MASON-MERCER

EXPANSION COMPENSATORS & HOUSED EXPANSION JOINTS

EXTERNALLY PRESSURIZED EXPANSION JOINTS

INTERNALLY PRESSURIZED EXPANSION JOINTS

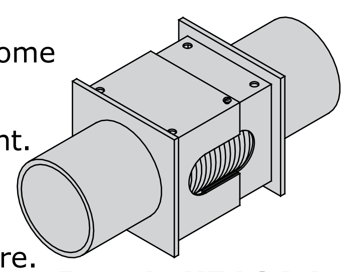
We are all interested in product development, but it is often difficult to trace. Let us share what we have learned.

When applying internally pressurized expansion joints, the designer has to be concerned with extension, compression, angular and torsional motion. Like automobile tires, rubber expansion joints are thick skinned forgiving creatures that tolerate abuse. Stainless steel is very reliable too, but only if expertly designed, properly anchored and guided. All of us have taken a strip of metal and bent it back and forth until it cracked and snapped. Multiple corrugations designed to low stresses eliminate the problem.

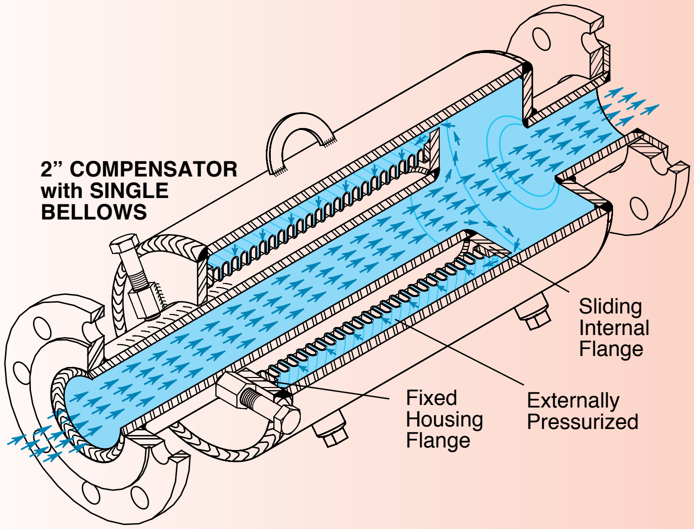
An anchor close to an expansion joint stabilizes one side. Then two guides, one 4 diameters from the joint and the other a minimum of 14 diameters from the first, lead the piping straight in and out. If the anchors are both up and down-stream, four guides are required, two on each side. Improper anchoring or guiding leads to failure. If major movements are required, it may become necessary to increase the outside diameter to prevent buckling. This increases both thrust and cost.

There is always the worry of personal injury from hot liquid or steam, even though the evolution from steel to galvanized steel, copper, bronze and finally stainless steel, has increased service life and operating pressures.

Some designer tried to solve some of these internally pressurized problems by telescoping two square housings around the joint. It reduced the rotational problem, but without the two external guides, the possibility of angular failure is always there.

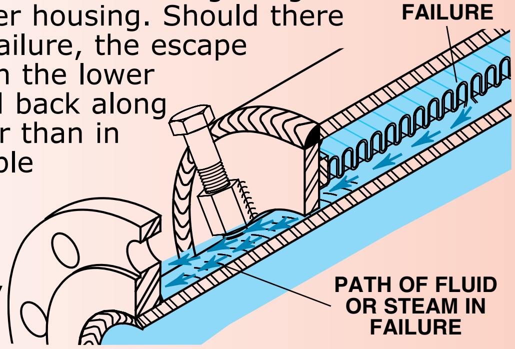


Bulletin HEJ-31-1



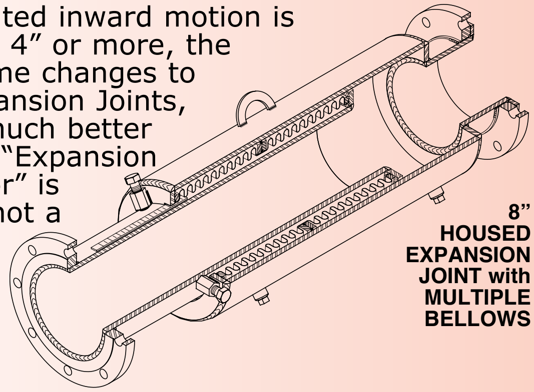
Some years later there was a major change in concept. The industry turned to a completely housed construction. In this design, the bellows is welded to a sliding flange on the end of the piping, and to the fixed flange where the moving pipe enters. Unlike the old design, the fluid or gas surrounds the bellows so it is "Externally Pressurized". The design manuals say that a bellows is more stable when externally pressurized, but we have found no satisfactory explanation.

Self guiding is provided by the pipe passing through the opening on the one end and the small clearance of the moving flange inside the outer housing. Should there be a bellows failure, the escape is only through the lower clearance, and back along the pipe rather than in an unpredictable direction. The housing is a great safety feature, particularly in steam lines.



For whatever reason, the entire industry refers to 2" movement designs as Expansion Compensators. They are shipped preset to allow for inward travel only in hot lines. Should there be a dual temperature situation, there is no engineering reason the compensator cannot be moved in 3/4" before installation, so it would accommodate 1 1/4" pipe expansion and 3/4" contraction or some other setting.

When the rated inward motion is increased to 4" or more, the industry name changes to Housed Expansion Joints, which is a much better description. "Expansion Compensator" is a function, not a product.



Oddly enough, some people still describe the 2" movement Expansion Compensators as internally pressurized. They are not. Only the old design on page 1 is internally pressurized.

We had no illusions about coming up with a very different approach, but it is never our way to introduce a product without improvement. So just as we did with the straight hoses and Vees, we purchased twenty or thirty compensators and housed expansion joints from various manufacturers to see what was going on.

Perhaps the original engineer designed a whole range of consistent products. However, the more samples we looked at, the more confusing it became. There was no consistency. When people copy products to cheapen them or never completely understand the original design, the copy often suffers.

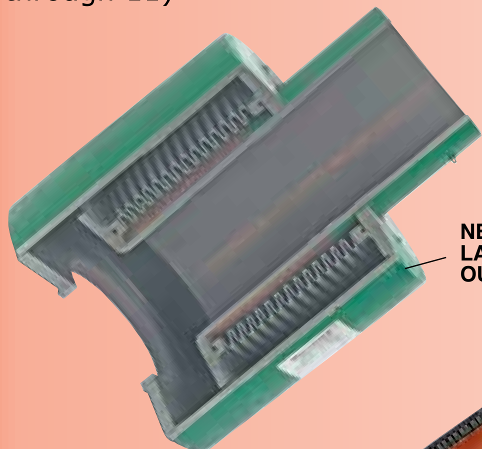
Virtually all manufacturers advertise 2" movement multi-ply bellows. Many companies just buy and resell without writing specs or testing. When their suppliers deliver single ply, the resale company would not know. There is no great harm, as the only reason to go to multiple plies is to increase pressure ratings without using a single thicker wall. A single thickness with the same corrugations and movements would suffer higher stresses, a shorter service life and the bellows would have a higher spring rate even though low spring rates are relatively unimportant. To maintain the same service life, the bellows would have to be longer to reduce movement per corrugation, and in addition to space considerations, more costly designs to manufacture.

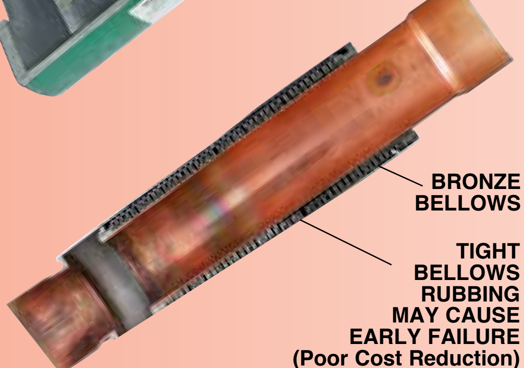
Moving on to 4" and 8", most manufacturers use 2 ply, and some 3. The number is not particularly important. However, with greater movement, it becomes more difficult to maintain stability. Any stretched bellows is stable. However, pipelines do not only expand, they must cool and contract. When the motion is reversed and the bellows compressed, it can become unstable and buckle. Most manufacturers design to the maximum stable length and weld them to guide rings between sections to prevent buckling of a longer column.

Our own designs vary from product to product, just depending on what works best. Since people like to know what they are buying, we note the number of bellows and plies for all products at this writing. Most companies do not.

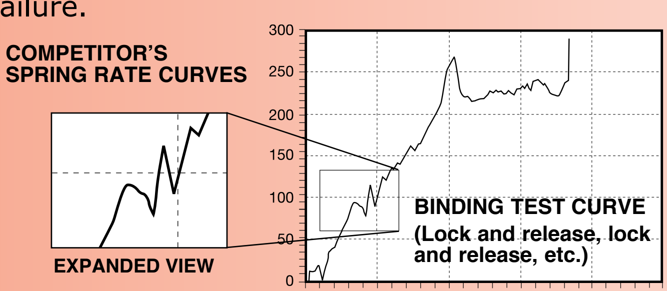
We found that to prevent buckling, some manufacturers had their bellows rubbing against the inside pipe or the outer shell. It would seem they must wear through and leak earlier, so tight fits are a poor way to go. (See bronze bellows photo on page 3)

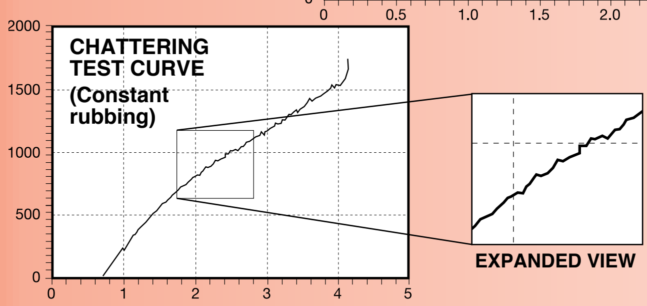
Others went to huge outer housings as compared to the inner pipe, so their products were clumsy (below). In our own designs, we have succeeded in providing good working clearances, both between the inside of the bellows and the moving pipe as well as the outer shell. We note clearances on all product drawings. Competitors do not. (See pages 6 through 11)

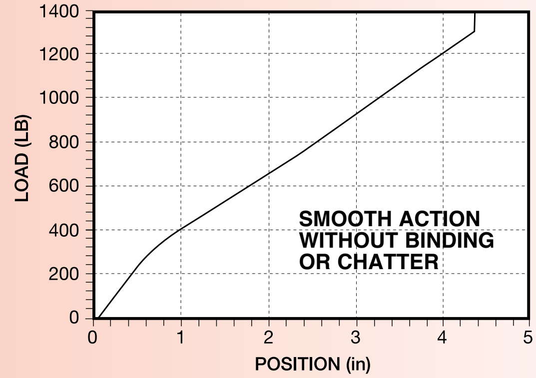




In checking spring rates, we found that some competitors are so concerned with alignment, that clearances between the moving pipe and the entry collar as well as the moving inner flange, and the outer shell were so tight that binding was a serious problem. We are publishing a few test curves to show this condition. Since there is no need for so small a tolerance, our clearances are roomier for smoother travel, as shown by the Mason test curve at the top of the next column. When expansion joints bind, it increases the anchorage loads. Binding intermediate rings stretch bellows unevenly and can cause failure.

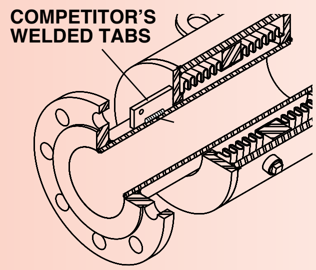


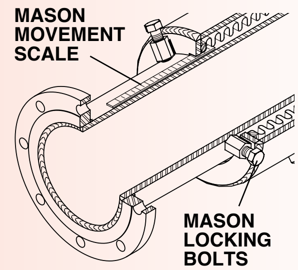




TYPICAL 4" TRAVEL MASON SPRING RATE CURVE

Another improvement is our introducing locking bolts to maintain the installed position. All of the other manufacturers use welded tabs. The tabs are knocked out after the piping is fixed to the expansion joint. Sometimes they are flimsy and fall off. More importantly, the side welds are often within the movement of the pipe entering the housing. The weld has to tear its way through until it clears. Not the smooth motion we would all like to have.

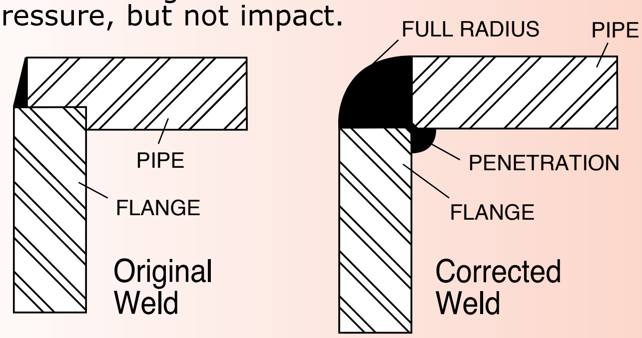




Perhaps our most interesting contribution is the introduction of a scale to confirm the starting position is zero for the average installation. Many of the stop-tabbed samples we checked were not. When the joint is in service, the scale indicates how much the pipe has expanded and how much the bellows have been extended. In a hot and cold situation, you can loosen the restraining bolts, and push the bellows to the desired starting position to allow for a line cooling down or a seasonal change in temperature. Reading the scale makes it easy. Re-lock the bolts and continue with the installation. (Note: the 2" movement expansion compensators have a 0, 1" and 2" reference only.)

If for whatever reason you have to remove an expansion joint temporarily, you can retighten the locking bolts, remove it, do the maintenance work and reinstall the expansion joint without fighting it into position as you would have to with any other device. Loosen the bolts and it is back in service. Welded tabs would have been long gone. While any good mechanic can find a way, this is much easier.

Shortly after we sold our first housed expansion joints, we had a serious failure even before they were put into service. One of our contractors was prefabbing as much as possible to minimize time on the jobsite. Rather than installing the housed expansion joint between pipe ends in the field, he welded long extensions to the pipe on both sides. In normal rough handling, one of the modified joints was dropped. The cantilever of the long welded pipe snapped the flange off the fixed end. When we got it back in the shop, we found the method we were using in machining the flange to the I.D. of the housing left a small lip around the pipe perimeter as sketched. This undersized weld looked great and would have held the pressure, but not impact.



Here again, we checked competitor's products, and found our original technique was typical. We re-examined all of our welds and changed every one to good piping practice with welds as sketched. Maybe this is overkill, but neither you nor we will ever suffer a weld failure again and that's good to know.

Earlier we suggested the bellows spring rate was insignificant. The reason is the thrust from a housed expansion joint is equal to the area as calculated to about the center of the bellows multiplied by the pressure in the pipe line. Typically a 4" pipe bellows might have a 61/4" diameter to the center of the corrugation. At 225 psi the thrust force is a nominal 6900 lbs. The spring rate of our 4" travel HEJ is 300 lbs. per inch. The 8" HEJ is 150 lbs. per inch. Therefore, with either joint the total bellows resistance at 4" or 8" travel is 1200 lbs. This increases the anchor load to 6900 plus 1200 lbs. or 8100 lbs. total. 1200/8100 =15%. If a competitive product were half as stiff, the anchorage requirement would drop to 7500 lbs. If twice as stiff, it would increase to 9300 lbs. In the real world, when designing an anchor, all these numbers are in the same order of magnitude. The spring force is relatively insignificant, except for an extremely unusual installation where there might be concern for buckling of copper pipe or something of that nature.

SAFETY FACTOR

Our last worry was the question of safety factor.

A flexible hose or internally pressurized expansion joint fails because the walls fail in tension beyond a given pressure. Since all housed expansion joints are pressurized externally, that is not the phenomena. The pressure on the outside eventually forces the corrugations to squirm and become distorted until they collapse completely, as shown by one of our test photographs.

Competitor Pressure Failures

According to the standards established by The Stainless Steel Expansion Joint Institute, an expansion joint is considered safe when this collapse occurs at 2.25 times the working pressure. That means the safety factor is only 2.25. Most manufacturers do not publish their collapse ratios, but a 2.25 safety factor seemed very low. Braided hoses have safety factors between 3 and 4. Why is 2.25 acceptable in an expansion joint?

Flexible products are always riskier than solid pipe, so it seemed only right that our housed expansion joints and expansion compensators should have a **safety factor** between **3.5** and **4** as published and what we have worked to in all designs.

All expansion joints are more subject to collapse, when fully extended. Our ratings are all at full extension. In many cases the collapse may take place without leakage. However, when the pipe system cools down and the cycle reverses, the collapsed area is crushed and dramatic leakage follows. Should it turn out our spring rates are higher than some of our competitors, it is because of our safer bellows construction. Safety is far more important than spring rate.

We have an elaborate test facility to test Mercer Rubber Expansion Joints and all Stainless Steel products. All product designs are thoroughly tested before marketing. Unfortunately, our tests show design ratings by competitors are often optimistic. Testing rather than theoretical design is the only answer.

Spring Rate Test in Progress

Hydro Pressure Test in Progress

If you have never had a problem with an expansion compensator or housed expansion joint, everything we have discussed may seem unimportant. However, our improvements will keep both of us out of trouble and make life easier. Let's review.

Mason Improvements

1. Good operating clearances to prevent binding.
2. A much better locking mechanism that can be used to partially compress joints prior to installation to allow for contraction as well as expansion on installations with temperatures below ambient when in service. The locking device is a permanent part of the construction. They can always be tightened to hold the expansion joint in a particular position for removal while piping is serviced.
3. A depth gauge on the moving end to monitor movements, make certain that joints are at the 0 position before installation, or used to pre-set joints in some preferred position.
4. Great attention to canister and pipe welding details.
5. Internal and external clearances to prevent bellows wear because of rubbing.
6. Safety factors between 3.5 and 4, compared to others at 2.25. Double drains on most designs, generous lifting near the center of gravity for easier handling.
7. A raised face flange and a floating flange on all flanged products for easier installation and bellows anti-torquing protection.
8. Grooved fittings are beveled as well to allow welding into pipe lines as an alternate method. (Mason does not recommend welding.)
9. Our staff of in-house engineers holding licenses in virtually all of the States with the capability to design or review complete piping systems when our clients need those services. We will try to help you in any case should you have bought from others that offer no engineering service. Seismic problems can be addressed as well.

If the following tables of externally pressurized stock items do not meet all of your requirements, please let us offer custom product. We also manufacture internally pressurized products and welcome inquiries on these as well. We are here to help.

Thanks for bearing with me.

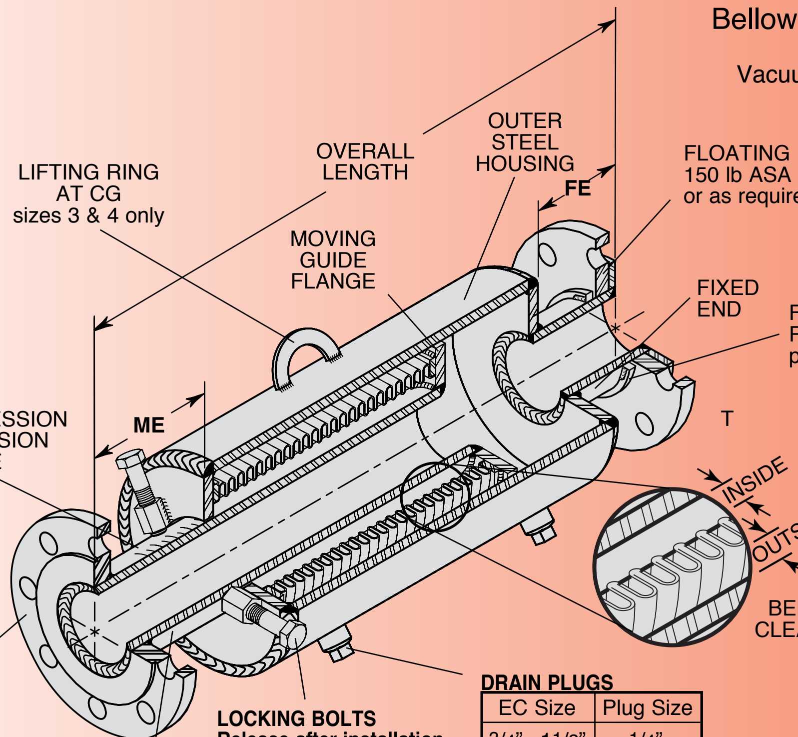
Norman J. Mason, President

ECFFL

2" (50mm) Movement
EXPANSION COMPENSATOR with FIXED & FLOATING FLANGES

Bellows are externally pressurized.
3.5 Minimum Safety Factor for both Bellows and Housing.

Vacuum Rating is 30 in (762mm) Hg



LOCKING BOLTS
Release after installation

EC Size	Bolt No & Size
3/4" – 2"	2 - 3/8"
2 1/2" – 3"	2 - 1/2"
4"	3 - 5/8"

DRAIN PLUGS

EC Size	Plug Size
3/4" – 1 1/2"	1/4"
2" – 3"	3/8"
4"	1/2"

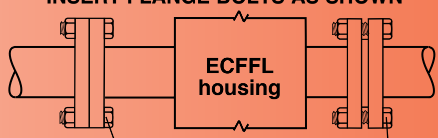
FLANGE BOLT and NUT REQUIREMENT (by Others)

ECFFL Size	Quantity	Size & Length
3/4	8	1/2 x 2 1/2
1	8	1/2 x 2 1/2
1 1/4	8	1/2 x 2 1/2
1 1/2	8	1/2 x 2 3/4
2 & 2 1/2	8	5/8 x 3
3	8	5/8 x 3 1/4
4	16	5/8 x 3 1/4

PRESSURE REDUCTION TABLE

Temperature (°F)	(°C)	Rated Pressure (psi)	(kg/cm²)
200	93	182	12.8
250	121	176	12.4
300	149	170	12.0
400	204	156	11.0
500	260	154	10.8
600	316	142	10.7
700	371	148	10.4
800	427	Not Recommended	

INSERT FLANGE BOLTS AS SHOWN



CARBON STEEL PLATE FLANGE THICKNESS

Pipe Size (in)	(mm)	Flange Thickness T (in)	(mm)
3/4 thru 4	20 thru 100	5/8	16

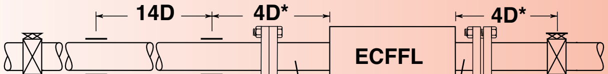
ECFFL DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 2" (50mm) COMPRESSION, 1/2" (13mm) EXTENSION

Type & Size	Pipe Size (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust† @ 200 psi (lbs)	13.8 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
ECFFL-3/4	3/4	20	12 1/2	318	3 1/2	89	1 3/4	44	2 7/8	73	0.10	3	0.43	11	89	16	350	159	200	14	11	5
ECFFL-1	1	25	12 1/2	318	3 1/2	89	1 3/4	44	3 1/2	89	0.13	3	0.55	14	95	17	500	227	200	14	14	6
ECFFL-1 1/4	1 1/4	32	13	330	3 3/4	95	2	51	4	102	0.15	4	0.47	12	103	18	800	363	200	14	15	7
ECFFL-1 1/2	1 1/2	40	13	330	3 3/4	95	2	51	4 1/2	114	0.17	4	0.46	12	106	19	1100	499	200	14	19	9
ECFFL-2	2	50	13 1/2	343	4 1/8	105	2 1/8	54	5 1/4	133	0.17	4	0.52	13	110	20	1600	726	200	14	24	11
ECFFL-2 1/2	2 1/2	65	14 1/4	362	4 1/4	108	2 1/4	55	6 1/4	159	0.24	6	0.53	14	126	23	2400	1089	200	14	35	16
ECFFL-3	3	80	14 3/4	375	4 1/2	115	2 1/2	65	6 5/8	168	0.32	8	0.37	9	140	25	3500	1588	200	14	47	21
ECFFL-4	4	100	14 3/4	375	4 1/2	115	2 1/2	65	8 5/8	219	0.33	8	0.81	21	150	27	5200	2359	200	14	70	32

†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

GUIDE SPACING – Referencing Pipe Diameter "D"

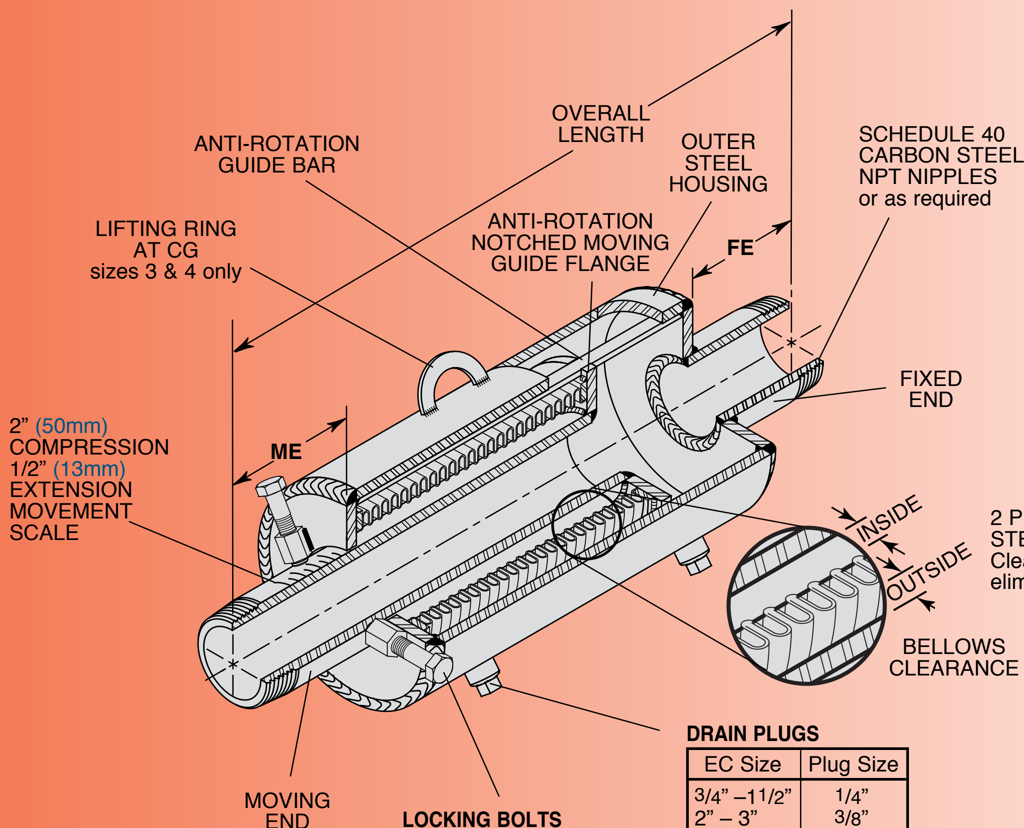
Guides and Anchor for ECFFL located near Anchor



Guides and Anchors for ECFFL located between Anchors

*Plus an additional 3" (76mm) for Sizes 3/4 to 2 1/2

Bellows are externally pressurized.
3.5 Minimum Safety Factor for both Bellows and Housing.



DRAIN PLUGS

EC Size	Plug Size
3/4" – 1 1/2"	1/4"
2" – 3"	3/8"
4"	1/2"

LOCKING BOLTS
Release after installation

EC Size	Bolt No & Size
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2 1/2" – 3"	2 - 1/2"
4"	3 - 5/8"

PRESSURE REDUCTION TABLE

Temperature (°F)	(°C)	Rated Pressure (psi)	(kg/cm²)
200	93	182	12.8
250	121	176	12.4
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400	204	156	11.0
500	260	154	10.8
600	316	142	10.7
700	371	148	10.4
800	427	Not Recommended	

Vacuum Rating is 30 in (762mm) Hg

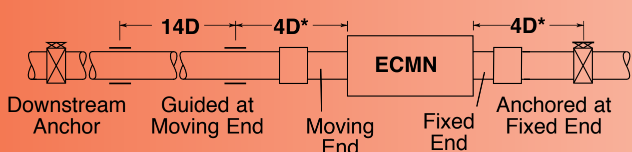
ECMN DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 2" (50mm) COMPRESSION, 1/2" (13mm) EXTENSION

Type & Size	Pipe Size (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust† @ 200 psi (lbs)	13.8 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
ECMN-3/4	3/4	20	12 1/2	318	3 3/4	95	1 5/8	40	2 7/8	73	0.10	3	0.43	11	89	16	350	159	200	14	7	3
ECMN-1	1	25	12 1/2	318	3 3/4	95	1 5/8	40	3 1/2	89	0.13	3	0.55	14	95	17	500	227	200	14	10	4
ECMN-1 1/4	1 1/4	32	13	330	4	100	1 7/8	46	4	102	0.15	4	0.47	12	103	18	800	363	200	14	11	5
ECMN-1 1/2	1 1/2	40	13	330	4	100	1 7/8	46	4 1/2	114	0.17	4	0.46	12	106	19	1100	499	200	14	13	6
ECMN-2	2	50	13 1/2	343	4 1/8	103	2 1/8	53	5 1/4	133	0.17	4	0.52	13	110	20	1600	726	200	14	16	7
ECMN-2 1/2	2 1/2	65	14 1/4	362	4 3/8	110	2 1/4	55	6 1/4	159	0.24	6	0.53	14	126	23	2400	1089	200	14	23	10
ECMN-3	3	80	14 3/4	375	4 1/2	115	2 1/2	65	6 5/8	168	0.32	8	0.37	9	140	25	3500	1588	200	14	32	15
ECMN-4	4	100	14 3/4	375	4 1/2	115	2 1/2	65	8 5/8	219	0.33	8	0.81	21	150	27	5200	2359	200	14	50	23

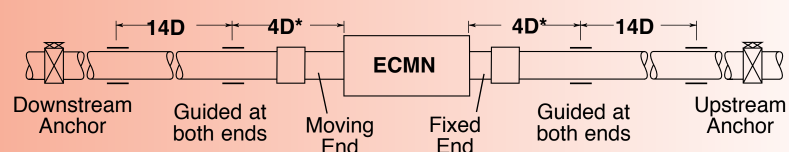
†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

GUIDE SPACING – Referencing Pipe Diameter "D"

Guides and Anchor for ECMN located near Anchor



Guides and Anchors for ECMN located between Anchors

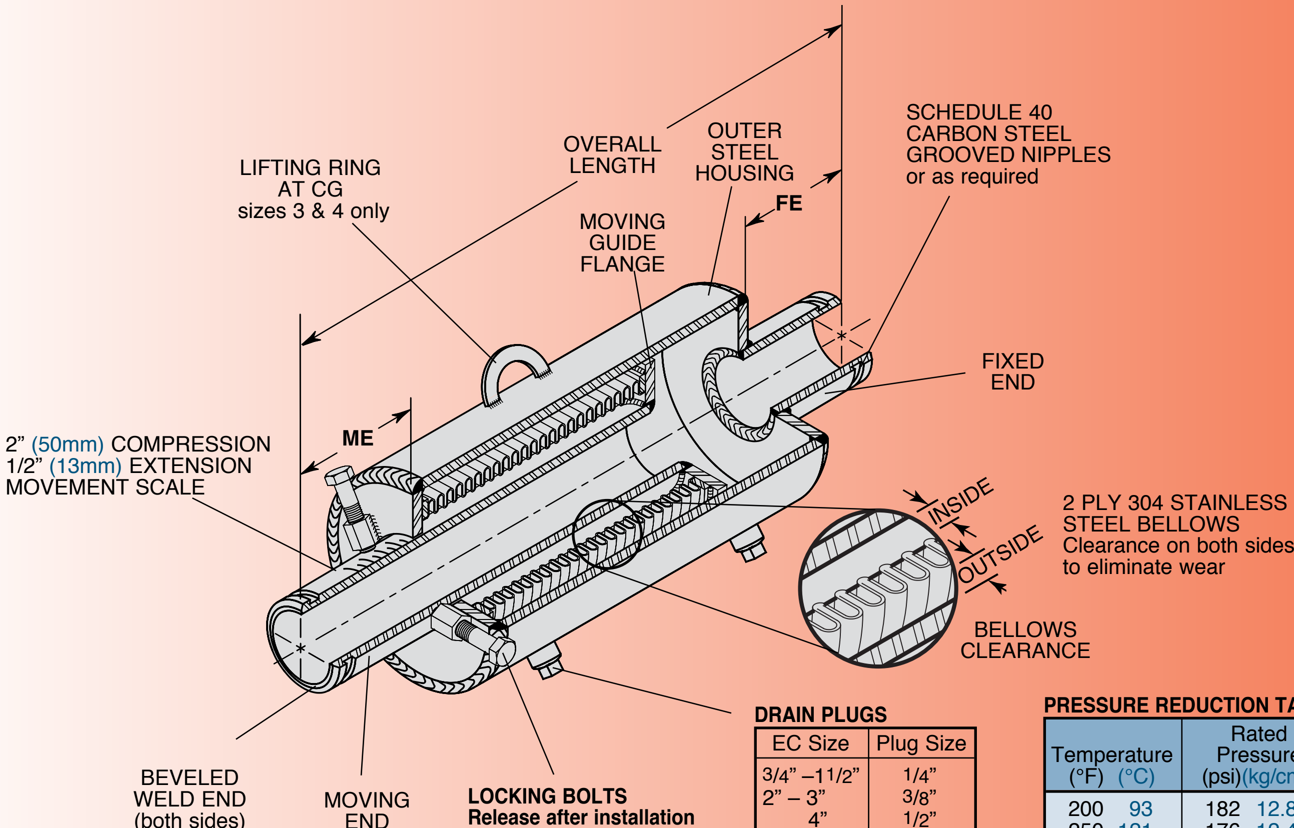


*Plus an additional 3" (76mm) for Sizes 3/4 to 2 1/2

ECWGN

2" (50mm) Movement
EXPANSION COMPENSATOR WELD END GROOVED NIPPLES

Bellows are externally pressurized.
3.5 Minimum Safety Factor for both Bellows and Housing.



DRAIN PLUGS

EC Size	Plug Size
3/4" – 1 1/2"	1/4"
2" – 3"	3/8"
4"	1/2"

LOCKING BOLTS
Release after installation

EC Size	Bolt No & Size
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2 1/2" – 3"	2 - 1/2"
4"	3 - 5/8"

PRESSURE REDUCTION TABLE

Temperature (°F)	(°C)	Rated Pressure (psi)	(kg/cm²)
200	93	182	12.8
250	121	176	12.4
300	149	170	12.0
400	204	156	11.0
500	260	154	10.8
600	316	142	10.7
700	371	148	10.4
800	427	Not Recommended	

GROOVED NIPPLES MAY BE WELDED IN PIPELINES AS AN ALTERNATE. MASON DOES NOT RECOMMEND WELDING.

Vacuum Rating is 30 in (762mm) Hg

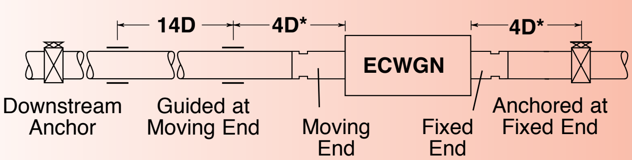
ECWGN DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 2" (50mm) COMPRESSION, 1/2" (13mm) EXTENSION

Type & Size	Pipe Size (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Nominal Bellows Clearance Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust† @ 200 psi (lbs)	13.8 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
ECWGN-3/4	3/4	20	12 1/2	318	3 3/4	95	1 5/8	40	2 7/8	73	0.10	3	0.43	11	89	16	350	159	200	14	7	3
ECWGN-1	1	25	12 1/2	318	3 3/4	95	1 5/8	40	3 1/2	89	0.13	3	0.55	14	95	17	500	227	200	14	9	4
ECWGN-1 1/4	1 1/4	32	13	330	4	100	1 7/8	46	4	102	0.15	4	0.47	12	103	18	800	363	200	14	10	5
ECWGN-1 1/2	1 1/2	40	13	330	4	100	1 7/8	46	4 1/2	114	0.17	4	0.46	12	106	19	1100	499	200	14	13	6
ECWGN-2	2	50	13 1/2	343	4 1/8	103	2 1/4	55	5 1/4	133	0.17	4	0.52	13	110	20	1600	726	200	14	17	8
ECWGN-2 1/2	2 1/2	65	14 1/4	362	4 3/8	110	2 1/4	55	6 1/4	159	0.24	6	0.53	14	126	23	2400	1089	200	14	24	11
ECWGN-3	3	80	14 3/4	375	4 1/2	115	2 1/2	65	6 5/8	168	0.32	8	0.37	9	140	25	3500	1588	200	14	33	15
ECWGN-4	4	100	14 3/4	375	4 1/2	115	2 1/2	65	8 5/8	219	0.33	8	0.81	21	150	27	5200	2359	200	14	50	23

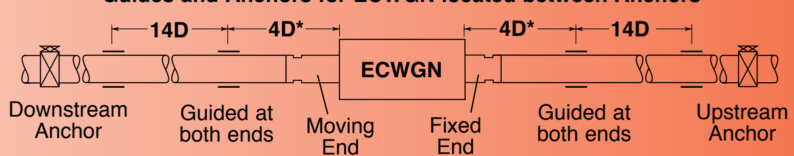
†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

GUIDE SPACING – Referencing Pipe Diameter "D"

Guides and Anchor for ECWGN located near Anchor

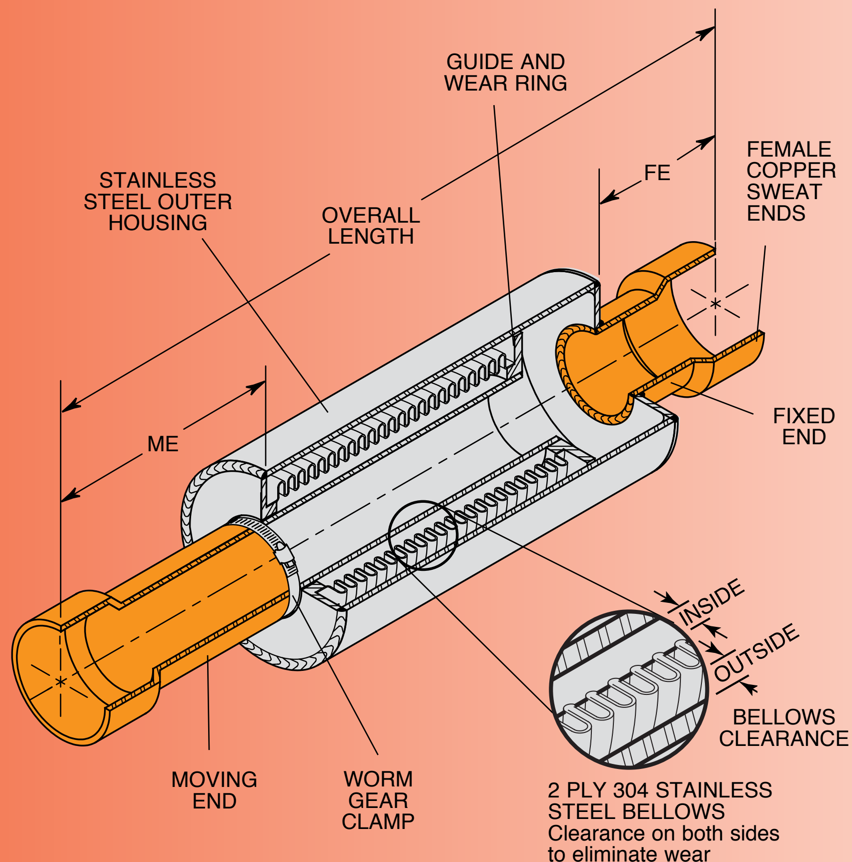


Guides and Anchors for ECWGN located between Anchors



*Plus an additional 3" (76mm) for Sizes 3/4 to 2 1/2

Bellows are externally pressurized.
3.5 Minimum Safety Factor for both Bellows and Housing.



INSTALLATION:

1. Thoroughly clean male and female ends using steel wool and steel brushes.
2. Apply flux.
3. Heat joint for proper flow of silver solder. Silver solder flows around 430°F. Composition is silver and tin only. There should be no lead content.
4. Do not use brazing rod or other high temperature techniques. Overheating will cause leaks.
5. Remove Worm Gear Clamp.

PRESSURE REDUCTION TABLE

Temperature (°F)	(°C)	Rated Pressure (psi)	(kg/cm²)
150	66	160	11
300	149	145	10
400	204	135	9

Vacuum Rating is 30 in (762mm) Hg

ECCPS DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 2” (50mm) COMPRESSION, 1/2” (13mm) EXTENSION

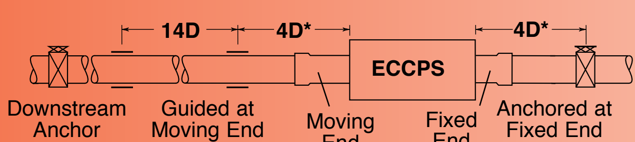
Type & Size	Tubing Size†† (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust†† @ 200 psi (lbs)	13.8 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
ECCPS-3/4	3/4	20	11 1/2	292	3 1/8	79	1 5/8	40	2	51	0.17	4	0.11	3	23	4	320	145	200	14	2	1
ECCPS-1	1	25	11 1/2	292	3 1/8	79	1 5/8	40	2	51	0.22	6	0.13	3	44	8	520	236	200	14	2	1
ECCPS-1 1/4	1 1/4	32	12	305	3 1/2	89	1 3/4	44	2 3/4	70	0.20	5	0.22	6	50	9	630	286	200	14	3	2
ECCPS-1 1/2	1 1/2	40	12	305	3 1/2	89	1 3/4	44	2 3/4	70	0.17	4	0.20	5	98	18	750	340	200	14	4	2
ECCPS-2	2	50	12 1/4	311	3 3/4	95	1 3/4	44	3 1/2	89	0.16	4	0.13	3	168	30	1160	526	200	14	5	2
ECCPS-2 1/2	2 1/2	65	13 1/4	337	4 1/4	108	2 1/8	54	4	102	0.20	5	0.22	6	195	35	1810	821	200	14	6	3
ECCPS-3	3	80	13 1/4	337	4 1/4	108	2 1/8	54	4 1/4	114	0.21	5	0.28	7	316	57	2440	1107	200	14	7	3
ECCPS-4	4	100	14 1/2	368	4 3/8	111	2 1/2	65	6	150	0.14	4	0.30	8	350	63	3700	1678	200	14	25	11

††Female end fits over copper tubing, e.g. 1 1/2” (40mm) fits over 1 1/2” (40mm) tubing.

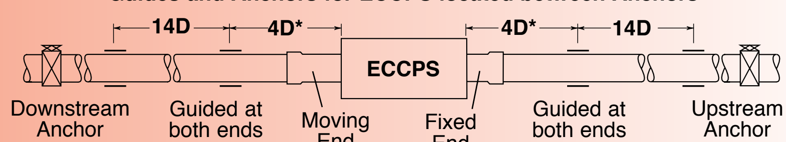
†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

GUIDE SPACING – Referencing Pipe Diameter “D”

Guides and Anchor for ECCPS located near Anchor



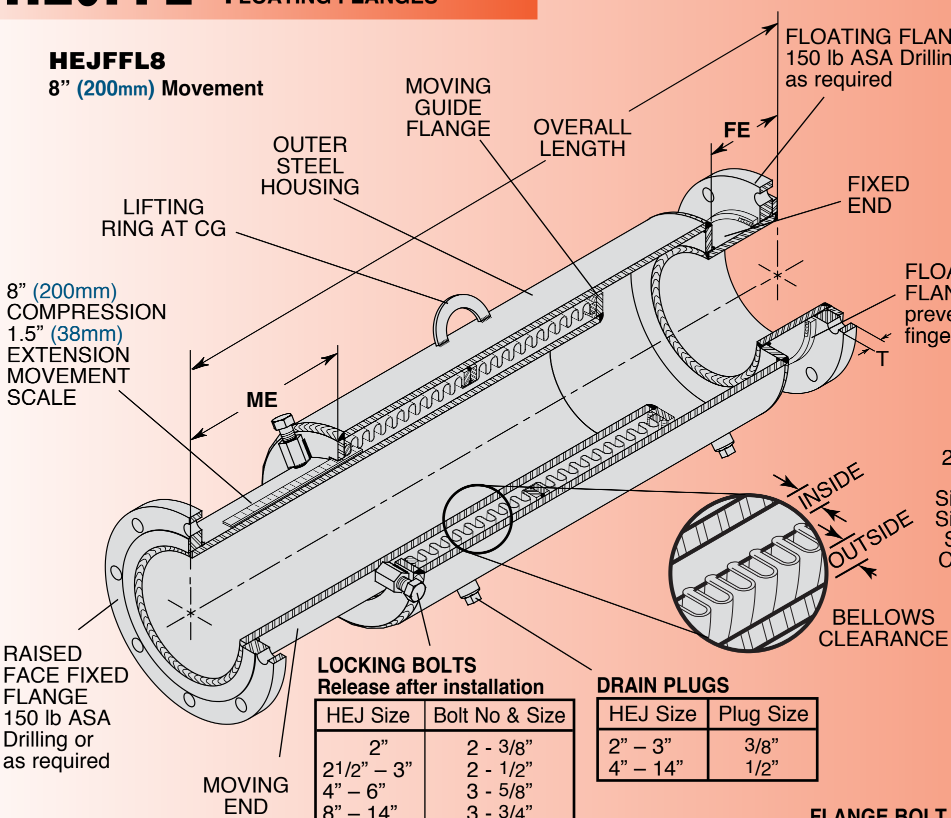
Guides and Anchors for ECCPS located between Anchors

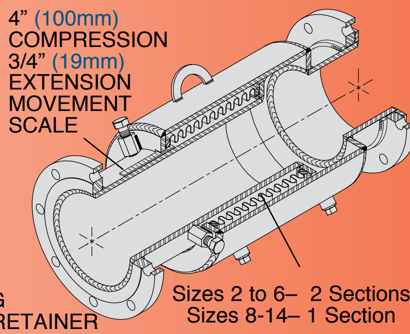


*Plus an additional 3” (76mm) for Sizes 3/4 to 2 1/2

HEJFFL HOUSED EXPANSION JOINT with FIXED and FLOATING FLANGES

HEJFFL8
8" (200mm) Movement





HEJFFL4
4" (100mm) Movement

2 PLY 304 STAINLESS STEEL BELLOWS
Sizes 2 to 3– 4 Sections
Sizes 4 to 6– 3 Sections
Sizes 8-14– 2 Sections
Clearance on both sides to eliminate wear

Bellows are externally pressurized. 3.5 Minimum Safety Factor for both Bellows and Housing.

LOCKING BOLTS
Release after installation

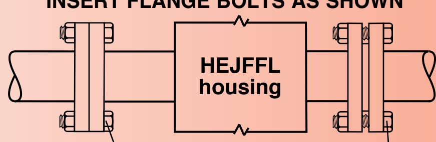
HEJ Size	Bolt No & Size
2"	2 - 3/8"
2 1/2" – 3"	2 - 1/2"
4" – 6"	3 - 5/8"
8" – 14"	3 - 3/4"

DRAIN PLUGS

HEJ Size	Plug Size
2" – 3"	3/8"
4" – 14"	1/2"

Vacuum Rating is 30 in (762mm) Hg

INSERT FLANGE BOLTS AS SHOWN



HEAD AT FIXED FLANGE– INSIDE
HEAD AT FLOATING FLANGE– PIPE SIDE

CARBON STEEL PLATE FLANGE

Pipe Size (in)	Pipe Size (mm)	Flange Thickness T (in)	Flange Thickness T (mm)
2 thru 4	20 thru 100	5/8	16
5 thru 6	125 thru 150	3/4	19
8 thru 14	200 thru 350	1	25

FLANGE BOLT and NUT REQUIREMENT (by Others)

HEJFFL Size	Quantity	Size & Length
2 & 2 1/2	8	5/8 x 3
3	8	5/8 x 3 1/4
4	16	5/8 x 3 1/4
5 & 6	16	3/4 x 3 1/2
8	16	3/4 x 4
10	24	3/4 x 4
12	24	7/8 x 4 1/4
14	24	1 x 4 1/2

PRESSURE REDUCTION TABLE

Temperature (°F)	Temperature (°C)	Rated Pressure (psi)	Rated Pressure (kg/cm²)
200	93	205	14.4
250	121	198	13.9
300	149	191	13.4
400	204	176	12.4
500	260	173	12.2
600	316	171	12.0
700	371	167	11.7
800	427	Not Recommended	

HEJFFL4 DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 4" (100mm) COMPRESSION, 3/4" (19mm) EXTENSION

Type & Size	Pipe Size (in)	Pipe Size (mm)	Overall Length (in)	Overall Length (mm)	ME Moving End Neutral Length (in)	ME (mm)	FE Fixed End Length (in)	FE (mm)	Outer Housing O.D. (in)	Outer Housing O.D. (mm)	Nominal Bellows Clearance Inside (in)	Inside (mm)	Outside (in)	Outside (mm)	Spring Rate (lbs/in)	Spring Rate (kg/cm)	Thrust† @ 225 psi (lbs)	Thrust† @ 15.5 bar (kg)	Rated Pressure @70°F (psi)	Rated Pressure @21°C (kg/cm²)	Ship Wt. (lbs)	Ship Wt. (kg)
HEJFFL4-2	2	50	26 1/2	673	8 3/8	213	3 1/8	79	5 9/16	141	0.39	10	0.39	10	165	30	2500	1134	225	16	50	23
HEJFFL4-2 1/2	2 1/2	65	26 1/2	673	8 3/8	213	3 1/8	79	5 9/16	141	0.25	6	0.25	6	235	42	2700	1225	225	16	51	23
HEJFFL4-3	3	80	26 1/2	673	8 3/8	213	3 1/8	79	6 5/8	168	0.32	8	0.33	8	240	43	3900	1769	225	16	65	29
HEJFFL4-4	4	100	26 1/2	673	8 3/8	213	3 1/8	79	8 5/8	219	0.49	12	0.35	9	300	54	6900	3130	225	16	87	39
HEJFFL4-5	5	125	28 1/2	723	8 3/8	213	4 1/8	105	9 5/8	244	0.39	10	0.41	10	400	72	9500	4309	225	16	90	41
HEJFFL4-6	6	150	28 1/2	723	8 3/8	213	4 1/8	105	10 3/4	273	0.39	10	0.39	10	500	90	12600	5715	225	16	137	62
HEJFFL4-8	8	200	28 1/2	723	8 3/8	213	4 1/8	105	12 3/4	384	0.39	10	0.39	10	600	107	19000	8618	225	16	180	82
HEJFFL4-10	10	250	28 1/2	723	8 3/8	213	4 1/8	105	16	406	0.53	13	0.53	13	800	143	30000	13608	225	16	230	104
HEJFFL4-12	12	300	28 1/2	723	8 3/8	213	4 1/8	105	18	457	0.42	11	0.41	10	1175	210	40000	18144	225	16	273	124
HEJFFL4-14	14	350	30	762	8 3/8	213	4 1/8	105	20	500	0.43	11	0.42	11	1400	250	64000	29030	225	16	320	145

HEJFFL8 DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 8" (200mm) COMPRESSION, 1.5" (38mm) EXTENSION

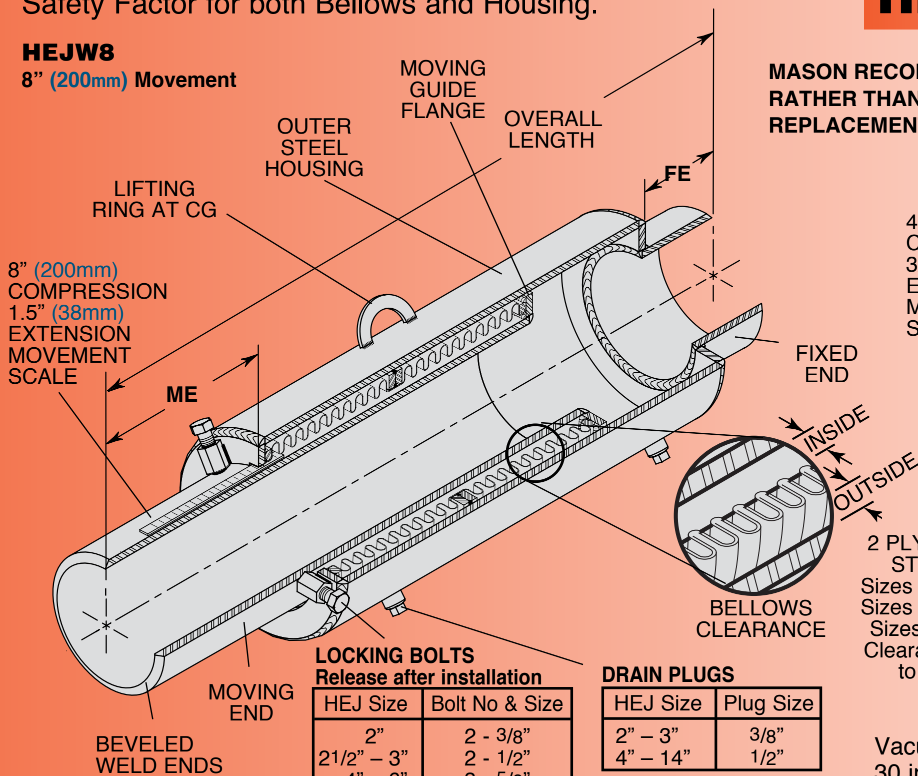
Type & Size	Pipe Size (in)	Pipe Size (mm)	Overall Length (in)	Overall Length (mm)	ME Moving End Neutral Length (in)	ME (mm)	FE Fixed End Length (in)	FE (mm)	Outer Housing O.D. (in)	Outer Housing O.D. (mm)	Nominal Bellows Clearance Inside (in)	Inside (mm)	Outside (in)	Outside (mm)	Spring Rate (lbs/in)	Spring Rate (kg/cm)	Thrust† @ 225 psi (lbs)	Thrust† @ 15.5 bar (kg)	Rated Pressure @70°F (psi)	Rated Pressure @21°C (kg/cm²)	Ship Wt. (lbs)	Ship Wt. (kg)
HEJFFL8-2	2	50	43	1092	10 7/8	276	3 1/8	79	5 9/16	141	0.39	10	0.39	10	83	15	2500	1134	225	16	50	23
HEJFFL8-2 1/2	2 1/2	65	43	1092	10 7/8	276	3 1/8	79	5 9/16	141	0.25	6	0.25	6	118	21	2700	1225	225	16	51	23
HEJFFL8-3	3	80	43	1092	10 7/8	276	3 1/8	79	6 5/8	168	0.32	8	0.33	8	120	22	3900	1769	225	16	65	29
HEJFFL8-4	4	100	43	1092	10 7/8	276	3 1/8	79	8 5/8	219	0.49	12	0.35	9	150	27	6900	3130	225	16	87	39
HEJFFL8-5	5	125	47	1194	12 7/8	327	4 1/8	105	9 5/8	244	0.39	10	0.41	10	200	36	9500	4309	225	16	90	41
HEJFFL8-6	6	150	47	1194	12 7/8	327	4 1/8	105	10 3/4	273	0.39	10	0.39	10	250	45	12600	5715	225	16	137	62
HEJFFL8-8	8	200	47	1194	12 7/8	327	4 1/8	105	12 3/4	384	0.39	10	0.39	10	300	54	19000	8618	225	16	180	82
HEJFFL8-10	10	250	47	1194	12 7/8	327	4 1/8	105	16	406	0.53	13	0.53	13	400	72	30000	13608	225	16	230	104
HEJFFL8-12	12	300	47	1194	12 7/8	327	4 1/8	105	18	457	0.42	11	0.41	10	588	105	40000	18144	225	16	273	124
HEJFFL8-14	14	350	50	1270	12 7/8	327	4 1/8	105	20	500	0.43	11	0.42	11	700	125	64000	29030	225	16	320	145

†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

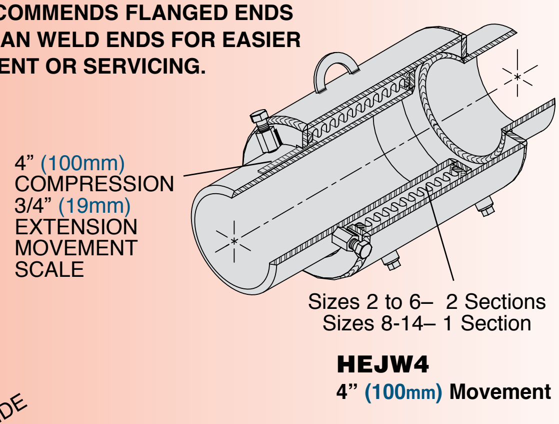
HEJW HOUSED EXPANSION JOINT with WELD ENDS

Bellows are externally pressurized. 3.5 Minimum Safety Factor for both Bellows and Housing.

HEJW8
8" (200mm) Movement



MASON RECOMMENDS FLANGED ENDS RATHER THAN WELD ENDS FOR EASIER REPLACEMENT OR SERVICING.



HEJW4
4" (100mm) Movement

2 PLY 304 STAINLESS STEEL BELLOWS
Sizes 2 to 3– 4 Sections
Sizes 4 to 6– 3 Sections
Sizes 8-14– 2 Sections
Clearance on both sides to eliminate wear

LOCKING BOLTS
Release after installation

HEJ Size	Bolt No & Size
2"	2 - 3/8"
21/2" – 3"	2 - 1/2"
4" – 6"	3 - 5/8"
8" – 14"	3 - 3/4"

DRAIN PLUGS

HEJ Size	Plug Size
2" – 3"	3/8"
4" – 14"	1/2"

Vacuum Rating is 30 in (762mm) Hg

PRESSURE REDUCTION TABLE

Temperature (°F)	(°C)	Rated Pressure (psi)	(kg/cm²)
200	93	205	14.4
250	121	198	13.9
300	149	191	13.4
400	204	176	12.4
500	260	173	12.2
600	316	171	12.0
700	371	167	11.7
800	427	Not Recommended	

HEJW4 DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 4" (100mm) COMPRESSION, 3/4" (19mm) EXTENSION

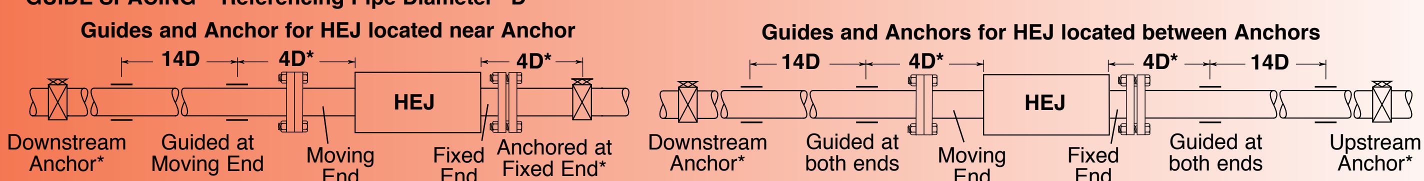
Type & Size	Pipe Size (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust† @ 225 psi (lbs)	15.5 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
HEJW4-2	2	50	22	559	51/2	140	11/2	38	59/16	141	0.39	10	0.39	10	165	30	2500	1134	225	16	50	23
HEJW4-21/2	21/2	65	22	559	51/2	140	11/2	38	59/16	141	0.25	6	0.25	6	235	42	2700	1225	225	16	51	23
HEJW4-3	3	80	22	559	51/2	140	11/2	38	65/8	168	0.32	8	0.33	8	240	43	3900	1769	225	16	65	29
HEJW4-4	4	100	241/2	622	6	152	11/2	38	85/8	219	0.49	12	0.35	9	300	54	6900	3130	225	16	87	39
HEJW4-5	5	125	241/2	622	6	152	21/2	64	95/8	244	0.39	10	0.41	10	400	72	9500	4309	225	16	90	41
HEJW4-6	6	150	241/2	622	6	152	21/2	64	103/4	273	0.39	10	0.39	10	500	90	12600	5715	225	16	137	62
HEJW4-8	8	200	241/2	622	6	152	21/2	64	123/4	384	0.39	10	0.39	10	600	107	19000	8618	225	16	180	82
HEJW4-10	10	250	241/2	622	6	152	21/2	64	16	406	0.53	13	0.53	13	800	143	30000	13608	225	16	230	104
HEJW4-12	12	300	241/2	622	6	152	21/2	64	18	457	0.42	11	0.41	10	1175	210	40000	18144	225	16	273	124
HEJW4-14	14	350	26	660	6	152	21/2	64	20	500	0.43	11	0.42	11	1400	250	64000	29030	225	16	320	145

HEJW8 DIMENSIONS AND PRESSURE RATINGS (British & Metric Units) 8" (200mm) COMPRESSION, 1.5" (38mm) EXTENSION

Type & Size	Pipe Size (in)	(mm)	Overall Length (in)	(mm)	ME Moving End Neutral Length (in)	(mm)	FE Fixed End Length (in)	(mm)	Outer Housing O.D. (in)	(mm)	Nominal Bellows Clearance Inside (in)	(mm)	Outside (in)	(mm)	Spring Rate (lbs/in)	(kg/cm)	Thrust† @ 225 psi (lbs)	15.5 bar (kg)	Rated Pressure @70°F (psi)	@21°C (kg/cm²)	Ship Wt. (lbs)	(kg)
HEJW8-2	2	50	40	1016	91/2	241	11/2	38	59/16	141	0.39	10	0.39	10	83	15	2500	1134	225	16	50	23
HEJW8-21/2	21/2	65	40	1016	91/2	241	11/2	38	59/16	141	0.25	6	0.25	6	118	21	2700	1225	225	16	51	23
HEJW8-3	3	80	40	1016	91/2	241	11/2	38	65/8	168	0.32	8	0.33	8	120	22	3900	1769	225	16	65	29
HEJW8-4	4	100	40	1016	91/2	241	11/2	38	85/8	219	0.49	12	0.35	9	150	27	6900	3130	225	16	87	39
HEJW8-5	5	125	421/2	1080	10	254	21/2	64	95/8	244	0.39	10	0.41	10	200	36	9500	4309	225	16	90	41
HEJW8-6	6	150	421/2	1080	10	254	21/2	64	103/4	273	0.39	10	0.39	10	250	45	12600	5715	225	16	137	62
HEJW8-8	8	200	421/2	1080	10	254	21/2	64	123/4	384	0.39	10	0.39	10	300	54	19000	8618	225	16	180	82
HEJW8-10	10	250	421/2	1080	10	254	21/2	64	16	406	0.53	13	0.53	13	400	72	30000	13608	225	16	230	104
HEJW8-12	12	300	421/2	1080	10	254	21/2	64	18	457	0.42	11	0.41	10	588	105	40000	18144	225	16	273	124
HEJW8-14	14	350	451/2	1156	10	254	21/2	64	20	500	0.43	11	0.42	11	700	125	64000	29030	225	16	320	145

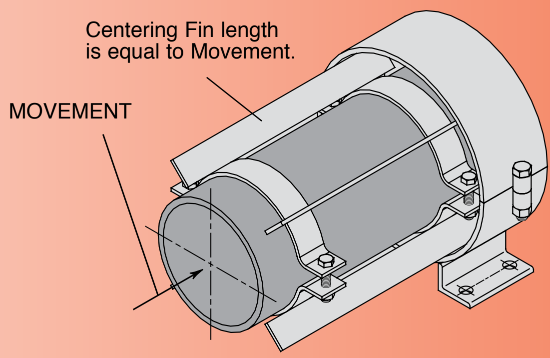
†Lower Thrust Forces in proportion at lower pressures, i.e. 100 psi Force = 100/225 x published Thrust. Forces on Pipe Anchors must include Thrust Force and Spring Force. Spring Force is determined by multiplying the joint Spring Rate by its Thermal Movement (in/mm).

GUIDE SPACING – Referencing Pipe Diameter "D"

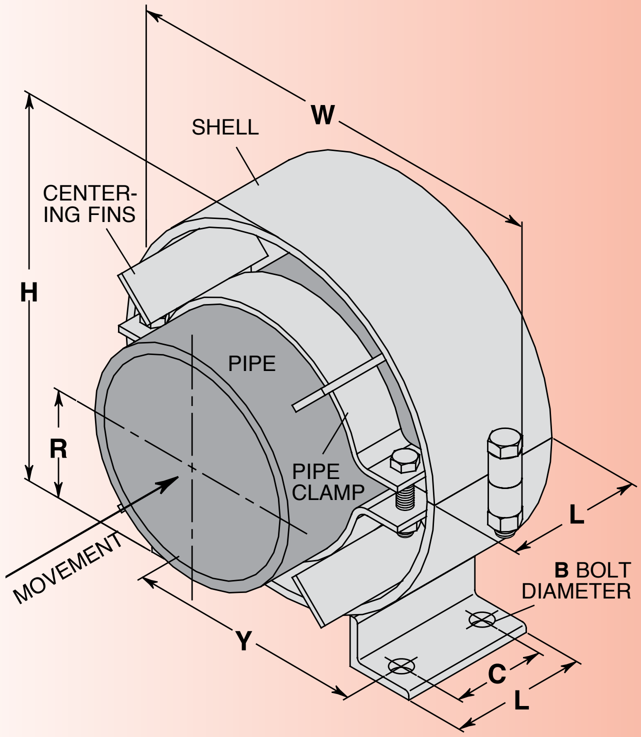


*Plus an additional 5" (125mm) for Sizes 2 & 21/2

SPG TYPICAL SPIDER PIPE GUIDES



Typical GG through PP Two Clamp Configuration



Typical AA through FF One Clamp Configuration

SPG SHELL SELECTION TABLE for 4" (100mm), 6" (150mm) & 8" (200mm) MOVEMENT

Pipe Size (in)	Pipe Size (mm)	SHELL CODE LETTERS / Insulation Thickness 1" 25mm	1 1/2" 32mm	2" 50mm	2 1/2" 65mm	3" 80mm	3 1/2" 90mm	4" 100mm	Max. Standard Mvmt.±* (in)	Max. Standard Mvmt.±* (mm)
1/2	15	AA	AA	BB	DD	DD	DD	EE	4	100
3/4	20	AA	BB	CC	DD	DD	EE	EE	4	100
1	25	AA	BB	CC	DD	DD	EE	EE	4	100
1 1/4	32	AA	BB	CC	DD	DD	EE	EE	4	100
1 1/2	40	BB	BB	CC	DD	DD	EE	EE	4	100
2	50	BB	CC	DD	DD	EE	EE	FF	4	100
2 1/2	65	CC	CC	DD	DD	EE	EE	FF	4	100
3	80	CC	DD	DD	EE	FF	FF	FF	4	100
4	100	DD	DD	EE	EE	FF	FF	GG	6	150
5	125	EE	EE	EE	FF	FF	GG	HH	6	150
6	150	EE	EE	FF	FF	GG	HH	HH	6	150
8	200	FF	FF	GG	HH	HH	JJ	JJ	6	150
10	250	HH	HH	HH	JJ	JJ	KK	KK	6	150
12	300	JJ	JJ	JJ	KK	KK	LL	LL	8	150
14	350	KK	KK	KK	KK	LL	LL	MM	8	150
16	400	LL	LL	LL	LL	MM	MM	NN	8	150
18	450	MM	MM	MM	MM	NN	NN	NN	8	150
20	500	NN	NN	NN	NN	PP	PP	PP	8	150
24	600	PP	PP	PP	PP	—	—	—	8	150

*Centering Fin length is equal to the Maximum Standard Movement. Non-standard movements are available.

SPG DIMENSIONS (inches)

Type	Shell Code	H	R	W	Y	B	C	L
SPG	AA	5 7/8	3 1/2	6 1/8	4 1/8	5/8	1 3/4	3
SPG	BB	6 3/4	4	7 1/8	4 3/8	5/8	1 3/4	3
SPG	CC	7 5/8	4 3/8	8 1/8	5 1/8	5/8	1 3/4	3
SPG	DD	9 1/4	5 1/4	10 1/8	6 1/8	5/8	1 3/4	3
SPG	EE	11 5/8	6 1/4	12 1/8	7	5/8	2 3/4	4
SPG	FF	13 3/8	7	14 1/8	8 1/4	5/8	2 3/4	4
SPG	GG	15 1/8	7 7/8	16 1/8	9 7/8	3/4	4	6
SPG	HH	17	8 7/8	18 1/8	10 7/8	3/4	4	6
SPG	JJ	18 3/4	9 3/4	20 1/8	11 7/8	3/4	4	6
SPG	KK	21	10 7/8	22 1/8	11 3/4	3/4	6	8
SPG	LL	23 1/8	12 1/8	24 1/8	14 1/2	7/8	6	8
SPG	MM	25	13	26 1/8	15 1/2	7/8	6	8
SPG	NN	27 3/4	14 3/4	28 1/8	17 1/8	1 1/8	6	8
SPG	PP	31 1/2	16 1/2	32 1/8	19 1/4	1 1/8	6	8

SPG DIMENSIONS (mm)

Type	Shell Code	H	R	W	Y	B	C	L
SPG	AA	149	90	156	104	16	44	76
SPG	BB	171	102	181	111	16	44	76
SPG	CC	194	111	206	130	16	44	76
SPG	DD	235	133	257	156	16	44	76
SPG	EE	295	159	308	178	16	70	102
SPG	FF	340	178	360	210	16	70	102
SPG	GG	384	200	410	251	19	102	152
SPG	HH	432	225	460	276	19	102	152
SPG	JJ	476	248	511	302	19	102	152
SPG	KK	533	276	562	298	19	152	203
SPG	LL	587	308	613	368	22	152	203
SPG	MM	635	330	664	394	22	152	203
SPG	NN	705	375	714	435	22	152	203
SPG	PP	800	419	816	489	22	152	203

MASON – MERCER
350 Rabro Drive, Hauppauge, NY 11788 • FAX 631/348-0279
MASON– 631/348-0282 • Email info@Mason-Ind.com • Website www.Mason-Ind.com
MERCER– 631/582-1524 • Email info@Mercer-Rubber.com • Website www.Mercer-Rubber.com

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