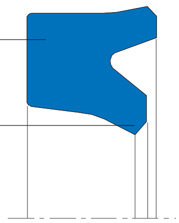
MERKEL® U-RING T20

Merkel® U-ring T20 is a sealing element made of polyurethane with asymmetrical profile for the sealing of piston rods.



Applications

Ideally suited as a secondary seal in a sealing system. Preferred use as a single seal in the pressure range up to 26 MPa. For less critical applications, it can also be used as a single seal in the pressure range up to 45 MPa. Available nominal diameters up to 2,000 mm.

Material

Material	Designation	Color
Polyurethane	95 AU V142	dark blue
Polyurethane	94 AU 30000	dark blue

The material is determined by the nominal diameter and the production process involved.

VALUE TO THE CUSTOMER

- Extended service life in the sealing system, due to volume compensation
- Functional reliability in the event of radial deflection due to profile size overlap
- Operating reliability, due to sturdiness of the polyurethane profile ring
- High sealing effect, due to prominent sealing edge (high line force)
- Secured against metallic contact by high extrusion resistance (large seal gap)
- Favorable friction values at low pressures due to short contact length (secondary seal)
- Simple and secure installation (single-piece element)

FREUDENBERG
SEALING TECHNOLOGIES

TECHNICAL PROPERTIES

Operating Conditions

Material	95 AU V142	94 AU 30000
Hydraulic oils, HL, HLP	−30 … +110 °C	−35 … +120 °C
HFA Fluids	+5 … +50 °C	+5 … +60 °C
HFB Fluids	+5 … +50 °C	+5 … +60 °C
HFC Fluids	−30 … +40 °C	−35 … +60 °C
HFD Fluids	–	Must be tested
Water	+5 … +40 °C	+5 … +80 °C
HETG (rape-seed oil)	−30 … +60 °C	−35 … +70 °C
HEES (synth. ester)	−30 … +60 °C	−35 … +90 °C
HEPG (glycol)	−30 … +40 °C	−35 … +60 °C
Mineral Greases	−30 … +110 °C	−35 … +120 °C
Pressure	40 MPa	45 MPa
Sliding Speed	0,5 m/s*	0,5 m/s*

* When the Merkel® T20 is used as a secondary seal, sliding speed of up to 1,5 m/s can be permitted.

Notes: The limit values for the temperature application range are general indications related to the media group. Since the unspecified additives of the oil manufacturers have a significant impact on the resistance of the sealing materials, their resistance must be explicitly checked in the actual medium used.

The specified figures for pressure, temperature, and sliding speed are maximum values and must not be applied simultaneously.

Surface Finish

Parameter	Tolerance [µm]		
	Sliding Surface	Groove	Groove Sides
R_a	0,05 … 0,3 µm	≤1,6 µm	≤3,0 µm
$Rz1_{max}$	≤3,0 µm	≤6,3 µm	≤15,0 µm

Material content M_r > 50 % to max. 90 %, with cut depth $c = R_z/2$ and reference line C_{ref} = 0 %.

The long-time behavior of a sealing element and its dependability against early failures are crucially influenced by the quality of the counter surface. A precise description and assessment of the surface is thus indispensable.
Based on current findings, we recommend supplementing the above definition of the surface finish of the sliding surface with the parameters shown in the following table. These new parameters based on the material content significantly improve the previously only general description of the material content, particularly with regard to the abrasiveness of the surface. Further information in our Technical Manual.

Surface Finish of the Sliding Surfaces

Parameter	Tolerance [µm]			
	HP-HVOF*	Plasma**	Hardchrome	Thermo-chem.***.
R_a	0,05 … 0,15	0,15 … 0,3	0,1 … 0,25	0,05 … 0,3
R_{pk}	≤0,1	≤0,1	≤0,3	≤0,5
R_{vk}	0,1 … 0,6	0,2 … 1,5	0,2 … 0,5	0,2 … 0,65
$Rz1_{max}$	./.	./.	./.	≤2,5
R_k	./.	./.	./.	0,25 … 0,7
R_{pkx}	./.	./.	./.	≤0,5
R_{vkx}	./.	./.	./.	0,2 … 2,0

* **High Pressure - High Velocity Oxygen Fuel Flame-sprayed Surfaces**
Carbides: WC/Ni, Cr_2C_3/NiCr
∅-Porosity: ≤0,5 %
Typical layer thickness: 125 µm

** **Ceramic Counter Surfaces**
Ceramic: $Al2O_3$, TiO_3, Cr_2O_3
∅-Porosity: ≤3 %
Typical layer thickness: 150 µm

*** **Hardened Counter Surfaces**
Nitro-carburized; induction hardened

Gap Dimension

The dimension D_2 is determined by factoring in the maximum permissible extrusion gap, the tolerances, the guide clearance, the deflection of the guide under load, and the pipe expansion. See also Merkel® Technical Manual. The maximum permissible extrusion gap with a one-sided position of the piston rod is significantly determined by the maximum operating pressure and the temperature-dependent dimensional stability of the seal material. Please also consult our Technical Manual.

Profile Dimension [mm]	Max. permissible gap dimension [mm]			
Profile	16 MPa	26 MPa	32 MPa	40 MPa
≤5,0	0,45	0,4	0,35	–
>5,0 … 7,5	0,5	0,45	0,4	0,35
>7,5 … 12,5	0,55	0,5	0,45	0,4
>12,5 … 15,0	0,6	0,55	0,45	0,4
>15,0 … 20,0	0,65	0,6	0,5	0,45
>20,0 … 25,0	0,65	0,6	0,5	0,45

TECHNICAL PROPERTIES AND INSTALLATION

Tolerances
If the Merkel® U-ring T20 is used as a secondary seal in a sealing system, a larger gap dimension can be set. The general rule applying here is $D_2 = d + 1$ mm with a tolerance of H11 for $D_2 \leq 400$ mm or +0,4 mm for $D_2 > 400$ mm.

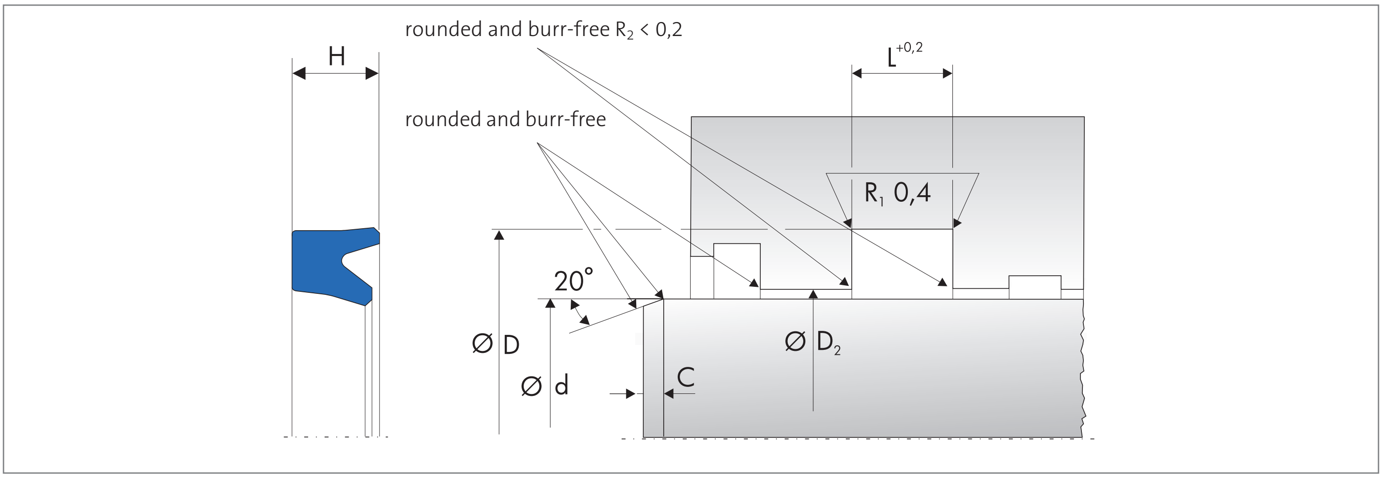
Diameter D [mm]	Tolerance
<400	H11

The tolerance for the diameters d and D_2 is specified in connection with the gap dimension calculation. In typical hydraulic applications up to a nominal dimension of 1000 mm, the tolerance fields f7 and f8 or H7 and H8 are usually chosen.

Design Notes
For U-rings with a nominal dimension of d < 25 mm, an axially accessible housing is required. U-rings with a nominal dimension of d > 25 mm can generally be installed in a recessed groove using a fitting tool or by hand. Depending on the ratio of the nominal diameter to the profile dimension, in individual cases an axially accessible housing will be required here as well. Please note the general design remarks in our Technical Manual.

Installation
Reliable seal function is dependent on correct installation. Please also consult our Technical Manual

Installation Diagram



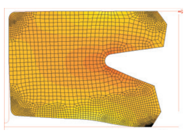
TECHNICAL PROPERTIES

Seal Configuration
The choice of a sealing element is crucially influenced by the material-dependent resistance to extrusion and the likewise material-dependent friction and wear behaviors.
The values of the principal characteristics (sealing effect, dimensional stability and friction or wear) are mutually contradictory in this context.
Depending on the operating and boundary conditions involved, U-rings made of polyurethane are used as individual seals, but more frequently in an appropriate combination of individual sealing and guide elements as a secondary seal in a sealing system.

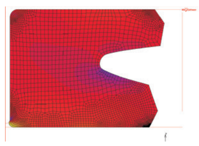
The characteristics of the individual elements in a sealing system are optimized in line with the principal requirement involved. An individual seal, or the primary seal in the system concerned, is exposed to the operating pressure. The principal requirement being high resistance to extrusion coupled with favorable frictional values under high pressure. The secondary seal in a sealing system is exposed to the low intermediate space pressure. The principal requirements in this case are the effective reduction of the residual-oil film released via the primary seal, coupled with favorable frictional values at low pressures.

Mold-release Volume
In a sealing system, the space between the primary and secondary seals is filled with hydraulic medium after a few cycles. The further entry of media leads to an increase of the pressure in the intermediate space. If a U-ring is used as the secondary seal, then it will act as a volume compensator under pressure by reason of the mold-release volume (Fig. 01). The pressure level in the intermediate space, and thus the thermal and mechanical loads as well, are effectively reduced.

Fig. 01



Merkel® U-ring T20 at 0 MPa



Merkel® U-ring T20 at 20 MPa

Sealing Effect
An element's sealing effect is described in terms of the ratio between the wiping effect and the return capability.

The initial sealing effect of compact, two-piece sealing elements is achieved by pressing the pre-stressing element. There is thus, of course, a close interdependence between the deformation of the loading element and the force being applied. A small change in the compression (due to tolerances and radial movement) results in a relevant change in the force being applied and thus ultimately in the sealing effect. In the case of the Merkel® U-ring T20, the initial sealing effect is entailed by the deformation of the sealing lips. Small changes in the radial contact pressure do not produce any relevant change in the pressure exerted by the sealing edge. The U-ring's geometry is thus, at a consistently high level of functionality, tolerant to radial deflections.

In the high-pressure range, many sealing elements exhibit a satisfactory sealing effect, attributable solely to the high contact pressure on the counter surface. In the pressure range up to 5 MPa (intermediate space pressure in the sealing system), by contrast, the sealing effect is crucially influenced by the edge geometry and the contact stress. The compression characteristic under the sealing edge is generally optimized so as to ensure effective wiping ability in the pressure chamber (rapid pressure rise) and a good return capability from the back (slow pressure rise). (See Fig. 02).
In comparison to compact sealing elements, the U-ring geometry of the Merkel® T20 exhibits a short contact length at low pressure, with a defined pressing maximum value. The oil film is effectively downsized here, all that remains is the wetting on the counter surface, desirable in terms of the sliding characteristics.

Friction
With sealing elements made of polyurethane, the material properties mean that a high sealing effect is achieved. Depending on the force being applied and the size of the contact area, the seal material is intermeshed to a greater or lesser extent with the counter surface. The closer the contact, the higher the friction force will be. Due to the small contact length of a PU U-ring in the low-pressure range, significantly lower friction values are achieved in comparison to compact sealing elements made of polyurethane.
As the secondary seal in a sealing system, the Merkel® U-ring T20 is subjected to significantly less than the mold-release pressure. If, however, the U-ring is being used as an individual seal, the operating pressure may rise to a level above the U-ring's mold-release pressure. Because of the increased intermeshing between the seal material and the counter surface due to the enlarged contact area, the amount of friction rises. If the working pressure is between 5 MPa and 10 MPa, the friction-optimized version LF 300 (LF = "low friction") with a grooved contact surface is the preferable option.

TECHNICAL PROPERTIES

Extrusion

The resistance to extrusion is essentially determined by the properties of the seal materials. In addition, not only the size of the deformation, but the deformation volume available also plays a crucial role. Due to the generally larger volume provided by a U-ring, larger gaps can be permitted here under otherwise identical boundary conditions in comparison to a compact seal with a slip ring made of polyurethane. This significantly reduces the possibility of unwanted metallic contacts.

The sealing system's service life is extended by using the Merkel® U-ring T20 in the sealing system concerned, since as a volume compensator it substantially reduces the thermal and mechanical stresses involved, thus assuring stable long term behavior.

Due to a U-ring's larger deformation volume, larger gaps can be permitted, thus significantly reducing the possibility of metallic contacts.

The Merkel® T20 exhibits an edge geometry designed for optimum sealing effect. Individual seals and sealing systems with a Merkel T20 as the secondary seal score highly in terms of a very good sealing effect.

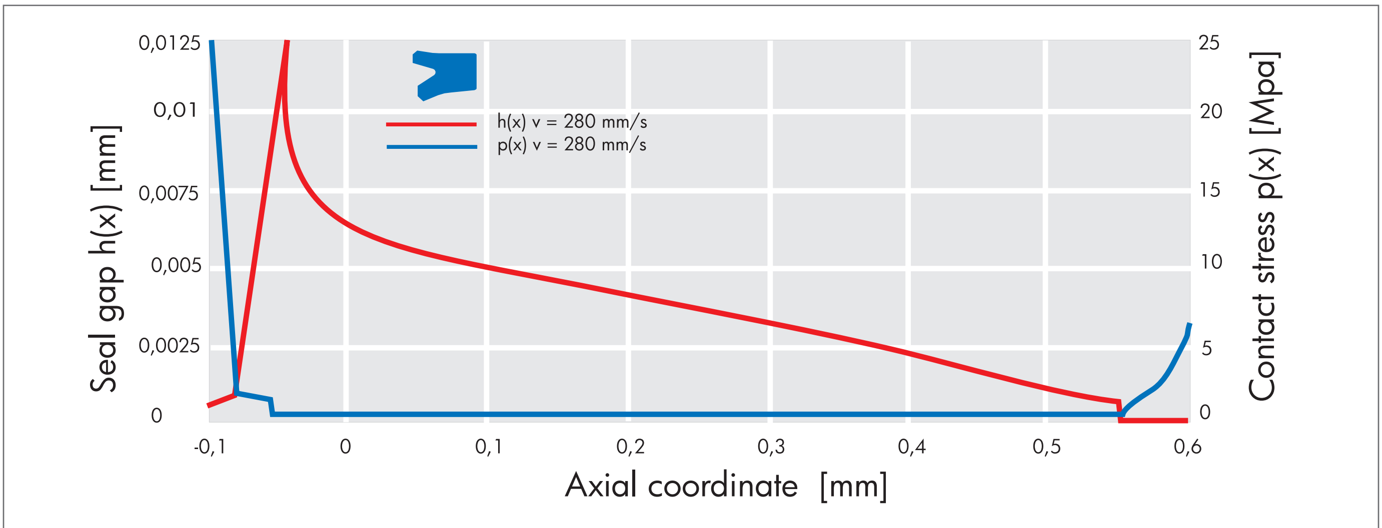


Fig. 02: Contact stress p and contact height h for the T20 U-ring, extending rod at 0,5 MPa operating pressure, 0,28 m/s velocity