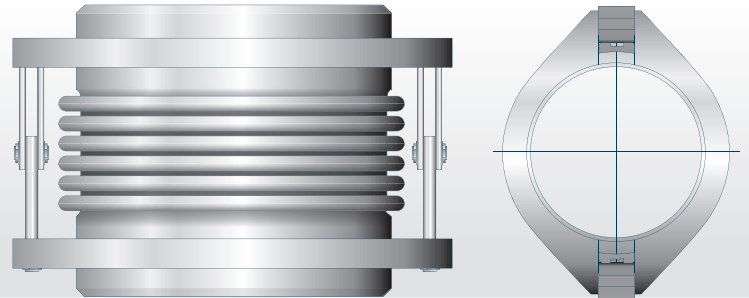


## DESIGN CONDITIONS

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>
End Fittings and Bracket Options	<b>Carbon Steel/Stainless Steel</b>
Optional Extra Components	<b>Pipe ends or pipe ends with flanges</b>

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



## GENERAL INFORMATION

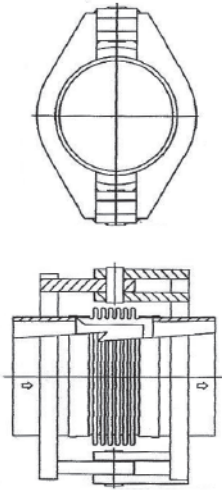
The standard SHP range is comprised of hinged expansion joints having stainless steel membranes, carbon steel pipe ends. These expansion joints are designed to permit angular rotation in one plane only by the use of a pair of pins through hinge plates, attached to the pipe ends. The hinges and pins are designed to restrain the thrust of the expansion joint due to internal pressure. These expansion joints are used in sets of two or three or with gimbal expansion joints. 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. Particular care should be taken during installation to make sure the flow arrows are in the right direction (see the Installation section of this document for further information).

NOMINAL SIZE (mm)	PIPE DIAMETER (mm)	PART NUMBER	ANGULAR SPRING RATE Nm/deg	ALLOWABLE ANGULATION + OR - °	OVERALL LENGTH (mm)
50	60.3	SHP/0050/16/001	7.3	5	280
65	76.1	SHP/0065/16/001	13.5	5	280
80	88.9	SHP/0080/16/001	20.5	5	280
100	114.3	SHP/0100/16/001	40	5	280
125	139.7	SHP/0125/16/001	70	6.5	370
150	168.3	SHP/0150/16/001	114	6.5	370
200	219.1	SHP/0200/16/001	178	7	420
250	273	SHP/0250/16/001	324	7	450
300	324	SHP/0300/16/001	520	7	450
350	357	SHP/0350/16/001	1246	6	500
400	406	SHP/0400/16/001	1489	5	550
450	457	SHP/0450/16/001	3103	4	550
500	508	SHP/0500/16/001	4143	4	550
550	559	SHP/0550/16/001	4128	3	550
600	610	SHP/0600/16/001	4909	3	550
700	711	SHP/0700/16/001	11046	3	600
750	762	SHP/0750/16/001	12982	3	650
800	813	SHP/0800/16/001	15037	2.5	700
900	914	SHP/0900/16/001	20331	2.5	750
1000	1016	SHP/1000/16/001	27383	2.25	800

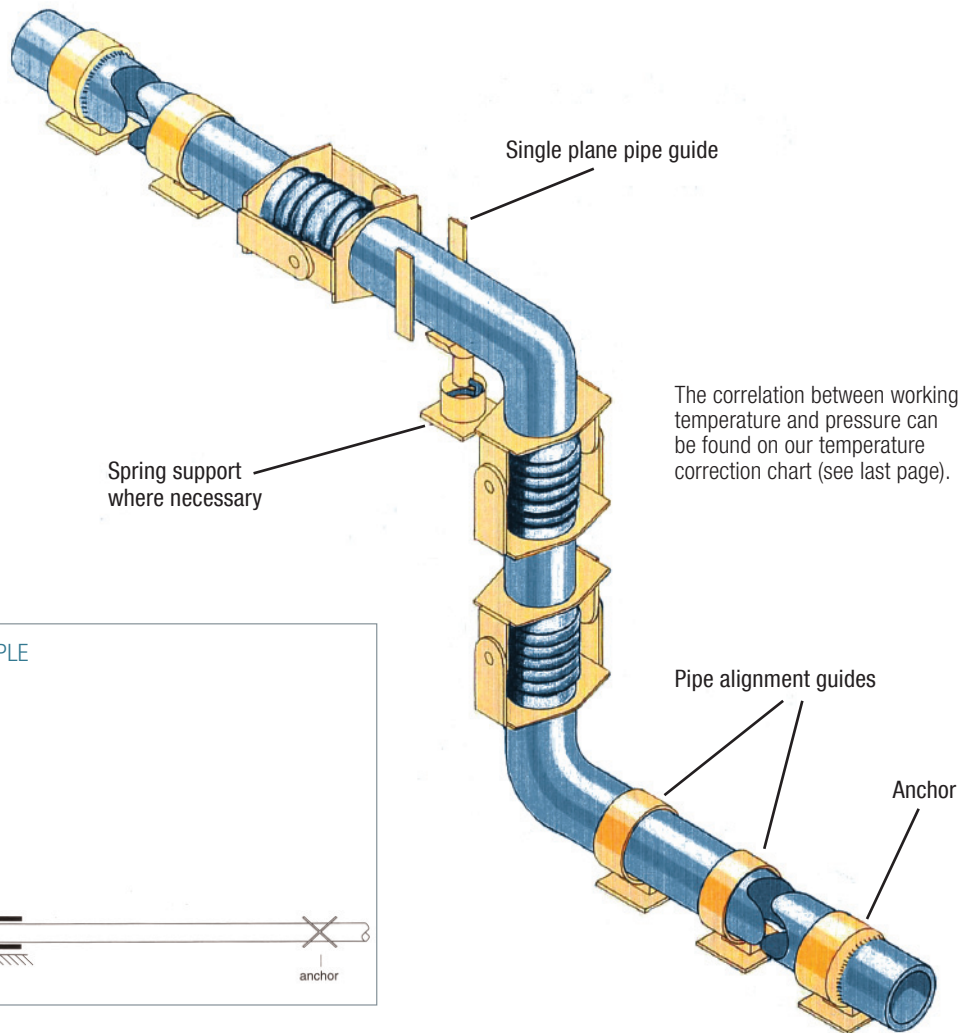
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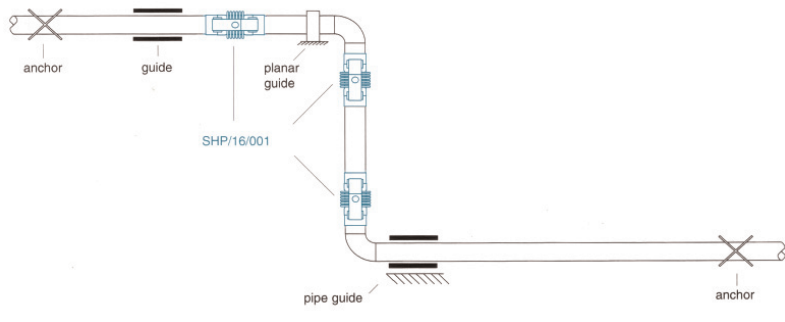
PLAN VIEW FOR PIPE END  
SINGLE HINGE EXPANSION JOINTS



A TYPICAL APPLICATION EXAMPLE OF A 3 PIN SINGLE HINGE SYSTEM



PLAN VIEW OF A TYPICAL APPLICATION EXAMPLE



APPLICATION INFORMATION

In order to utilise the expansion joints most efficiently, this distance should be made as large as possible. Expansion joint hinges are normally designed to absorb the full pressure thrust of the expansion joint and may be designed to support the weight of piping and equipment, wind loads or similar externally applied forces. Where such external forces are anticipated, their direction and magnitude must be indicated to the expansion joint manufacturer so that the hinges can be adequately designed to withstand these forces.

piping legs perpendicular to that segment, since the expansion joints are restricted to pure angular rotation by their hinges and cannot extend or compress. The amount of bending deflection imposed on each of the two long piping legs may be controlled by proper design of guides and supports. Where one leg is sufficiently flexible to absorb the full thermal growth of the offset leg, the other long leg may be controlled to permit longitudinal movement only. The planar guides shown at the ends of the long piping runs near the elbows are intended to maintain the plane of the piping system only and must allow for the bending deflections of the long piping legs. In calculating guide clearances, considerations shall be given to the fact that the thermal expansion of the offset piping leg containing the expansion joints will be partially offset by the reduction in length resulting from the displacement of the centre pipe section. The latter effect may be neglected only where the distance between hinge pins is very large and the lateral displacement small. This effect can be minimised by cold springing the expansion joints 50% of the full rated deflection.

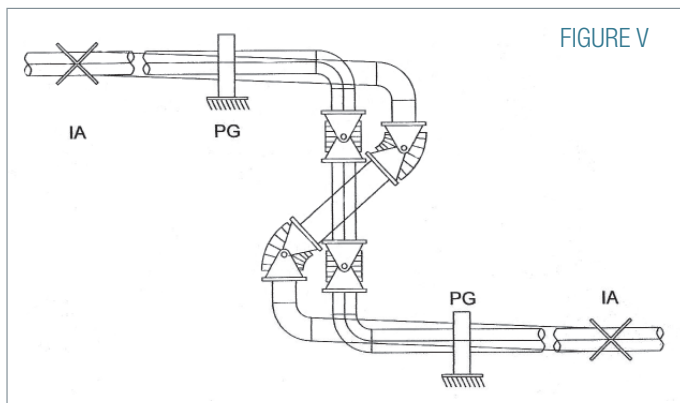


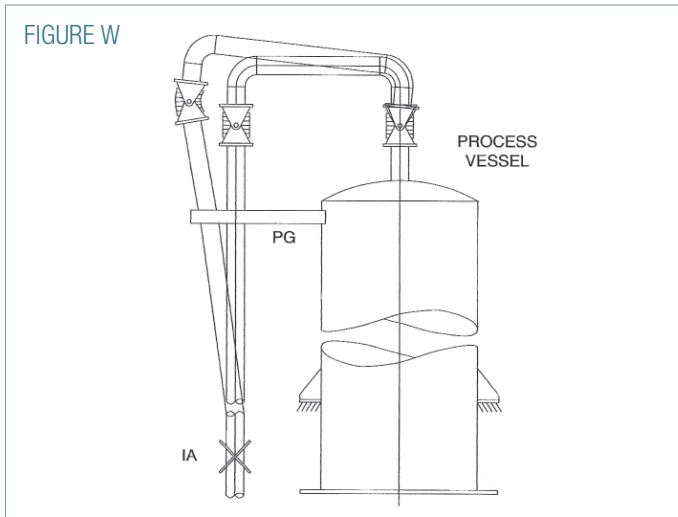
Figure V illustrates the use of a two-hinge system to absorb the major thermal expansions in a single plane "Z" bend. Since the pressure thrust is absorbed by the hinges on the expansion joint, only intermediate anchors are required at each of the piping system. The thermal expansion of the offset section containing the expansion joints must be absorbed by bending of the

Because of the ability of the hinges to transmit loads, support of a hinged system can frequently be simplified. Assuming that Figure V is an elevation view and that the upper piping leg is sufficiently flexible to absorb the total expansion of the vertical leg, it would be possible to use sliding supports on the lower horizontal run to support its weight and restrict it to longitudinal movement only. By utilising the rigidity of the hinges, a substantial portion of the weight of the upper horizontal leg may also be carried on these lower supports. It should be noted that the sliding supports nearest the vertical leg must be designed to resist the force required to deflect the piping. Spring supports must be used throughout the length of the upper horizontal leg where bending occurs. Beyond that point, sliding supports may be used.

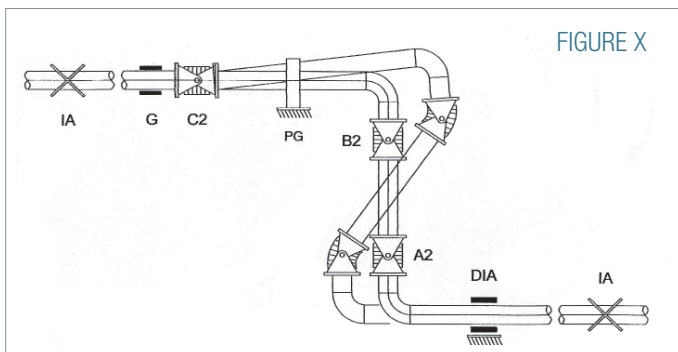
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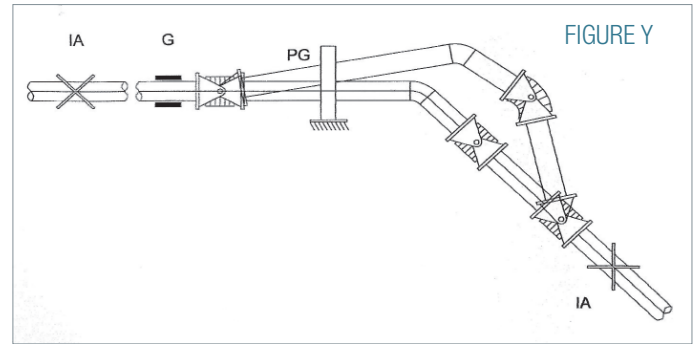




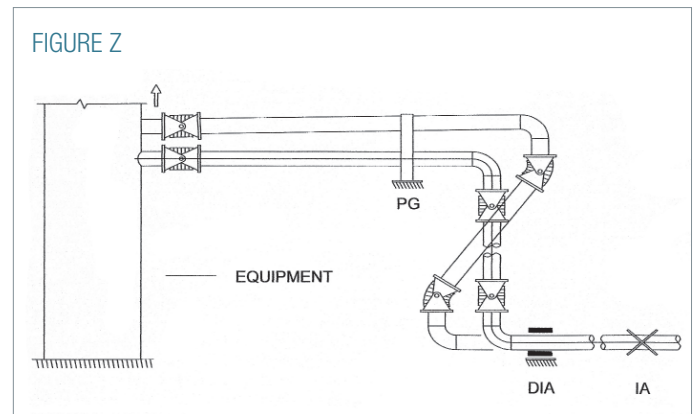
In location hinged expansion joints for more efficient use, it should be noted that the hinges need not be co-linear in order to function properly. Figure W illustrates a two-hinge expansion joint. In this case, the expansion joints will absorb only the differential vertical growth between the vessel and the pipe riser. Any horizontal movement due to piping expansion, vibration and wind loads will be absorbed by bending of the vertical pipe leg. A planar guide may be installed near the top of the vessel to protect the hinged expansion joints from the wind loads at right angles to the plane of the piping. The anchor shown at the bottom of the riser is an intermediate anchor only, since the pressure load is absorbed by the expansion joint hinges. Depending upon the dimensions and weight of the piping system, complete support may be obtained from the process vessel and from the intermediate anchor. If additional supports are required, spring type supports should be used. The vertical piping may be cold sprung to reduce bending stresses, utilising the hinges to withstand the cold spring force.



Where piping in a single plane system is not sufficiently flexible to absorb the bending deflections involved in a two hinge system, or where the loads resulting from such bending exceed the allowable limits for connected equipment, a system of three hinged expansion joints may be used. Figure X illustrates a system of three hinged expansion joints in a single plane "Z" bend. The thermal expansion of the offset piping section is absorbed by the action of the expansion joints B2 and C2. It is therefore evident that the expansion joint B2 must be capable of absorbing the total of the rotations of the expansion joints A2 and C2.



As in previous cases, the anchors at the ends of the piping system are intermediate anchors only. In this case, all deflection is absorbed by the expansion joints and negligible pipe bending loads will be imposed upon these anchors. Where the distance between the anchor at the left and the first hinged expansion joint, as shown in Figure X. This pipe guide will minimise bending of the pipe section between expansion joint C2 and the left hand anchor which might otherwise result from the moment required to rotate the expansion joint. One or more additional guides may be used to maintain the plane of the piping system and relieve the hinges of bending forces which may be created by external loads. Support of the piping system may be accomplished in various ways, utilising available supporting structures with greatest efficiency. It is essential that spring supports be used to permit free movement of the piping between the expansion joints.



A hinged expansion joint system may be used effectively in applications involving movement other than the pure thermal growth of piping. Figure Z illustrates an application combining the thermal expansion of a piping system with the single plane movements of a piece of connected equipment. So long as all movements are restricted to a single plane, the behaviour of the expansion joint system is quite similar to that of the system shown in Figure X. An intermediate anchor is required at one end of the piping, while the equipment serves as an intermediate anchor at the opposite end. The displacements of the equipment are added to those of the piping to evaluate the movements of the expansion joints. Planar guide clearances in the plane of the piping must be adequate to allow for the equipment movement as well as the piping rotations. Among the major advantages of hinged expansion joints are their compact size, which facilitates installation, and the great rigidity and strength which can be incorporated into the hinge structures. By the use of these individual units, it is frequently possible to compensate for the thermal expansion of irregular and complex piping configurations which might preclude the use of other types of expansion joints. Because of the ability of the hinge structure to transmit loads, piping systems containing hinged expansion joints impose minimum forces on the pipe anchors. Such systems may be supported at virtually any point which does not interfere with the free movement of the system.

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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 an 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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