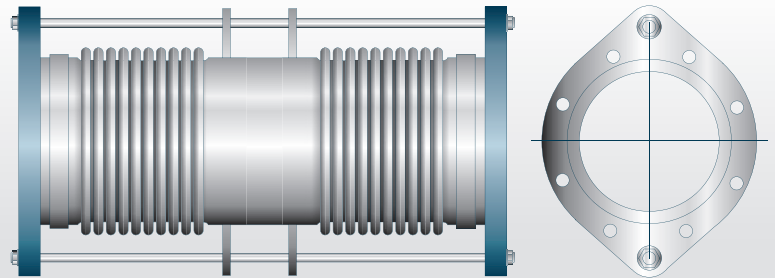


**DESIGN CONDITIONS**

Max. Design Pressure	<b>16 Bar</b>
Max. Design Temperature	<b>300°C</b>
Test Pressure	<b>24 Bar</b>
Bellow Options	<b>321/316/Alloy</b>
Flange Options	<b>Carbon Steel/Stainless Steel</b>
Bracketry of Tie Bar Options	<b>Carbon Steel Tie Bars, Bracketry and Spherical Washers/Stainless Steel</b>

**NOTE:** If not specified our engineers will automatically select the first option. *i.e.* 321, carbon steel, stainless steel.

**GENERAL INFORMATION**

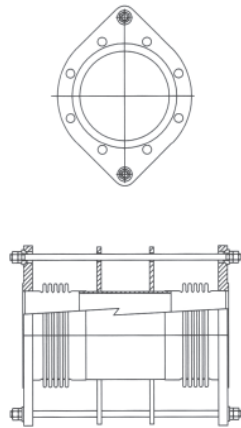
The standard DTF range of expansion joints is comprised of units having two sets of stainless steel convolutions and carbon steel flanges fitted with tie bars seated on spherical washers. The tie bars are designed to continuously restrain the pressure thrust of the expansion joint whilst permitting limited lateral deflection. Guides should be positioned to allow freedom of movement of the pipework and also prevent sag and pressure deflection (see the Application section of this document for further information) "Cold spring" can be applied on installation. Recommendations contained in our literature on installation should be followed. (See the Installation section of this document for further information).

NOMINAL SIZE (mm)	PIPE DIAMETER (mm)	PART NUMBER	LATERAL MOVEMENT (+ or - 50 mm)		LATERAL MOVEMENT (+ or - 75 mm)		LATERAL MOVEMENT (+ or - 100 mm)		LATERAL MOVEMENT (+ or - 150 mm)	
			Overall length	Spring rate	Overall length	Spring rate	Overall length	Spring rate	Overall length	Spring rate
50	60.3	DTF/0050/16/001	700	2.5	1000	1.1	1300	0.6	1900	0.3
65	76.1	DTF/0065/16/001	700	4.8	1000	2.1	1300	1.1	1900	0.5
80	88.9	DTF/0080/16/001	700	7.6	1000	3.3	1300	1.8	1900	0.8
100	114.3	DTF/0100/16/001	700	15.5	1000	6.6	1300	3.7	1900	1.6
125	139.7	DTF/0125/16/001	700	34	1000	13.3	1300	7.1	1900	3
150	168.3	DTF/0150/16/001	700	58	1000	23	1300	12	1900	5
200	219.1	DTF/0200/16/001	700	109	1000	39	1300	20	1900	8
250	273	DTF/0250/16/001	700	206	1000	74	1300	38	1900	15
300	324	DTF/0300/16/001	700	339	1000	122	1300	62	1900	25
350	357	DTF/0350/16/001	900	410	1200	187	1450	116	2000	54
400	406	DTF/0400/16/001	1000	368	1250	203	1500	129	2100	58
450	457	DTF/0450/16/001	1100	594	1350	349	1700	199	2350	94
500	508	DTF/0500/16/001	1150	714	1500	364	1850	220	2550	106
550	559	DTF/0550/16/001	1200	643	1650	289	2100	163	2750	89
600	610	DTF/0600/16/001	1250	693	1700	322	2150	185	3050	84
700	711	DTF/0700/16/001	1400	1286	1900	596	2400	343	3400	156
750	762	DTF/0750/16/001	1550	1542	2000	652	2500	382	3500	177
800	813	DTF/0800/16/001	1600	1501	2100	656	2600	397	3600	191
900	914	DTF/0900/16/001	1800	1493	2300	723	2800	458	3900	219
1000	1016	DTF/1000/16/001	2000	1544	2500	809	3000	533	4200	253

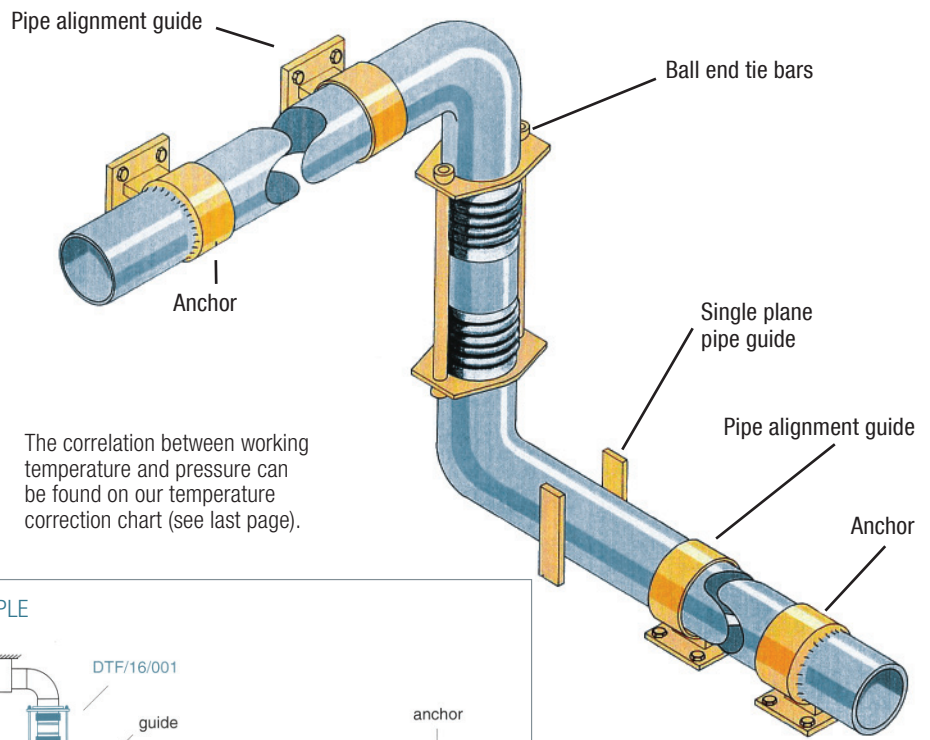
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PLAN VIEW FOR FLANGED DOUBLE TIED EXPANSION JOINT

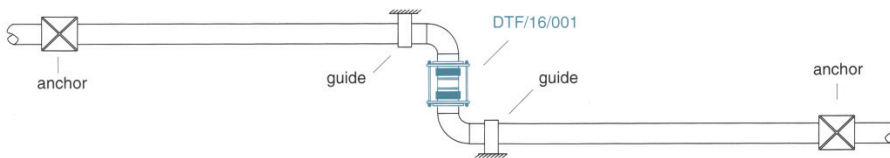


A TYPICAL APPLICATION EXAMPLE OF A DOUBLE TIED SYSTEM



The correlation between working temperature and pressure can be found on our temperature correction chart (see last page).

PLAN VIEW OF A TYPICAL APPLICATION EXAMPLE



APPLICATION INFORMATION

The two figures below are examples in which the main anchors at either end of the expansion joint are replaced by tie bars. Where the piping configuration permits, the use of tie bars adjusted to prevent axial movement frequently simplifies and reduces the cost of the installation. Because of these tie bars, the expansion joint is not capable of absorbing any axial movement other than its own thermal expansion. The thermal expansion of the piping in the shorter leg, as a result, imposed as deflection on the longer piping leg. Where the longer piping leg is not sufficiently flexible and where the dimension of the shorter leg is suitable, tie bars may be installed spanning the entire short leg, so that no deflection is imposed on the longer run from this source.

Where appreciable amounts of lateral deflection are imposed upon the expansion joint, some shortening of the expansion joint results from the displacement of the tie bars as shown in Figure K. Care should be taken to ensure that sufficient piping flexibility exists to absorb this deflection and that adequate clearances are provided in the guide to permit deflection of the piping. The amount of this deflection can be minimised by cold springing the expansion joint in the lateral direction as shown in figure L. The principal restriction upon the use of single expansion joints for lateral deflection or combined axial movement and lateral deflection is the limited amount of lateral deflection which such an expansion joint can absorb. The allowable lateral deflection is directly proportional to the ratio of convoluted length to diameter which, in turn, is restricted by considerations of stability and manufacturing limitations. While eminently suitable for applications where the principal movement is axial, the relatively small available lateral movement severely limits the type of application illustrated in figures K and L. Where operating pressures and temperatures are high, or where availability of suitable structures precludes the use of main anchors and multiple guides, a single axial application may not be feasible and another type of expansion joint may result in far more economical installation.

FIGURE K

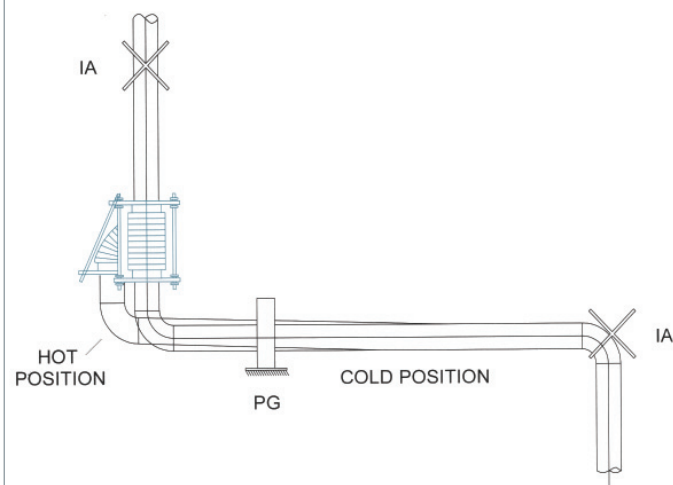
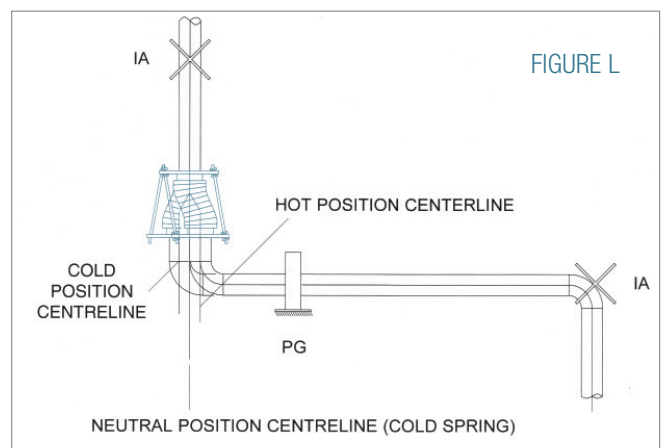


FIGURE L



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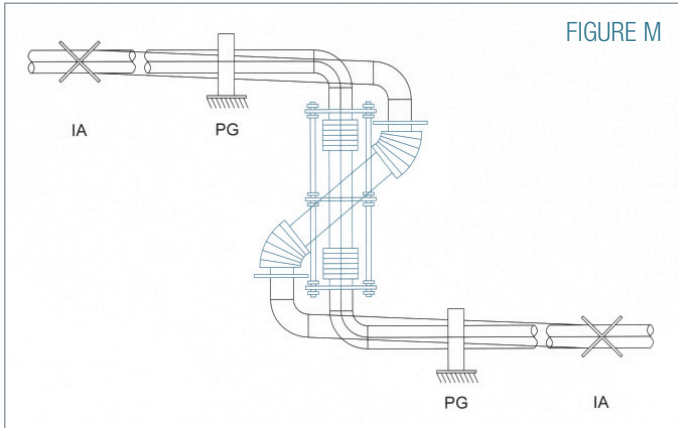


**APPLICATION INFORMATION (CONTINUED)**

**UNIVERSAL EXPANSION JOINTS**

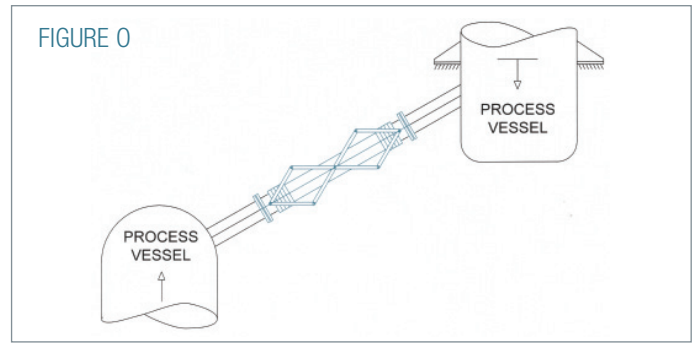
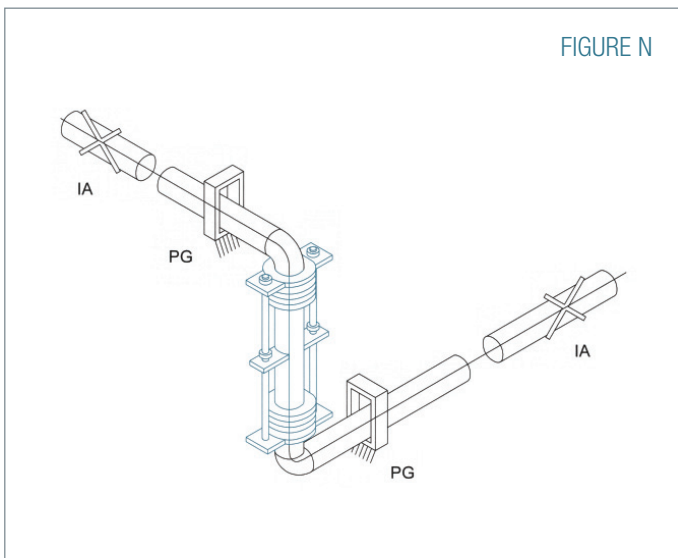
The universal expansion joint is particularly well adapted to the absorption of lateral deflection. In addition, this design may be used to absorb axial movement, angular rotation or any combination of the three. A common application of the universal expansion joint is its use as a tied expansion joint in a 90 degree piping offset with tie rods adjusted to prevent external axial movement. Two such applications are shown in figures M and N.

Figure M shows a tied universal expansion joint used to absorb lateral deflection in a single plane Z bend. Where dimensionally feasible, the expansion joint should be designed to fill the entire offset leg so that its expansion is absorbed within the tie rods as axial movement. The tie rod should be extended to the elbow centre line when practical. The thermal movement of the horizontal lines is absorbed as lateral deflection by the expansion joint.



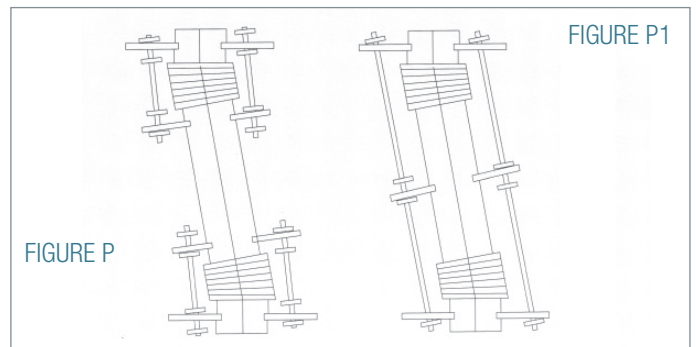
Both anchors are intermediate anchors since the pressure loading is absorbed by the tie rods. Only directional guiding is required since the compressive load on the pipe consists only of the force necessary to deflect the expansion joint. Any thermal expansion of the offset leg external to the tie rods, such as that of the elbows at either end, must be absorbed by bending of the horizontal pipe legs. Provision should be made in the design of the guides to allow for both this deflection and the reduced length of the expansion joint in its deflection position. In addition, particularly in the case of long universal expansion joints under high pressure, additional allowance may be necessary to compensate for stretching of the tie rods under load. The expansion joint manufacturer should be consulted for recommended minimum guide clearances.

Figure M shows a typical application of tied universal expansion joint in a three-plane Z bend. Since the universal expansion joint can absorb lateral deflection in any direction, the two horizontal piping legs may lie at any angle in the horizontal plane.



In cases where a universal expansion joint must absorb axial movement other than its own thermal growth, it cannot function as a tied expansion joint and must be used in combination with main anchors to absorb pressure loading. One such case is shown in Figure O. The relative expansion between the two vessels results in both axial movement and lateral deflection on the expansion joint. Both vessels must be designed to absorb main anchor loading. Control bars or pantographic linkages may be used to distribute the movement between the bellows and control their movements. Numerous variations are possible in the design of universal expansion joints. Bars, pantographic linkages, slotted hinges or external structural members may be used in a horizontal installation, for example, where it is desirable to support the centre pipe section of the expansion joint independently of the bellows. In a single plane system, the rods may be replaced by two bars with pinned connections at either end of expansion joint. This construction is so commonly used that it has been given the standard nomenclature of swing expansion joint. In some cases two sets of short control bars, each set spanning one of the two bellows in the universal expansion joint are used instead of the overall bars shown in most of the illustrations. This arrangement is frequently used where the control bars are used for control and stability and not for absorption of pressure loading. This can result when the universal expansion joint is very long in relation to its diameter, or a large number of convolutions are used at each bellows of the expansion joint, or where the expansion joint is subject of external forces.

It may be desirable to incorporate control devices in the expansion joint to prevent excessive displacement of the bellows and the relatively free pipe section between them. Figures P and P1 show two forms of controls which may be used for this purpose. In Figure P, short bars are used spanning each of the bellows in expansion joint. Stops are provided on the bars so that, once the expansion joint has reached its rated lateral deflection, the stops will be engaged by members rigidly fastened to pipe portions of the expansion joint. Figure P1 shows a similar device adapted to an expansion joint with overall bars. The bar stops are engaged by a plate or lug attached to the centre pipe portion and movement of this part beyond its design deflection is restrained. In order to obtain maximum control from these devices, the stops are usually oriented to lie in the plane of resultant movement of the expansion joint, affording maximum leverage as well as greater sensitivity to small movement. Devices of this nature are usually furnished by the manufacturer dependent upon the design characteristics of the expansion joint. Its use is sometimes precluded by the configuration of the piping, the operating conditions or even by manufacturing and transportation limitations. It may be undesirable or impossible to fabricate, ship to the job site and install a universal expansion joint which would span the full length of the offset where, for example, the length of the offset leg in a Z bend is extremely long. When the expansion joint is very long in relation to its diameter, the flexibility of overall bars may reduce the effectiveness of the control so that the centre pipe section becomes unstable. Other types of expansion joints may offer a more desirable solution when such limits are encountered.



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## INSTALLATION INSTRUCTIONS

The position of anchors and guides relative to expansion joints will vary with each installation and type of joint. The following is a list of basic rules for expansion joints, in accordance with E.J.M.A. (Expansion Joint Manufacturers Association), and the new British Standard Code of Practice for metallic bellows expansion joints, which provide a useful guide and will ensure a satisfactory installation.

- 1 Divide the pipe length into sections ensuring that the expansion of each section is within the allowable movement of a bellows joint. Locate intermediate anchors at the end of each section and main anchors at each end of the pipe run.
- 2 Locate expansion joints adjacent to each other and position the guides so that the first is not more than 4 pipe diameters from the expansion joint and the second not more than 14 pipe diameters from the first guide.
- 3 Position other guides and supports according to the piping weight, diameter and internal pressure to ensure freedom from sag or pressure deflection, refer to Data Sheet 1 (004/79/1)
- 4 Check that each guide is approximately 1.5 pipe diameters in length for pipes up to 8" diameter and approximately 12" long for larger sizes. Some approved designs are illustrated.
- 5 Never use more than one expansion joint between two anchors, unless they form part of a expansion joint assembly, such as an articulated joint and have been supplied with full knowledge of the pipe layout.
- 6 Thermosel® expansion joints may be cold drawn from their neutral position by up to half the total rated expansion. Data Sheet 1 (004/79/1) provides for installation at different ambient temperatures.
- 7 Pipe anchors should be located at changes in pipe direction, or whenever necessary to divide straight lengths to suit maximum expansion joint movement. Joints should be at least 4 pipe diameters from dampers, gate valves, butterfly valves or other accessories.
- 8 Expansion joints should never be used to correct pipe alignment or fitting errors beyond the design parameters of the joint. Torsional strain for example is not permitted and flange holes must therefore be carefully aligned.
- 9 When internal sleeves are fitted, directional flow arrows indicate the correct way to install the unit with respect to the actual direction of flow.
- 10 Shipping restraints (painted red) when supplied, maintain the overall length of the assembly for shipment. These devices may also be used to pre-compress, pre-extend or laterally offset the bellows, to facilitate correct installation, and must be removed prior to test or commissioning.
- 11 The convolutions of stainless steel expansion joints must be protected from weld splatter. Foreign material entering the space between the convolutions, either internally or externally, will prevent correct operation of the joint and may result in premature failure.
- 12 Standard expansion joints are pressure tested prior to despatch to 1.5 times the operating pressure, and pipework should not be tested in excess of this. Testing should not be carried out until the anchors are secure and the pipework correctly guided.
- 13 Where a gaseous system is to be hydraulically tested, determine whether the piping and bellows joints require additional temporary support to carry the weight of water to be used during the test.
- 14 Main anchors must be designed to withstand the highest combined effects of pressure thrust, spring rate force and the friction force generated by guides. See Data Sheet 4 (007/79/1).
- 15 Insulation materials containing sulphides, chlorides or other contaminants must not be used on stainless steel expansion joints and must not be allowed to fall between the convolutions. Aluminium, lead or zinc bearing paints, must not be used on stainless steels.

## SAFETY RECOMMENDATIONS

### Inspection prior to Start-up or Pressure Test

Expansion joints are usually considered to be non-repairable items and generally do not fall into the category for which maintenance procedures are required. However, immediately after the installation is complete a careful visual inspection should be made of the entire piping system to ensure that there is no evidence of damage, with particular emphasis on the following:

- 1 Are anchors, guides, and supports installed in accordance with the system drawings?
- 2 Is the proper expansion joint in the proper location?
- 3 Are the flow direction and pre-positioning of the expansion joint correct?
- 4 Have all of the expansion joint shipping devices been removed?
- 5 If the system has been designed for gas, and is to be tested with water, has provision been made for proper support of the additional dead weight load on the piping and expansion joint? Some water may remain in the bellows convolutions after the test. If this is detrimental to the bellows or system operation, means should be provided to remove this water.
- 6 Are all guides, pipe supports and the expansion joints free to permit pipe movement?
- 7 Has any expansion joint been damaged during handling and installation?
- 8 Is any expansion joint misaligned? This can be determined by measuring the joint overall length, inspection of the convolution geometry, and checking clearance at critical points on the expansion joint and at other points in the system.
- 9 Are the bellows and other movable portions of the expansion joint free of foreign objects?

### Inspection during and immediately after pressure test

#### **WARNING: Extreme care must be exercised while inspecting any pressurised system or component**

A visual inspection of the system should include the following:

- 1 Evidence of leakage or loss of pressure.
- 2 Distortion or yielding of anchors, expansion hardware, the bellows and other piping components.
- 3 Any unanticipated movement of the piping due to pressure.
- 4 Evidence of instability in the bellows.
- 5 The guides, expansion joints, and other movable parts of the system should be inspected for evidence of binding.
- 6 Any evidence of abnormality or damage should be reviewed and evaluated by competent design authority.

### Periodic Inservice Inspection

#### **WARNING: Extreme care must be exercised while inspecting any pressurised system or component.**

- 1 Immediately after placing the system in operation, a visual inspection should be conducted to insure that the thermal expansion is being absorbed by the expansion joints in the manner for which they were designed.
- 2 The bellows should be inspected for evidence of unanticipated vibration.
- 3 A program of periodic inspection should be planned and conducted throughout the operating life of the system. The frequency of these inspections should be determined by the service and environmental conditions involved. Such inspections can pinpoint the more obvious potential problems such as external corrosion, loosening of threaded fasteners, and deterioration of anchors, guides and other hardware. It must be understood that this inspection programme, without any other backup information cannot give evidence of damage due to fatigue, stress corrosion or general internal corrosion. These can be the cause of sudden failures and generally occur without any visual or audible warning.
- 4 When any inspection reveals evidence of malfunction, damage or deterioration, this should be reviewed by competent design authority for resolution. Additionally, any changes in the system operating conditions such as pressure, temperature, movement, flow, velocity, etc that may adversely affect the expansion joint should be reported to, and evaluated by, a competent design authority.

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**THERMOSEL®**

## DESIGN STANDARDS

All standard units are designed to Thermosel® standard formulae which have been verified by tests witnessed by independent testing authorities.

The designs also conform to the requirements of the internationally recognised standard E.J.M.A. (Expansion Joint Manufacturers Association) and the British Standard Code of Practice for selection joints for use in pressure systems.

Pearwalk Engineering Ltd is represented on the British Standard Committee responsible for the preparation of the latter.

## QUALITY

It is our policy to maintain our product reliability and company service to industry at the highest level compatible with realistic costs.

The quality control and manufacturing procedures as specified on our website [www.pearwalkengineering.com](http://www.pearwalkengineering.com) meet the requirements of all major company, national and international quality standards.

## SURVEY SOCIETIES

Thermosel® units are acceptable to all National and International Survey Societies. Pearwalk Engineering has received either type approval or is approved by individual societies as a manufacturer of bellows expansion joints in accordance with the societies' Conditions of Survey and Witness of Tests during the course of manufacture.

Copies of type approval certificates are available upon request. An additional charge will be made for certification covering survey society approval on individual units which are not type approved.

## ORDERING

The purchase order for standard units must identify the type of unit required by reference to the ordering code as follows:

**Typical Part number:** SAF/0100/16/001/NP16/150

Unit description / Nominal bore / Pressure rating / Type Number / End fittings / Lateral Movement (Double units only).

The unit price for standard units will be quoted on the current price list. Flange details must be stated on the purchase order in addition to the ordering code.

## TEMPERATURE CORRECTION CHART

### Pressure/Temperature compensation

20°C	100%
100°C	80%
200°C	68%
300°C	64%
400°C	60%
500°C	58%
600°C	55%

## ALTERNATIVE COMPONENTS OR MATERIALS

Where the operating or environmental conditions exceed the limits specified for the standard unit range or where special end fittings are required, alternative units can be designed and supplied.

Typical variations include choice of material for the membranes and end fittings, multi-ply membrane construction and alternative end fittings such as screwed pipe ends, vee flanges or swivel flanges.

Please discuss your special requirements with our sales engineers.

## RESERVATIONS

We reserve the right:

- in the interest of design improvement to alter the design specification without prior notice.
- to invoice at prices ruling at date of dispatch

## FURTHER INFORMATION

For further information about Thermosel® products please visit our website at [www.pearwalkengineering.com](http://www.pearwalkengineering.com)

Below is our list of standard parts:

### UNIT DESCRIPTION

APS - Axial Pipe End Screwed  
SAP - Single Axial Pipe End  
SAPV - Single Axial Pipe End (Victaulic)  
SAF - Single Axial Flanged  
DAP - Double Axial Pipe End  
DAF - Double Axial Flanged  
DUP - Double Universal Pipe End  
DUF - Double Universal Pipe End  
SAV - Single Axial Van-Stone  
DAV - Double Axial Van-Stone  
STF - Single Tied Flanged  
STP - Single Tied Pipe End  
STPV - Single Tied Pipe End (Victaulic)  
DTF - Double Tied Flanged  
DTP - Double Tied Pipe End  
DHF - Double Hinge Flanged  
DHP - Double Hinge Pipe End  
SHF - Single Hinge Flanged  
SHP - Single Hinge Pipe End  
SGF - Single Gimbal Flanged  
SGP - Single Gimbal Pipe End  
DGF - Double Gimbal Flanged  
DGP - Double Gimbal Pipe End  
SMP - Single Multi-Ply Pumpflex  
SMT - Single Multi-ply Pumpflex Tied  
TRB - Thermosel Rubber Bellows  
MFS - Metallic Flexible Hose with Swivel Ends  
HEX - Heat Exchanger Joint

### TYPE NUMBERS:

001 - Carbon steel fittings no internal sleeve  
002 - Carbon steel fittings single internal sleeve  
003 - Carbon steel fittings telescopic internal sleeves  
004 - Carbon steel fittings single internal sleeve, telescopic external sleeves  
005 - Carbon steel fittings single internal sleeve, telescopic external sleeves  
006 - Carbon steel fittings telescopic internal sleeves, telescopic external sleeves  
007 - Carbon steel fittings no internal sleeve, shroud  
008 - Carbon steel fittings single internal sleeve, shroud  
009 - Carbon steel fittings telescopic sleeves, shroud  
010 - Stainless steel fittings no internal sleeve  
011 - Stainless steel fittings single internal sleeve  
012 - Stainless steel fittings telescopic internal sleeves  
013 - Stainless steel fittings no internal sleeve, telescopic external sleeves  
014 - Stainless steel fittings single internal sleeve, telescopic external sleeves  
015 - Stainless steel fittings telescopic internal sleeves, telescopic external sleeves  
016 - Stainless steel fittings no internal sleeve, shroud  
017 - Stainless steel fittings single internal sleeve, shroud  
018 - Stainless steel fittings telescopic internal sleeves, shroud  
020 - Twin Sphere Union (Neoprene)  
021 - Single Sphere Flanged (Neoprene)  
022 - Single Sphere Flanged Tied (Neoprene)  
030 - Galvanised Fittings (fixed male & swivel female)  
120 - Twin Sphere Union (E.P.D.M.)  
121 - Twin Sphere Flanged (E.P.D.M.)  
122 - Twin Sphere Flanged Tied (E.P.D.M.)

### END FITTINGS:

PN6 - Drilled  
PN16 - Drilled  
PN25 - Drilled  
PN40 - Drilled  
BS10A - BS10 Table A  
BS10D - BS10 Table D  
BS10E - BS10 Table E  
BS10F - BS10 Table F  
BS10H - BS10 Table H  
ASA150  
ASA300  
JIS 5k - Drilled  
JIS 10K - Drilled  
JIS 16K - Drilled  
JIS 20K - Drilled

### NOMINAL BORE:

0015 - 4000 mm

### PRESSURE RATINGS:

2.5 bar  
10 bar  
16 bar  
25 bar

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