Guide elements do have very important role for sealing elements to function properly in hydraulic and pneumatic systems. The transverse forces in hydraulic and pneumatic cylinders will cause momentums to occur inside the system.

There is need for guide elements to absorb such momentums in order to prevent the damaging factors to the sealing elements as well as to the system. Guide elements are installed in the piston and gland caps to absorb the radial forces-moments in the system preventing metal to metal contact with piston to the cylinder bore and rod to the gland cap. The elastic deformation of the components under the load (deflection of the guide element, bending of the shaft, stretching of the cylinder) creates an angular deviation between the piston and bore or rod and gland cap. Calculation based on the parallel axis generally gives incorrect results. In this respect it is vital to take this into consideration when calculating the guide elements.

Nowadays most of the cylinders have non metal guide elements instead of metal guide elements. Non metallic guide elements do have very low friction coefficient, high bearing capacity, excellent cushioning effect and able to work in vibrated systems. They are easily installed into open grooves, prevents hydrodynamic pressure and diesel effect, able to absorb the angular deviations between the piston-bore and rod-gland cap and economical guiding solution which make them used widely in the applications.

During the application of the non metallic guide strips the gap (k) should be checked according to our catalogue information prior to installation to prevent hydrodynamic pressure and to increase the life-span.

**Figure 31** Load distribution with a metal guide element

**Figure 32** Load distribution with non metallic guide element

**Figure 33** Surface contact pressure vs speed at 60°C

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**MATERIALS USED IN GUIDE ELEMENTS AND THEIR CHARACTERISTICS**

Today the cylinders are expected to work with high speed, high forces without any problems during the application. Operating temperature, sliding speed, media and the operating forces of the system are important factors in choosing the guide element to achieve these expectations. Most common non metallic guide element materials are special filled PTFE, special filled or pure Polyacetal (POM), fiber or polyester resin. Utilization of the metallic guide elements reduced over the past years but still they are being used for some applications.

Our guide elements can be divided into three main categories. Figure 33 shows the surface contact pressure values of these. Surface contact pressure resistance of the non metallic guide element decreases when the sliding speed and temperature increases (Figure 33 and Figure 34). In this respect the height calculation of the guide element should be done according to the maximum system temperature and speed information.
Guide strip width (mm) $b$

Transverse force (N) $F$

Safety factor ($f \approx 2$) $f$

Permissible surface contact pressure (N/mm²) $P_t$

Nominal diameter of rod or piston (mm) $d$

It is not required to have metal to metal contact with piston-bore and rod-gland cap. That is why under the transverse forces, maximum angular deviation for the guide element should be less than the permissible sealing gap defined in the catalogue.

**GUIDE ELEMENT HEIGHT&WIDTH CALCULATIONS**

The elastic deformation of the components under the load (deflection of the guide element, bending of the shaft, extending/shrinking of the cylinder) creates an angular deviation between the piston and bore or rod and gland cap. Calculation based on the parallel axis generally gives incorrect results. In this respect it is vital to take this into consideration when calculating the guide elements.

Geometric consideration (angular deviation, additional force applications to the system, etc) should be taken into account when calculating the transverse load applied on the guide element and also the elastic deformation of all components involved (deflection of the guide element, bending of the shaft, stretching of the cylinder, etc). In this respect while making the calculations a safety factor (generally around 2) should be identified.

In long slender cylinders the permissible transverse force is limited by the bending strength of the rod and other factors. The general assumption that about 10% to 15% of the hydraulic force is applied as a transverse load.

**POM GUIDE ELEMENTS**

Polyacetal guide elements generally used with glass additive or pure form. They have a wide range of usage as a result of low service costs. Surface contact pressure of POM guide elements decreases the same level as the other thermoplastic materials when the temperatures go above +60°C. POM material has light and medium load bearing capacity.

**POLYESTER RESIN GUIDE ELEMENTS**

Polyester resin guide elements have improved function compared to straight metal guide elements thanks to their elastic structure. The low tension increase in the edge area and the elastic properties make these guide elements to withstand higher surface loads. The surface contact pressure and the characteristics under high operating temperature is greatly influenced by the composition of polyester resin-based material. Special texture of the polyester resin reduces the friction forces and prevents the break off material during the application. The radial load is distributed homogenously on these guide elements which enables to work on insufficient lubricated applications. Polyester resin guide elements have medium and high load bearing capacity.

**PTFE GUIDE ELEMENTS**

PTFE guide elements are commonly used in applications that has high operating temperature, aggressive media and in need of low friction forces. Bronze, carbon and MoS₂ additives improve the mechanical properties of PTFE material depending on the application. PTFE guide elements are being used with other high load bearing capacity guide elements on some particular applications. PTFE mainly absorbs the foreign particles in the system in such applications to prevent damaging of the cylinder bore or rod and not to stick these particles into harder guide elements. It has light load bearing capacity.
**GUIDE LENGTH CALCULATIONS IN GUIDE STRIP**

$L = \text{Guide strip length (mm)}$

$d = \text{Nominal diameter of rod (mm)}$

$D = \text{Nominal diameter of piston (mm)}$

$a = \text{Cross-sectional thickness of the guide strip (mm)}$

**Piston Application**

$L = \frac{3.14 \times (D-a)}{1.01} - 1.2 \text{ mm}$

**Rod Application**

$L = \frac{3.14 \times (d+a)}{1.01} - 1.2 \text{ mm}$