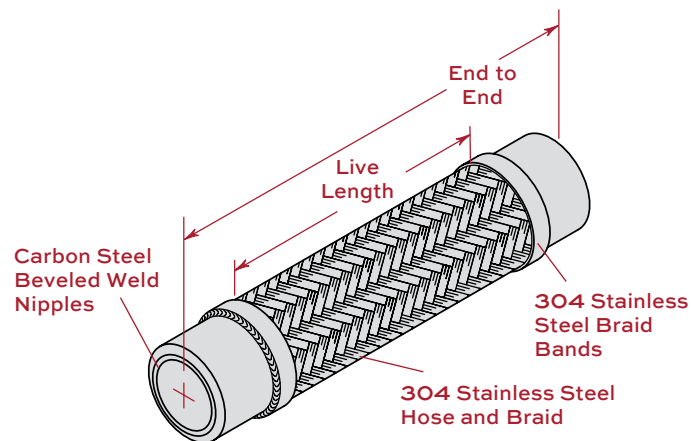
Step 3

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 8-15)

See Standard MN (See page 8-16) and FFL (See page 8-17) 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 (in) (mm)	MN End to End (in) (mm)	WN End to End (in) (mm)	Live Length (in) (mm)	Corru- gations per (ft) (m)	Maximum Permanent Lateral Offset (in) (mm)	Rated Pressure @70°F @21°C (psi) (kg/cm ²)	Min. Burst Pressure (psi) (kg/cm ²)	Safety Factor
CSAWN-	1/2 15	12 305	11 279	8 1/4 210	112 367	11/4 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	1 3/8 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%.