Sealing concepts for coaxial connectors part 2

The electrical connecting points in coaxial connectors must be protected against ambient influences. The requirements for a seal, a correct seal design and various seal shapes were presented to you in the first part of the two-part newsletter series. This second part describes the sealing materials and different sealing concepts.

Sealing materials

Technical plastics, i.e. polymer materials, are used in sealing technology. Polymer materials are to be understood as long molecule chains which can be interconnected (networked). They are divided into thermoplastics, duroplastics and elastomers roughly according to the mechanical-thermal behaviour of the polymer materials.

- Duroplastics: Permanently plastically networked after hardening.
- Thermoplastics: Reversibly plastically formed under heat.
- Elastomers: Elastically formable under pressure.

The elasticity of the materials plays a major role in the sealing technology so that highly elastic thermoplastics and elastomers are used here.
The best known representative of the elastomers is natural rubber. Synthetic rubbers, simply called rubbers in practice, are technically important.

Elastomers are very important in sealing technology because of their excellent physical properties.

- Rubbers allow relatively large production tolerances for the seals as well as for the parts that accommodate them. At the same time, relatively low contact tensions are achieved in pretensioning or pressing.
- Rubbers behave almost incompressibly, i.e. the volume remains virtually identical under pressure. This means that an O-ring, for example, transfers a certain pressure evenly in all directions.
- Elastomers allow a change in shape without great reactive force and without changing their volume. An elastomer seal therefore adapts easily to any space. This means that an O-ring under pressure on one side in a rectangular groove will adopt an almost rectangular shape.

Abbreviations ISO 1629 ASTM 1418	**Designation** according to the chemical composition	**Application**
CR	Chloroprene-Rubber	The most important special rubber quantity-wise next to NBR and IIR. Good chemical properties, ageing and ozone resistant. Known under its brand name Neoprene®.
NBR	Acrylic Nitrile-Butadiene-Rubber	Most frequently used sealing elastomer; mineral oil

		resistant, medium heat resistance, very resistant to wear;
EPDM	Ethylene-Propylene-Diene-Monomer	Suitable for hot water/steam and phosphate ester; not for mineral oil and diester.
VMQ	Vinyl-Methyl-Polysiloxam	Rubber with Siloxane-Q group, i.e. silicone-based. High temperature resistance

Table 1: Elastomers mainly used in sealing technology

Sealing concepts

Coaxial connectors can be designed based on three different types of tightness. Longitudinal tightness, transverse tightness and installation tightness.

Longitudinal tightness

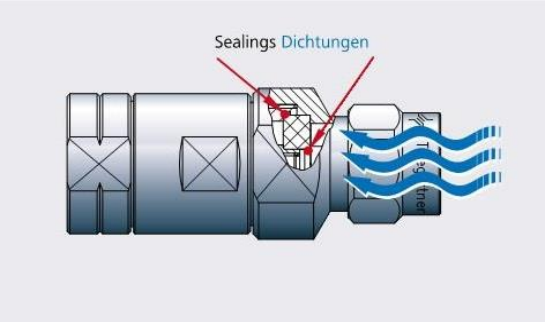

Figure 6: Longitudinal tightness in unplugged state

There may be a necessity for longitudinal tightness for coaxial plugs or sockets in the unplugged state. This prevents the passage of gases and moisture in axial direction through the possibly open connector face.
There are two common methods of ensuring longitudinal tightness. One method is a two-stage O-ring seal or a simple disc seal. In the sealing method with two O-rings, one O-ring is fitted between the housing and the insulation and one O-ring between the insulation and the contact bushing. Both O-rings are installed with intrinsic pressure and inserted together with the insulation or contact bushing into the housing. The housing has an installation chamfer to avoid damaging the housing-insulation sealing ring. Another possibility for longitudinal sealing is the use of a sealing disc. This disc seals both between the housing and dielectric and between the inner conductor and insulator.
The advantage of the disc is that is can replaced two O-rings. However, a constant pressure of the lower insulator is required to be able to use a sealing disc. Without this contact pressure, an air gap could result which can lead to possible leaks and poor return loss values. The solution with two O-rings is more common because of the high costs of the sealing disc and the good sealing values of O-rings.

Transverse tightness in the connection face

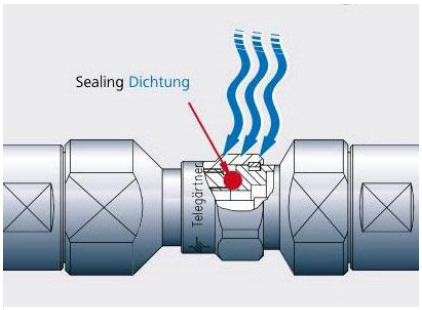

Figure 7: Transverse tightness in the connection face

A connection point must also or especially be protected against ambient influences in the closed state. The connection face is closed by a seal in the connection face between plug and socket as soon as the two connectors are coupled. There is also a sealing element around the outer conductor of the plug which is pressed by the outer conductor of the socket. This forced sealing ensures tightness up to 2.5 bar overpressure.

Transverse tightness of the plug system

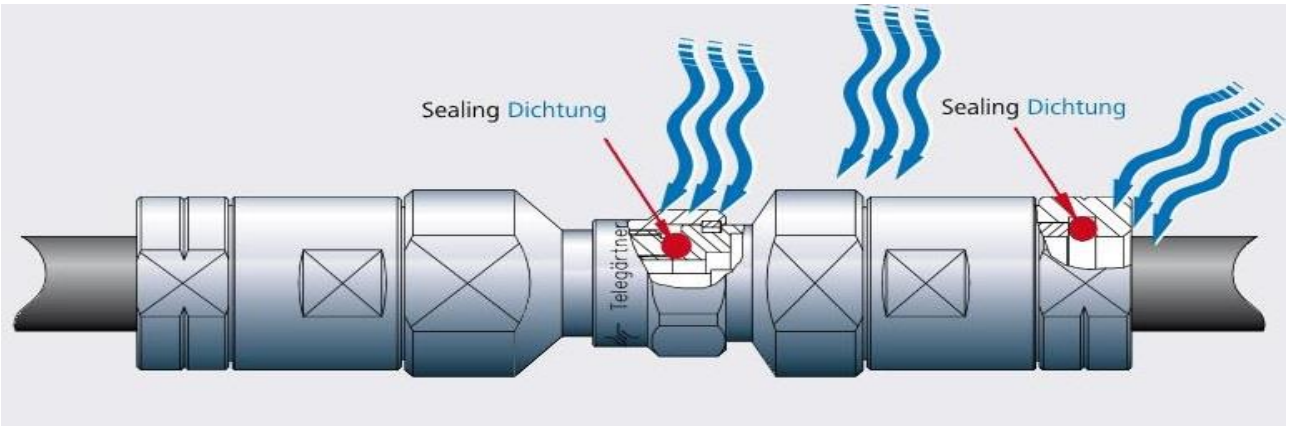

Figure 8: Transverse tightness of the entire plug system

The tightness requirements of individual connections or unplugged connectors also applies naturally to the same degree for the entire plug system. All the connection points must have an appropriate seal to achieve transverse tightness in a plug system. The connection points are between plug and socket and respectively at the cable transition points.

Installation tightness

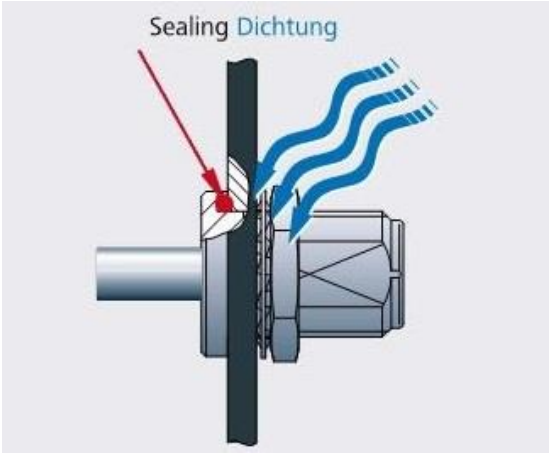

Figure 9: Installation tightness

The installation tightness ensures that no moisture or gases can penetrate the gap between the built-in connector and the housing bore. The installation tightness can be achieved in two different ways depending on the installation direction. The oversize sealing ring lies loose in a groove in the flange body and is pressed when screwing on.

Shrinkin Sleeve

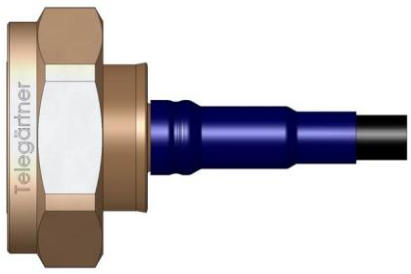

Figure 10: Shrink-on tube

Another possibility to seal the connection point between the cable and the connector is to use a shrinking sleeve. The plastic used is a thermoplastic, i.e. a plastic which changes shape in a certain temperature range. The shrink-on tube is shown in violet in figure 10. The shrink-on tube seals to the cable sheath and the connector housing. There is a choice between self-adhesive and non-adhesive shrink-on tubes. The adhesive on

the self-adhesive shrink-on tube becomes liquid under the effect of heat. The adhesive forms a positive locking connection when it cools and hardens and contributes additionally to the tightness. However, the poorer UV resistance of the adhesive is a disadvantage.