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A HISTORY OF
MASONFLEX
SUPERFLEX
& SAFEFLEX

SAFEFLEX Development

SEJ-3 BULLETIN

MASONFLEX

Single-Sphere MASONFLEX MFNC

Twin-Sphere MASONFLEX MFTNC

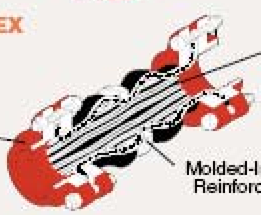
MASONFLEX MFTFU

SUPERFLEX

Single-Sphere SUPERFLEX MFNC

Twin-Sphere SUPERFLEX MFTNC

SUPERFLEX MFTFU



In 1976 we introduced our first spherical expansion joints, under the name "MASONFLEX". Although we had higher burst pressures than the other manufacturers, our technical literature still made people aware that Nylon reinforcement had to be derated at higher temperatures. MASONFLEX connectors did not always require control rod protection as the lengths at given pressures were predictable. Leaving a gap in the piping equal to these elongated lengths eliminated the control rods. Running field tests with many acoustical consultants proved the ability of twin sphere connectors to dramatically reduce sound and vibration transmission at blade passage frequency (number of pump blades x rpm).

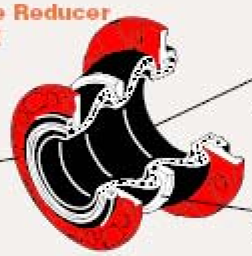
Our engineers never stand still when there is room for improvement and the company moved on to "SUPERFLEX". The SUPERFLEX elastomer was changed from Neoprene to EPDM as most applications are for water service. EPDM is superior to Neoprene in minimizing water swell and resistance to oxygen and ozone aging is outstanding. High temperature tolerance is much better as well.

All lengths were shortened to save space. The steel ring between the twin spheres prevented bulging, allowed for higher pressure ratings, reduced elongation and a higher range of pressures could be accommodated without the use of control rods.

The threaded union ends of the 3/4" (19mm) to 2" (50mm) diameter MFTFU were changed to three bolt flanges that could be supplied with fittings for copper tubing, stainless steel or PVC as well as standard pipe thread. This interchangeability of fittings was unknown in the industry and no other firm offers these options. The bolted flanged ends made installation both easier and more positive.

By changing to this ductile flange construction in the 3/4" (19mm) to 2" (50mm) sizes, we were able to increase the O.D. of the rubber flange that establishes the seal. This eliminated the pullout problems still so common to our competitors that continue to use cheap standard female unions. This change in end design has been widely copied because the engineering is so obviously better.

The SUPERFLEX series also included concentric reducers in all the popular sizes 3" (75mm) through 10" (250mm). This was the first such spherical connector and it continues to be something only available from Mason Industries. The molds are extremely expensive, and the product very difficult to build so our competitors have let that one slide by.



Between the two products, MASONFLEX and SUPERFLEX, we sell approximately 12,000 expansion joints per year with constantly increasing volume in spite of the influx of cheap copycat expansion joints from Taiwan, Malaysia, Korea and China. As with automotive tires, there must be some failures at this tremendous sales volume. While we feel that our failure percentage is much lower than our competitors, whenever there is a failure in a water pipeline, the cost of replacing the connector is nothing as compared to the water damage.

Equipment room drains are seldom designed to handle major failures. The water builds up in the equipment room and spills over to adjacent areas causing electrical problems and expensive cosmetic damage such as repainting of walls, soaking of carpets, and opening walls to make repairs. We are not talking about pin hole leakage but actual burst in the bodies or pullout at the flanges.

Hose body failures generally occur after many years of service in hot water systems. We found that the EPDM bodies would gradually harden and crack although the technical literature indicated that this should not be happening. Our Nylon tire cord reinforcement was an industry standard. We were aware of the need to lower the pressures at higher temperatures but not of the ultimate loss of tensile strength.

Spherical designs did not originate in the Far East where most spherical connectors are being manufactured. The technology started in Europe, was copied in Japan and we introduced it in Taiwan as participating partners.

Since expansion joints are labor intensive, production keeps moving to other countries as labor costs go up. Taiwan has progressed to high tech industries that are replacing the old rubber and foundry base. The same thing had happened in Japan. Thus the Japanese export manufacturers, some of whom had switched to Taiwan, have now moved on to Third World areas such as Malaysia. Mason Industries has opened a factory in Thailand. There are some exporters in Korea but the most recent entry is China. We know very little about the Chinese quality as they have just entered the American market so there is no installation history.

There is a misunderstanding about the size of the average spherical expansion joint factory in Asia. Most of the expansion joints are produced in small factories (less than 20 employees) that contain presses and mills, but not a 3 or 4 roll machine called a calender. This production weakness is extremely important because the calender is used to force the rubber into the tire cord reinforcement fabrics in a process called frictioning. Since these small factories simply do not have enough room, demand or skills to operate expensive calenders, Nylon tire cord is purchased from local tire companies already frictioned.

Tires are most commonly manufactured overseas using Natural Rubber or the nearest synthetic equivalent (SBR). Most Neoprene or EPDM expansion joints are really Natural Rubber frictioned tire cord covered by a Neoprene or EPDM cover and liner. This had been our technique as well, when manufacturing in Taiwan, and we were still one of the larger manufacturers, even after all the breakaways. All Taiwanese expansion joint manufacturers either worked for our founding company or a breakaway from a breakaway. Other Taiwanese companies have offered no new developments whatever.

Our Thailand factory is a large, completely equipped facility dedicated to expansion joint production. We have our own calender and friction our own fabrics. Thus the latest series of expansion joints, whether they are EPDM, Neoprene or Natural Rubber, contain fabrics that are frictioned in the same material as the covers and liners and clearly tagged with the materials that are being used. So for the first time, an EPDM temperature resistant connector has EPDM throughout.

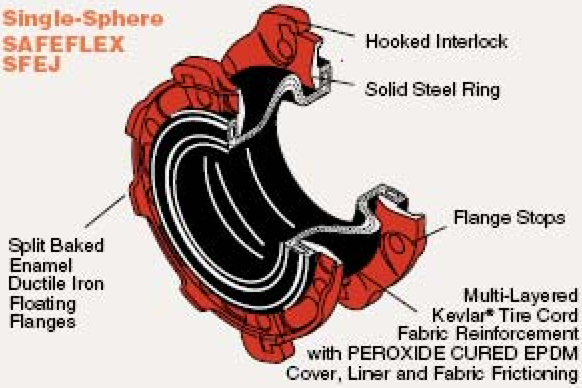
While we had been assured that the tire company Natural Rubber or SBR frictioning was safe at the higher temperatures when encapsulated between two Neoprene or EPDM layers, practice showed that this was not the case, and there was hardening of the inner carcass. There is always better adhesion and more even curing when all materials are identical and this is an additional benefit.

In 1996 we introduced Mason "SAFEFLEX", the culmination of 20 years of application and research. Our first goal was to fight elastomer heat failures and the beginning of this attack was the change to EPDM throughout.

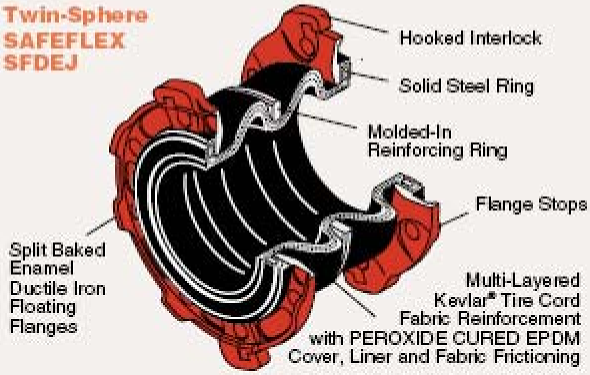
SAFEFLEX DEVELOPMENT

SAFEFLEX

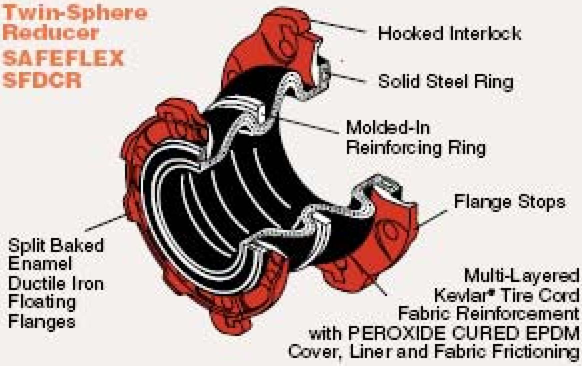
Single-Sphere SAFEFLEX SFEJ



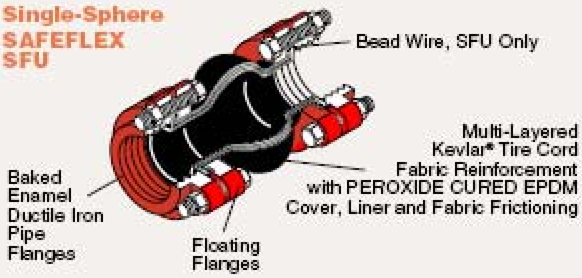
Twin-Sphere SAFEFLEX SFDEJ



Twin-Sphere Reducer SAFEFLEX SFDCR



Single-Sphere SAFEFLEX SFU



We continued our study, however, and found that the published properties of EPDM tolerating intermittent operating temperatures as high as 350°F (176°C) can only be reached when the curing system (the chemicals that stabilize or vulcanize EPDM during curing) are tailored to this performance. Most common curing systems are sulphur based.

In order to get to the best physicals, the curing agent must be peroxide. This method is more costly and slower acting than sulfur cures and slows down production. Therefore, peroxide is not commonly used. In SAFEFLEX the EPDM cover, liner and frictioning materials are all peroxide cured. This is the first reason we named the product "SAFEFLEX".

While Nylon tire cord continues to be the most commonly used reinforcement, a safe design is only as good as the weakest link, and having solved the EPDM temperature problem, we then looked for an alternate fabric that would not heat age either.

In referring to DuPont literature and in discussions with DuPont, we found that Polyester (DuPont Dacron) was much more resistant to higher temperatures and very close to the Nylon tensile strength. In addition, Polyester had a higher elongation modulus which means that using this fabric in place of Nylon would limit elongation. Once again, we were able to operate at higher pressures without the need for control rods. For a short time we used Polyester, but we found out later that DuPont Kevlar® at about six times the cost was the ultimate reinforcement.

In today's SAFEFLEX we have replaced Nylon with DuPont Kevlar®. While we have not raised temperature ratings above 250°F (121°C), we have virtually eliminated temperature aging or reduction of safety factor. The substitution of Kevlar® for Nylon gave us the second reason for changing the name to "SAFEFLEX".

While we had addressed the burst problems, we had yet to look at flange pullout.

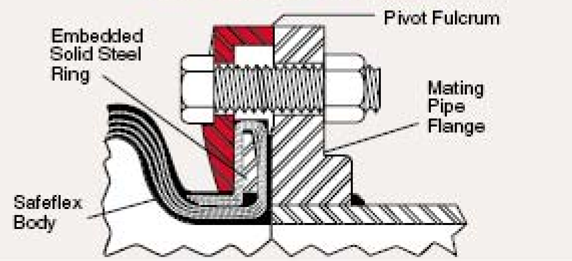
All other spherical connectors are sold with one piece flanges. These flanges are put on after the carcass is molded so the restraint against pullout must be an encapsulated flexible bead cable. The cable allows the rubber flange to be bent in while the flanges are popped into position. So long as this flexible cable is used, there is always the possibility of pullout.

The only solution was to replace the cable with a solid flat steel ring that could not pull through. In making this decision it was no longer possible to put one piece flanges on after the expansion joint was molded, and we needed split flanges.

In our early tests we found that the pressure forced the flange halves outward and the gap between the mating halves would allow for leakage when trying to reach burst pressures. Reducing hole diameters minimized this motion, but we still could not get to burst pressures before leakage occurred. That is the reason for the unique hooked ends on the flanges. The two flange halves interlock to prevent this spreading. This design solved the problem. The embedded solid flat steel rings are the third justification for the name "SAFEFLEX".

We were still faced with one more problem, and that was developing enough pressure on the embedded steel ring to avoid weeping. This was solved by putting stops around the outside edge of the flange, so that as the bolts are tightened the flanges rotate around these stops and apply pressure on the built-in steel ring where it is needed.

SAFEFLEX Flange Detail



These features make SAFEFLEX far more suitable for seismic movements. The body does not pull out of the flanges and with heat aging eliminated, an old connector can still withstand stretching beyond published limits much more readily.

All of these developments had been going on over a period of three years before we put the product into production. Having eliminated the problems of burst and the problems of pullout, we sincerely believe that our time and effort has been well spent in bringing you the safest product on the market, Mason "SAFEFLEX".

Why chance water damage, contingent liability or personal injury by using an expansion joint that may burst or pull out, when Safeflex is manufactured by a firm with both excellent engineering and a 40 year history of product support.

MASON INDUSTRIES, INC.

N. J. Mason

Norman J. Mason, President

SAFEFLEX SPECIFICATION:

Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar® tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable.

Sizes 2" (50mm) and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" (400mm) to 24" (600mm) may be single sphere.

Sizes 3/4" (19mm) to 1 1/2" (38mm) may have threaded two piece bolted flange assemblies, one sphere and cable retention.

Connectors shall be rated at 250 psi (1.72MPa) up to 170°F (77°C) with a uniform drop in allowable pressure to 215 psi (1.48MPa) at 250°F (121°C) in sizes through 14" (350mm). 16" (400mm) through 24" (600mm) single sphere minimum ratings are 180 psi (1.24MPa) at 170°F (77°C) and 150 psi (1.03MPa) at 250°F (121°C). Higher rated connectors may be used to accommodate service conditions. All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1.

Concentric reducers to the above ratings may be substituted for equal ended expansion joints.

Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods.

If control rods are used, they must have 1/2" (12mm) thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi (.7 kg/mm²) maximum on the washer area.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.