PTFE Slide Bearings

1.0 GENERAL INFORMATION

In a wide range of applications, PTFE Slide bearings are superior to conventional expansion plates, rollers and rocker arm type supports. They support petrochemical plant, heavy machinery, pipelines, buildings and bridge girders; they accommodate expansion, contraction and other reciprocating motions of any structure that moves as a result of thermal, seismic or differential forces.

Bearings for such applications must operate at high loads and low speeds, and it is under just these conditions that the self-lubricating properties of PTFE are at maximum. This factor, together with its no stick-slip and anti-weathering characteristics, is the principle reason why PTFE has proved to be so successful as a slide bearing material.

2.0 ADVANTAGES

2.1 The simplicity of the bearing design and its ease of fabrication and installation make the unit cost efficient.
2.2 The costs of a construction can be reduced by designing for expansion rather than strain.
2.3 Coefficient of friction over the bearing surface remains constant, even under worst case conditions.
2.4 The bearings are maintenance free - PTFE is inherently self-lubricating, while dirt particles are absorbed into the material. Only simple protection is required against the significant ingress of dirt.

3.0 DESIGN / SELECTION

Carpenter & Paterson offers a specialist service, based on many years experience in the use of PTFE and its application to slide bearings to assist in the design of bearing systems.

Low friction sliders with a coefficient of friction less than 0.1are available. They are designed specifically for the loads and movements required. Most assemblies are also designed to be compatible with our range of standard sliders and glides, such as Fig 381, Fig 382, Fig 384, etc as illustrated on page 141

Also 'stand alone' Slide Bearing Sandwich Plates Fig no SLB 90 are available - as shown on page 140

4.0 BEARING ASSEMBLIES

Carpenter & Paterson Slide Bearings consist of a single PTFE pad counterfaced with a polished stainless steel plate. The assembly is designed to ensure that the PTFE pad is covered by the S/S plate throughout the expected design movements.

The basic element is a 5mm PTFE sheet, recessed into a 10mm steel backing plate for straight forward field installation by welding or bolting. The corresponding 3mm thick polished stainless steel plate is shop fitted to a 6mm thick carbon steel plate. Alternative thicknesses and materials for the backing plates can be supplied.

Where operating conditions require them, thermal insulation and vibration damping pads may be bonded between the PTFE sheet and the backing plate, or between the backing plate and the structure. To allow operation at high ambient temperature, a high temperature epoxy resin system is used for bonding, and the adhesives are cured under strictly controlled conditions, ensuring that the bond is stronger than the PTFE itself.

As standard glass filled PTFE is used as the bearing material, the load bearing capacity is 140 kg/cm^2

5.0 COEFFICIENTS OF FRICTION

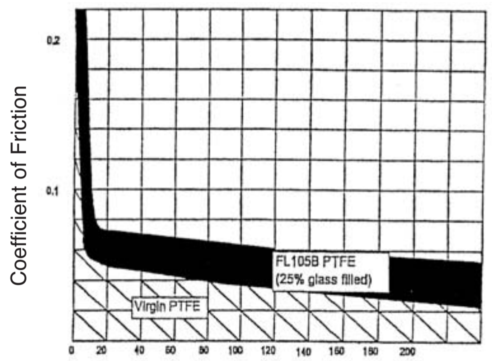
The coefficient of friction of PTFE materials is dependant on many variable, including pressure, sliding velocity and temperature. Opinion is divided about the effect of some variables, although it is agreed that high pressure and low velocities favour low friction.

The coefficient is less than that of any other solid engineering material. It has been variously reported from 0.02 to 0.2, but this depends on surface preparation and the test method. The load/friction chart (Figure 1) shows the effect of the load.

In general, the coefficient of friction between the mating surface and the PTFE slide bearing pad will be at a minimum when the stress in the PTFE is at a maximum (consistent with acceptable limits of creep), the bearing is made from unfilled PTFE, and the finish of the mating surface is highly polished.

In addition, one of the most important frictional characteristics of PTFE is the absence of 'stick-slip', because unlike all other conventional bearings, the static friction of PTFE is equal to or only marginally higher than the dynamic friction.

Figure 1 COEFFICIENT OF FRICTION: EFFECT OF LOADING



Bearing Pressure (kg/cm^2)
(Note: Virgin PTFE = 70 kg/cm^2 load capacity

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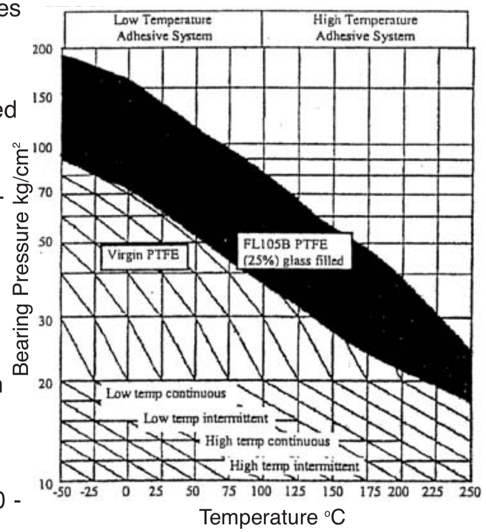
6.0 RECOMMENDED MAXIMUM BEARING PRESSURES

Figure 2 indicates the optimum pressure, but depending on circumstances, design pressures may be allowed to vary from the optimum.

With these pressures, a design coefficient of friction of 0.1 for unfilled PTFE or 0.12 for filled PTFE will give a significant margin of safety when operating conditions cannot accurately be predicted, but the figures obtained in practise will normally be considerably less than these.

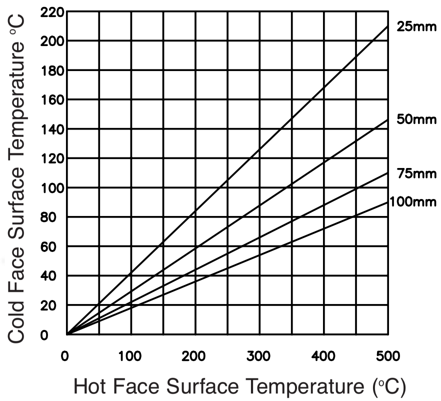
Figure 2 RECOMMENDED MAXIMUM BEARING PRESSURE



7.0 THERMAL INSULATION

Where the temperature at the faces of the PTFE is likely to exceed 150˚C by conduction through the bearing components, a thermal barrier must be interposed between the heat source and the sliding unit. Carpenter & Paterson recommend the use of Monolux 500 - the thickness required can be computed from the graph in Figure 3. The graph shows the external surface temperature that can be anticipated using Monolux 500 in constructions up to 100mm thickness, based on practical tests. The actual surface temperature will differ with variations in surface conductance.

Figure 3 Monolux 500: TEMPERATURE CHANGE FOR VARIOUS THICKNESSES



8.0 BONDING OF PTFE

Chemical bonding is the recommended method for locating the bearing material on its support, because the shear value of the epoxy adhesive is greater than that of the PTFE.

All bonded PTFE elements are not adversely affected by exposure to Ultra Violet light, providing the minimum thickness requirement of 1.5mm is met.

Site bonding of PTFE is not recommended - strictly controlled conditions of cleanliness, pressure and temperature are required to obtain a satisfactory bond between the PTFE and the substrate.

9.0 MATERIAL THICKNESS

The ideal thickness has been found to be 5mm, due to the recessing requirement. This is thick enough to allow for some constructional misalignment and to allow for dirt and grit embedment.

10.0 INSTALLATION

The bearing components can be located to the installation by bolting, tack-welding, full welding or mortar embedment, and the appropriate type of bearing should be chosen according to the installation method. The PTFE should be adequately protected against weld spatter, paint spray, metal swarf etc, during installation.

11.0 PAD DIMENSIONS

The top bearing pad should be larger than the bottom pad by an amount equal to the expected movement, in order to maintain a constant contact area.

12.0 BEARING TEMPERATURE

The temperature at the surface of the PTFE should generally be less than 120˚C and should never exceed 200˚C. As a rule of thumb, under normal conditions the temperature falls by 200˚C for every 100mm from the heat source (in ambient air) - for example, a typical horizontal vessel operating at 500˚C will have a bottom-of-saddle temperature of about 150˚C.

Temperature does not normally present a problem. However, if the bearing temperature is likely to exceed 150˚C a thermal insulator should be fitted between the structure and the bearing back plate (See 7.0 - use of Monolux material).

13.0 VIBRATION/ACCOUSTIC DAMPING PADS

Slide bearing units can be built with a variety of elastomer composite interlayers or backings to suit customers design parameters when acoustic or vibration damping is necessary. Elastomers may be used when simple angular or rotational movements are required.

14.0 SLIDEWAY RIGIDITY

When a series of slide bearings is used to form a slideway, for example for oil rig movement, the slideway supports must be sufficiently rigid to avoid deflection of the individual bearings or uneven loading. Deflection of only a few degrees could significantly increase the apparent coefficient of friction, and could cause bearing failure if all the load is carried by one end of the bearing pad.

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15.0 DESIGN STEPS

The following steps will provide an indication of the slide bearing requirements for a particular application:

1. Determine the load of the structure - this will indicate the total bearing area required at a suitable bearing pressure.
2. Decide the number and positions of the bearings according to the rigidity and function of the structure.
3. Take account of operating temperature limits, and specify any necessary thermal insulation.
4. Consider any unusual conditions affecting the bearings, such as the need for additional thermal insulation, damping pads, etc.
5. Decide the most appropriate method of mounting the bearings.
6. Select the types of bearings required and specify their dimensions.

16.0 TECHNICAL ADVANTAGES OF PTFE SLIDE BEARINGS

* PTFE has the lowest coefficient of friction of any known solid engineering material, including lubricated metal.
* There is no stick-slip action.
* They have indefinite life, since chemicals and weather have no effect on PTFE - moisture absorption is less than 0.01% even under icing conditions or immersion, and the material is chemically inert.
* No maintenance is required, PTFE will never cold weld to itself and therefore requires no lubrication.
* The bearings are easily installed, either pre-assembled or on site.
* PTFE bearings are far less bulky than alternative assemblies.
* There is no possibility of fatigue failure.
* Electrical and thermal insulation minimise galvanic corrosion and heat loss.
* Vibrations are damped
* Small particles which may become embedded do not cause binding of the surfaces.
* The slide bearing can accommodate some misalignment in construction without setting up stress corrosion along a leading edge, as can occur in conventional bearings.

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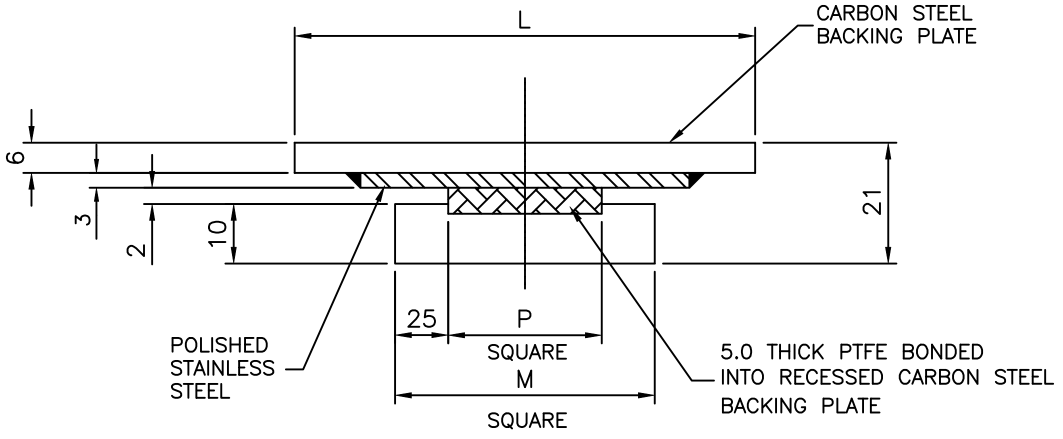
FIG. SLB 90



SLIDE BEARING

SIZE	RECOMMENDED LOADING (Kgf)	M mm	P mm	L mm MOVEMENT RANGE A	B	C
1	100-500	70	20	60	90	120
2	400-2000	90	40	80	110	140
3	800-4500	110	60	100	130	160
4	1500-8000	130	80	120	150	180
5	2500-13000	150	100	140	170	200
6	4000-22000	180	130	170	200	230
7	7000-43000	230	180	220	250	280
8	12000-70000	280	230	270	300	330

NOTES:- RANGE A ALLOWS ±13mm MOVEMENT
B ALLOWS ±25mm MOVEMENT
C ALLOWS ±40mm MOVEMENT

TOP PLATE CAN BE SUPPLIED SQUARE OR RECTANGULAR TO CATER FOR CO-ORDINATE DIRECTION MOVEMENTS.

STANDARD BEARING IS DESIGNED FOR SITE WELDING, ALTERNATIVE BOLTED ATTACHMENT CAN BE SUPPLIED.

IT IS RECOMMENDED THAT SLIDING CONTACT SURFACES ARE INSTALLED PARALLEL THROUGHOUT THE MOVEMENT RANGE

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Typical slider support arrangement utilising standard Carpenter & Paterson Ltd pipe saddles.