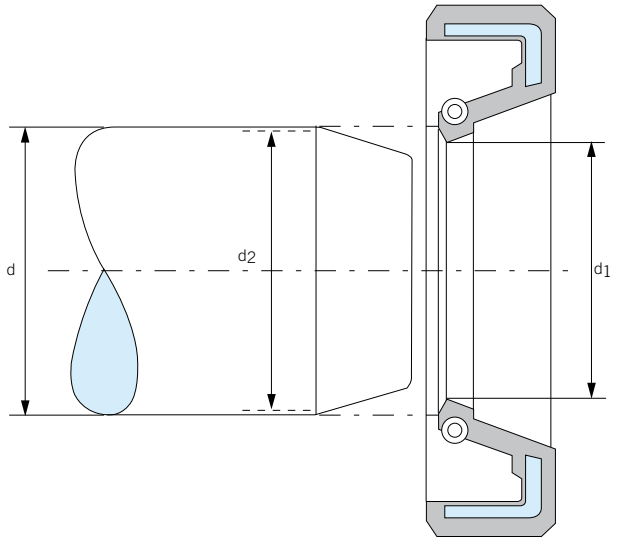
Shaft materials and tolerances

Material

The rubber material of the Oil Seal is much softer than the shaft, but due to friction between the shaft and the seal, it is possible for wear to occur on the contact surface of the shaft. The degree of wear depends on the structure of the shaft material. In general, the metal from which the shaft is made should have a homogeneous fine granulous structure and must have a minimum surface hardness of HRc 45. If the lubrication is doubtful, the medium is contaminated, dirt can enter from the outside and the speed of the shaft is more than 4 m/sec, the hardness of the shaft should be a minimum of HRc 55. In general, shafts of carbon steel or stainless steel are most suitable. Surface hardening is recommended. In the case of hard chromed shafts, the uniformity of the chrome plating has to meet very high requirements. In practice, such surfaces do not meet these optimum requirements. Coated shafts, for example with chrome oxide (ceramics) have to be carefully machined. The coating should not have pores larger than 0,05 mm. This is also the case for the surface of cast iron with a perlitic structure. In some cases, non-ferrous metals such as brass MS 58H are used. Ceramic sleeves and Erisleeves are very useful as too. Erisleeves are used in both original equipment assembly and repair.

Comment: Plastics are unsuitable due to their poor thermal conductivity. Because of this, underlip heat generation cannot be readily conducted away, which is not desirable.



Requirements of the shaft

Even more important than a correct interference fit of the Oil Seal is a perfectly smooth shaft in the region of the seal, particularly if shaft surface speed is high and the medium to be sealed is under a certain amount of excess pressure. The surface roughness of the shaft depends on the average profile depth Ra of the tool marks caused by the machining process. Oil Seals made of PTFE require, independent of the surface speed, a surface roughness of between 0,1 to 0,2 µm, because PTFE has less wear resistance than rubber seals.

For normal circumstances, the shaft in the region of the seal must have a surface roughness of approximately:

Ra	= 0,4 - 0,8 µm or -
CLa	= 8 tot 25 µm or
Rz	= 1,0 tot 4,0 µm and
Rmax	≤ 6,3 µm

To summarize, the surface of the shaft in the region of the seal should not have noticeable machining marks. For pivoting shafts and other difficult or critical sealing applications, it is recommended that Oil Seals with a helical groove hydrodynamic pattern, which has a pumping effect, be used. When grinding and polishing, an axial movement of the grindstone along the shaft must be avoided in order to prevent machine lay.

Tolerances

The sealing capacity of an Oil Seal also depends on the pressure exerted by the sealing lip on the shaft. The degree of pressure is directly related to the interference and the dimensional tolerances of Oil Seal and shaft. Interference is the difference between the shaft diameter and the inside diameter of the sealing lip (d – d1).

Where problems occur and a free running seal is essential, despite risk to sealing capacity, the shaft diameter may be reduced as long as at least 1/3rd of the minimum interference is preserved (d2)

Comment: the shaft in the region of the Oil Seal must have a dimensional tolerance of h11.