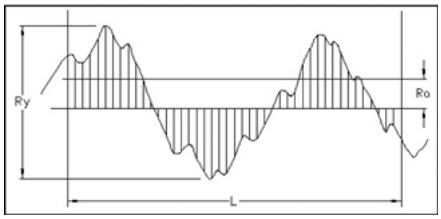
SURFACE FINISH

The surface finish has a critical influence on excellent sealing performance, low friction and long seal life. A finish that is either too rough or very smooth will cause a negative result. The surface microstructures allow pockets of fluid in very small volumes to pass under the seal with each cycle. This lubricating fluid lowers friction and extends seal life. Seal interface lubrication is reduced with a very fine surface finish and the seal will suffer increased friction and wear. In the case of rod sealing, a rougher finish may result in leakage if the fluid passes under the seal, is removed from the rod and not returned back into the cylinder. The wear rate is a major factor in the life of a dynamic application, and depends on the quality of the rod and the cylinder bore surface finish.

Definitions

The most frequently specified parameters in the fluid power industry are Ra, Ry, Rt, Rz, Rq, and Rsk which are defined in ISO 4287 and ISO 4288.



Ra is defined as the arithmetical mean deviation of the assessed profile. The inch equivalent parameter is CLA (centre line average). A surface finish of 0.4 µm Ra is equivalent to 16 µin CLA. The "checkmark" symbol used on drawings to specify a surface texture control requirement is an Ra specification.

Ry (also Rmax) is the maximum roughness height in one cutoff length (L) of the profile.

Rt is the maximum roughness height in five cutoff lengths of the roughness profile. Rz is the average of the five greatest peak-tovalley separations crossing the mean line in a single cutoff length.

Rq is the root mean square deviation of the assessed profile. The equivalent term in inches is RMS (Root Mean Square). The Rq (RMS) of a surface is approximately 10% greater than the Ra (CLA) value.

Rsk is the assessed profile skewness or the measure of symmetry about the mean. A negative Rsk indicates greater valleys than peaks and imparts a better seal mating surface.

Recommendations

A single parameter rating is not suffi cient in assessing the surface irregularities. Several parameters should be specifi ed to accurately evaluate the surface depth, shape and orientation and their affect on sealing performance, friction and wear.

Reciprocating Cylinder Rod	Reciprocating Cylinder Bore and Slow Rotary Rod
Hydraulic and Low Pressure Pneumatic	Hydraulic and Low Pressure Pneumatic
Ra = 4 to 12 µin [0.1 to 0.3 µm]	Ra = 4 to 20 µin [0.1 to 0.5 µm]
Rz 50 µin [1.3 µm]	Rz 80 µin [2.0 µm]
Rsk = -1.0 to -4.0	Rsk = -1.0 to -4.0

Surface Finishing

The surface roughness is dependent on the machining process employed. Scores, scratches, voids, concentric or linear machining marks are not permitted. Common production methods result in a metal surface fi nish of between 1 µin to 140 µin [0.02 µm to 3.5 µm] Ra roughness as shown in the table below.

Process Roughness Ra (µin [µm])

Turning	40 – 140 [1.0 - 3.5]
Boring	24 – 95 [0.6 - 2.4]
Broaching	16 – 63 [0.4 - 1.6]
Precision Rolling	8 – 48 [0.2 - 1.2]
Grinding	8 – 40 [0.2 - 1.0]
Smooth	3 – 12 [0.08 - 0.3]
Super Fine	0.5 – 3 [0.012 - 0.08]
Polished	0.5 – 3 [0.012 - 0.08]