Fabreeka®
Structural Expansion Bearings

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Fabreeka® is a leading manufacturer of products for reducing impact shock and vibration. Fabreeka® products have also been used successfully to reduce stresses and loads in supporting structures.

Fabreeka® has been a recognized leader in the expansion bearing and pipe slide field, incorporating the Fabreeka® pad to take up adverse rotation, misalignment conditions and the reduction of localized stresses and vibrations within structures.

To complement these expansion bearings, Fabreeka® provides a full line of products for all types of applications.

SBX Structural Expansion Bearing Specification

Polytetrafluorethylene (PTFE) self-lubricating surface bearing element shall be composed of 100 percent virgin (unfilled) polytetrafluorethylene polymer and bonded to a rigid confining substrate. The substrate shall limit the flow (elongation) of the confined PTFE to not more than 0.009" under load of 2,000 psi for 15 minutes at 78°F for a 2" x 3" test sample. The virgin (unfilled) PTFE shall have a thickness of not less than 1/32". The properties of the PTFE shall conform to the following requirements:

Requirement	Test Method	Value
Hardness at 78°F	ASTM D2240	50 - 65 Durometer D
Tensile Strength, psi	ASTM D1457	2800 (Min. Avg.)
Elongation %	ASTM D1457	200 (Min. Avg.)
Deformation Under Load %		
78°F-2000 psi (1/2" x 1/2" x 1/32")	ASTM D621	4 (Max.)
Specific Gravity	ASTM D792	2.14 to 2.21

The ***Bearing Pad*** shall comply with the AASHTO Specifications 18.4.10.1 and/or 18.10.2 "Preformed Fabric Pads" and consist of multiple layers of 8 ounce cotton-polyester duck impregnated with high quality rubber, capable of withstanding loads of 10,000 psi perpendicular to the plane of lamination. Actual dimensions are determined by design criteria as noted on the structural drawings. The bearing pad shall meet the environmental requirements of MIL-E-5272.

The ***Stainless Sheet*** shall be 20 gauge (GA), meeting AISI Type 304 (ASTM A-240) specifications and have a mirror finish of less than 10 microinches R.M.S. (Root-Mean-Square) on the side in contact with the PTFE. The reverse side shall be prepared for bonding to the carbon steel attachment plate. The stainless steel shall be 1/4" smaller than the carbon steel attachment plate all around, and these shall be bonded together with an epoxy adhesive meeting the following requirements:

EPOXY:

Requirement	Test Method	Value
Flexural Modulus	ASTM D790	2×10^4
Safe Operating Temperature		-60° to 145°C
Linear Expansion Coefficient, in/in	ASTM D696	4.8×10^{-5}
Bond Strength, psi		
(Tensile Shear at 77°F)	ASTM D1002	1,000

The ***Coefficient of Friction*** between the self-lubricating bearing element (PTFE) and the stainless steel shall not be more than 0.06 at 800 psi compressive loading.

Tolerances - The bearing pad shall have a shore "A" hardness of 90 ± 5. The expansion bearing total thickness will be ± 1/16". The PTFE thickness shall be -0/ + .016.

Fabreeka® Structural Expansion Bearings consist of an Upper Unit and a Lower Unit.

The **Upper Unit** includes a 10 GA carbon steel plate with a mirror finish stainless steel facing, epoxy-bonded and spot-welded to the bottom surface.

The **Lower Unit** is comprised of a Fabreeka® preformed fabric pad surfaced with PTFE. A rigid confining medium substrate bonds the PTFE to the pad, which is epoxy-bonded to a 10 GA carbon steel plate.

When the Upper and Lower Units are mated, the stainless steel facing slides on the PTFE surface with an extremely low coefficient of friction.

HOW TO DESIGN FABREEKA® SBX STRUCTURAL EXPANSION BEARINGS

Lower Unit: The "Fabreeka®-PTFE" Lower Unit must be designed first. Size and thickness requirements for the Lower Unit are easily determined by referring to the **"Design Reference Chart"** and example on Page 4. The "Fabreeka®-PTFE" pad is bonded to a 10 GA carbon steel attachment plate.

Upper Unit: The design of the "Steel - S.S." Upper Unit is determined by (1) the dimensions of the Lower Unit, (2) expansion considerations and (3) the type of application, including the lateral restraint system.

Steel:

A 10 GA carbon steel attachment plate to which the Stainless Steel facing is epoxy-bonded and spot-welded.

Stainless Steel:

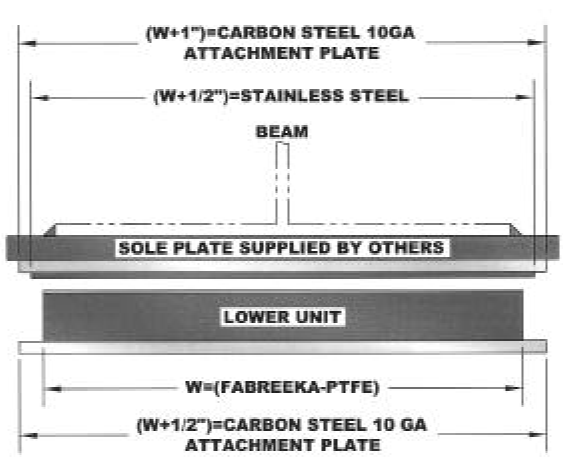
Stainless Steel facing is made 1/4" (6.4 mm) smaller all around than the 10 GA carbon steel attachment plate.

Steel Sole Plate:

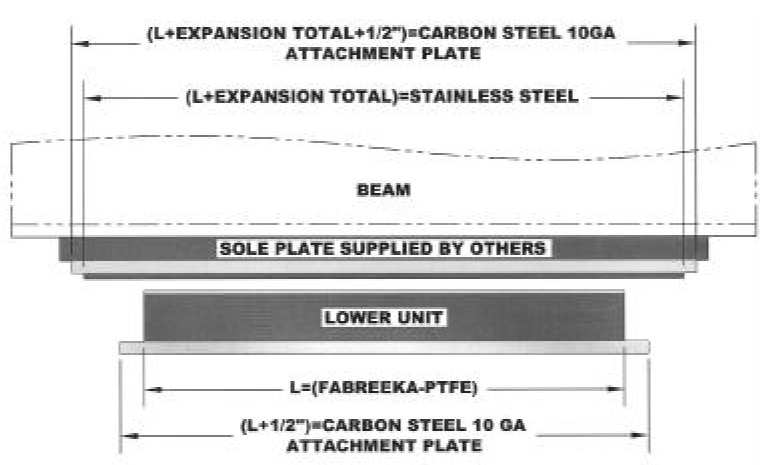
When used with steel bridge beams: Sole plates (supplied by others) welded directly to the beam flange should be of proper structural integrity. If the attachment plate is welded to an existing sole plate, it can be as thin as 10 GA (3.4 mm) thick.

When used with concrete bridge beams: Sole plates (supplied by others) should be furnished with welded studs, so that they may be cast into the beam.

When used in buildings and other structures: Sole plates can be as thin as 1/4" (6.4 mm), depending on the predetermined design.



END ELEVATION



SIDE ELEVATION

Notes:

1.0 BEARINGS MUST BE SET LEVEL.

2.0 A masonry/sole plate (supplied by others) can be used beneath the lower unit if there is a need to distribute the bearing load to meet allowable pressures to the support. Their size and thickness are determined accordingly.

3.0 The design of shear plates, anchor bolts and other forms of restraints (supplied by others), when required, will depend on the horizontal forces to be resisted.

4.0 It is preferred that sizing of stainless steel slide surface is calculated at two times the expansion for proper positioning in all temperatures.

FABREEKA

Design Reference Chart

(See derivation - Page 5)

Bearing Maximum Average Compressive Stress	Bearing Rotation Length / Bearing Thickness (L/T) Beam Rotation Across (L) - Radians																	
Radians	0.020	0.019	0.018	0.017	0.016	0.015	0.014	0.013	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.005	0.004	0.003
800 psi (5.5 N/mm^2)	**8.0**	**8.4**	**8.8**	**9.4**	**10.0**	**10.6**	**11.4**	**12.4**	**13.4**	**14.6**	**16.0**	**17.8**	**20.0**	**22.8**	**26.6**	**32.0**	**40.0**	**53.4**
1000 psi (7.0 N/mm^2)	6.0	6.3	6.7	7.0	7.5	7.9	8.6	9.1	10.0	10.9	11.9	13.3	14.9	17.0	19.8	23.8	29.8	39.7
1200 psi (8.5 N/mm^2)	**4.2**	**4.4**	**4.7**	**5.0**	**5.3**	**5.6**	**6.0**	**6.5**	**7.0**	**7.7**	**8.4**	**9.3**	**10.5**	**12.0**	**14.0**	**16.8**	**21.0**	**28.0**
1500 psi (10.0 N/mm^2)	1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.8	3.1	3.4	3.7	4.1	4.6	5.3	6.2	7.4	9.3	12.3

*If your design average stress exceeds the 1500 psi listed above, please contact **Fabreeka's® Engineering Department** for assistance.*

Design Example

Assume a **Fabreeka® Structural Expansion Bearing** is required to support a steel bridge beam 28" (711 mm) wide with a provision for a 1" (25.4 mm) expansion and subject to the following conditions:

Maximum average compressive stress = 800 psi (5.5 N/mm^2)
Maximum reaction (D.L. + L.L. + Impact) = 180 Kips (800 kN)
Maximum rotation = 0.015 radians

Lower Unit dimensions are determined as follows:

Total **Fabreeka® Pad** Area = $\frac{180{,}000 \text{ lbs } (800 \text{ kN})}{800 \text{ psi } (5.5 \text{ N/mm}^2)}$ = 225 sq in (145,161 mm^2)

making pad width (W) dimension equal to the beam width, then:

Pad Rotation Length (L) = $\frac{225 \text{ sq in } (145{,}161 \text{ mm}^2)}{28 \text{ in } (711 \text{ mm})}$ = 8 in (204 mm)

Now we must use the "Design Reference Chart" shown above to determine the thickness. At the intersection of the 800 psi (5.5 N/mm^2) line and 0.015 radians column, we obtain a length/thickness ratio of 10.6. Therefore:

Thickness (T) = $\frac{L}{10.6}$ = $\frac{8 \text{ in } (204 \text{ mm})}{10.6\ (10.6)}$ T = 0.75 in (19 mm)

The Fabreeka® Pad Lower Unit Dimensions are: W x L x T
28" x 8" x 3/4" thick (711 mm x 204 mm x 19 mm thick)

Upper Unit dimensions are determined by the dimensions of the Lower Unit, expansion considerations and the type of application (see sketch Page 3). Therefore:

The Upper Unit consists of a:

Carbon steel attachment plate:
29-1/2" x 10-1/2" x 10 GA thick
(749 mm x 267 mm x 3 mm thick)

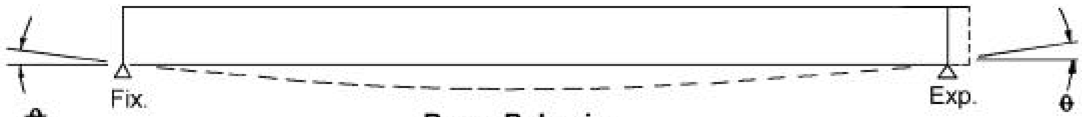
to which is epoxy-bonded and spot-welded:

Stainless Steel:
29" x 10" x 20 GA thick
(737 mm x 254 mm x 0.90 mm thick)

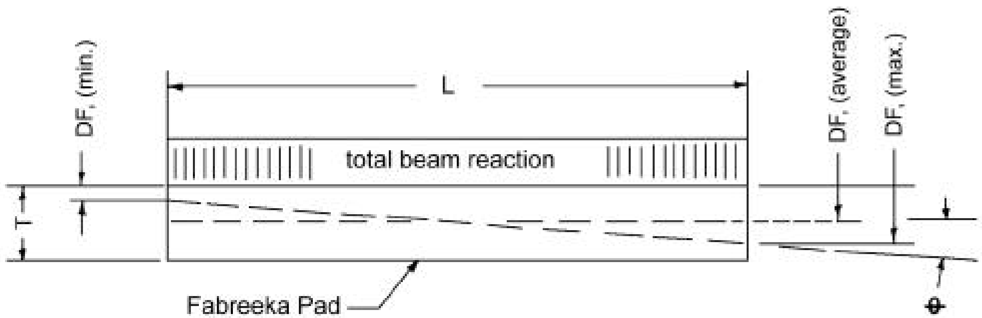
Note: The Upper Unit 10 GA carbon steel attachment plate is welded to the sole plate (supplied by others).

Feel free to contact the **Fabreeka® Engineering Department** any time at **1-800-322-7352** for design assistance.

Design Reference Chart Derivation



Beam Behavior



Pad Behavior

The L/T values shown in the "Design Reference Chart" were derived using the following procedure.

Pad stress distribution is a function of load, bearing angle, pad geometry and Fabreeka's® load-deflection characteristics as seen in the following formulas:

$$D_F\ (\text{max}) = D_F\ (\text{average}) + \frac{L}{2} \times \tan\theta\ (\text{DEG})$$

$$D_F\ (\text{min}) = D_F\ (\text{average}) - \frac{L}{2} \times \tan\theta\ (\text{DEG})$$

$$D_F\ (\text{max}) = D_F\ (\text{average}) + \frac{L}{2} \times {}^*\theta\ (\text{radians})$$

$$D_F\ (\text{min}) = D_F\ (\text{average}) - \frac{L}{2} \times {}^*\theta\ (\text{radians})$$

$$D_F\ (\text{max}) - D_F\ (\text{average}) = \frac{L}{2} \times \theta$$

and:

$$D_F\ (\text{max}) - D_F\ (\text{average}) = d \times T$$

Hence:

$$d \times T = \frac{L}{2} \times \theta$$

Therefore:

$$\frac{L}{T} = \frac{2d}{\theta}$$

and

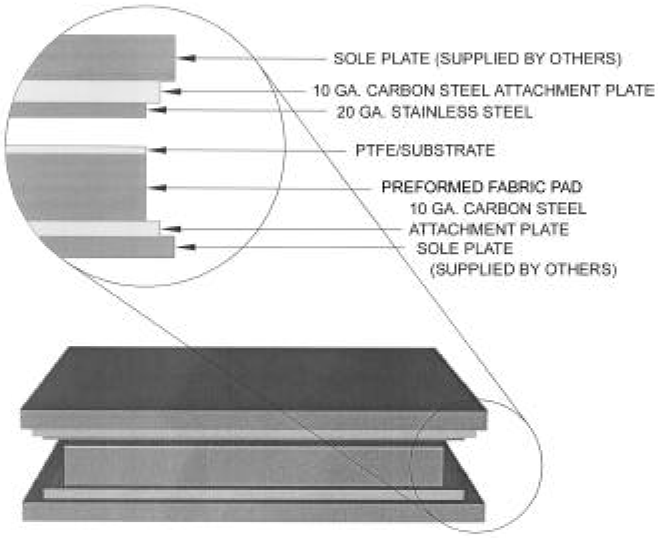
$$T = \frac{L}{2d/\theta}$$

Where:

- L = Fabreeka® pad dimension across which rotation occurs. Parallel to longitudinal axis of beam.
- T = Fabreeka® pad thickness (inches).
- D_F = Fabreeka® Deflection = Unit Deflection (strain in inches/inch).
- d = Unit Deflection (strain/increment due to rotation).
- $^*\theta$ = Angle (θ) in radians because angles are less than 5°.

BEARING CONFIGURATIONS

Structural Expansion Bearings (SBX)



Guidelines for Applications

SBX Structural Expansion Bearings are used when construction tolerances, high load and rotation are prominent with beam spans being excessive. This bearing is the most resilient in our full line of expansion bearings.

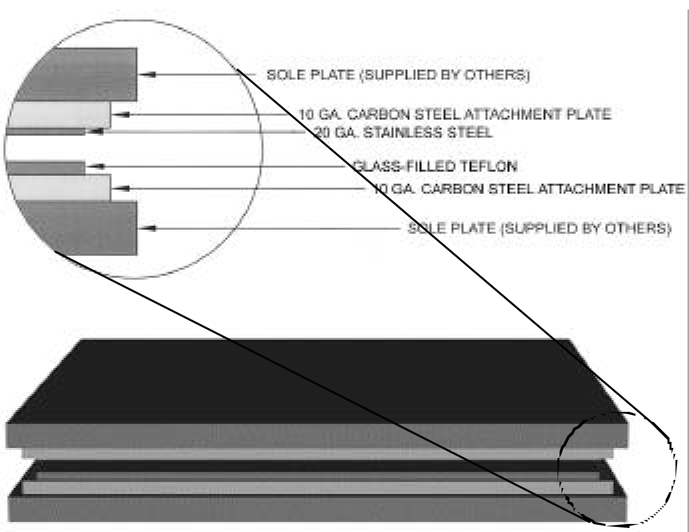
Please follow the design criteria on pages 3, 4, 5 of this brochure.

Typical applications include:

- **Bridges**
- **Complex Structures[1]**

[1]Complex Structures include structures where vortex shedding and seismic conditions are prevalent.

Expansion Bearings (STX)



Guidelines for Applications

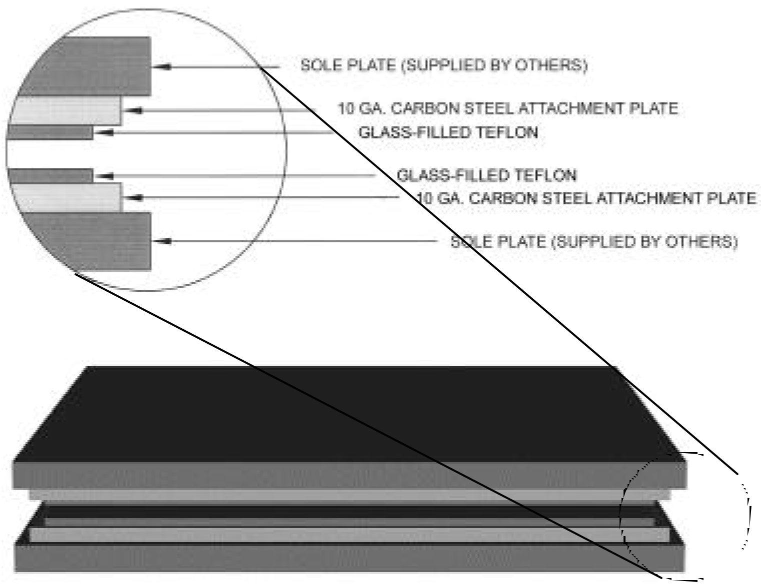
STX Expansion Bearings are used when construction tolerances, loads and rotation are moderate. This bearing has an extremely low coefficient of friction, which is exceptional for use where expansion is large.

Please note: Fabreeka® can supply various types of Teflon, based on customer requirements.

Typical applications include:

- **Pedestrian Bridges**
- **Parking Garages**
- **Small Buildings**
- **Tanks**
- **Vessels**
- **Pipelines**
- **Slip Joints**
- **Expansion Joints**

Expansion Bearings (TTX)



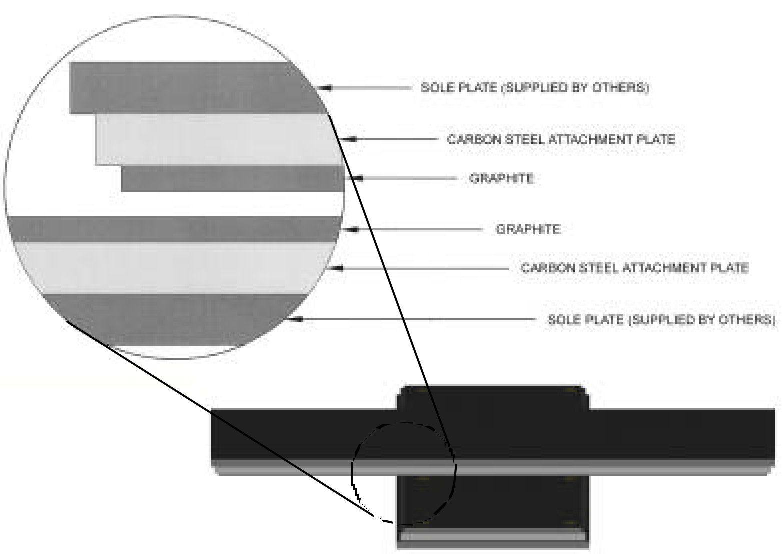
Guidelines for Applications

TTX Expansion Bearings are used when construction tolerances, loads and rotation are moderate. This bearing has a higher coefficient of friction than the STX Bearing and is used where expansion criterion is limited.

Typical applications include:

- **Tanks**
- **Vessels**
- **Slip Joints**
- **Expansion Joints**

Expansion Bearings (GGX)



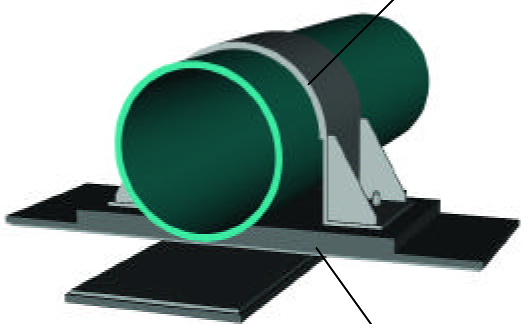
Guidelines for Applications

GGX Expansion Bearings are used when temperature is a factor - in excess of 275°F. Graphite is a versatile engineered material with an unusual combination of physical, electrical and chemical properties. These bearings are ideal for hostile environments where other types of materials may break down due to acids, solvents and high temperature. The GGX Expansion Bearings achieve effective performance in environments where temperatures range from -50°F to 700°F.

Typical applications include:

- **Steam Pipelines**
- **High Temp. Vessels**
- **Chemical Tanks**

Expansion Bearings / Pipelines



Expansion Bearing - Type dependent on application criteria. Please see Bearing Configurations.

Pipeline Applications

Fabreeka® Pipe Slides/Expansion Bearings facilitate the movement due to expansion and contraction from thermal and/or dynamic changes. The bearing element helps to distribute loadings and reduces localized stress concentrations.

Typical applications include:

- **Piping**
- **Transmission Lines**
- **Conduit**
- **General Plumbing**

Note: Please use our *Guidelines for Applications* sections to choose the proper bearing element based on your application criteria.

Ordering Example

Following are standard order/part numbers examples:

FAB - UU - SBX - YY

Fabreeka® Designation	Upper Unit	Bearing Type	Sliding Surface Length x Width

FAB - LU - SBX - XX - X

Fabreeka® Designation	Lower Unit	Bearing Type	Pad Length x Width	Pad Thickness*

*Pad thickness is calculated by using design criteria on pages 3, 4, 5 of this brochure.

All bearing attachment plates will be Fabreeka's® standard 10 GA A-569 carbon steel with the exception of bearing type GGX, which must be designed based on application specifications supplied. All other bearing types will have attachment plates, upper and lower, that will be supplied with a 1/4" lip around the sliding surface on all sides for intermediate non-continuous tack welding.

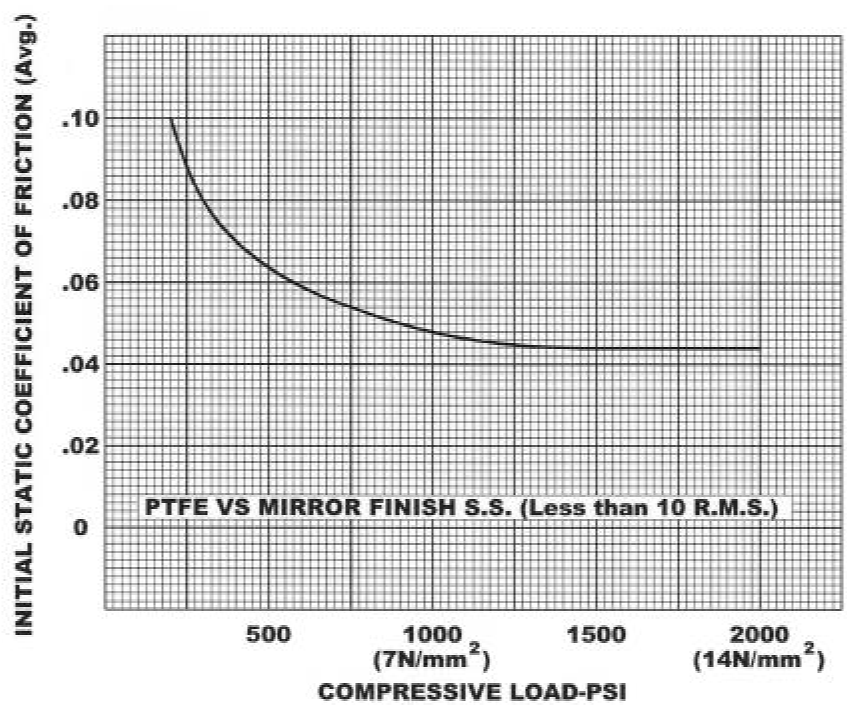
General Notes:

Care must be exercised and appropriate weld procedure used when welding the Upper Unit in place to insure that the epoxy bond area does not reach a temperature of (or exceeding) 300°F. It is therefore recommended that the smallest diameter welding rod be used to minimize heat build-up. *For example:* use a 1/8" diameter rod to run a 3/8" fillet weld.

For **MULTIDIRECTIONAL** expansion requirements, simply replace the slotted hole with an enlarged circular hole.

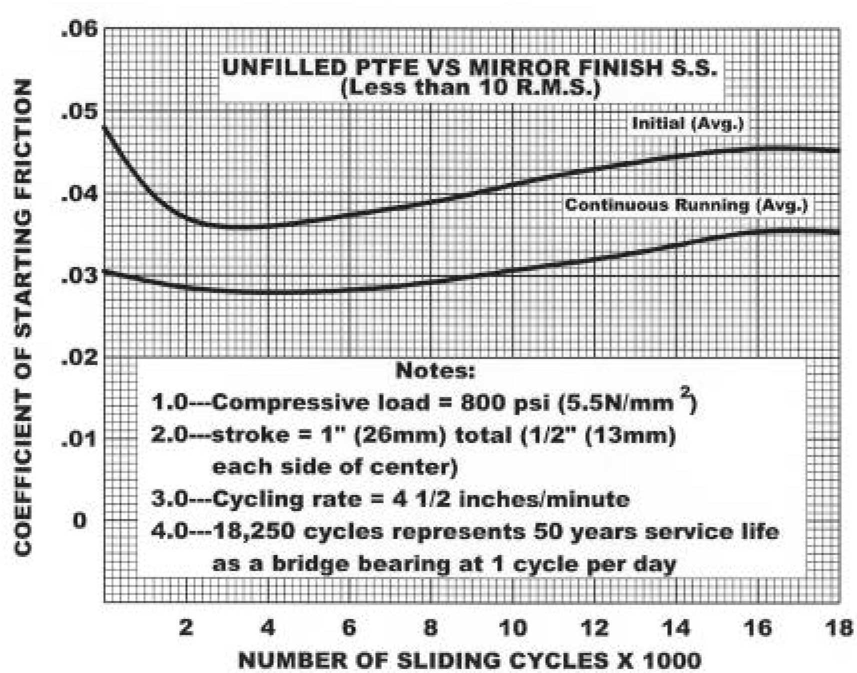
For **MULTIROTATIONAL** situations, the Fabreeka®-PTFE (Lower Unit) can be supplied in circular rather than rectangular shape. The circular (disc) shape assures a constant rotational length.

Average Coefficient of Friction



Note: Friction reduces as the compressive stress is increased.

Average 50-Year Test Life



Note: Initial starting friction reduces to a run-in value under continuous sliding conditions.

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