

## APPLICATION NOTES

# Silicone vs TPE

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# 1. Objective

For years Techno has been on the market with the aim of creating products which are innovative, safe and reliable over time, with high economic and functional performance.

This can be achieved by choosing the material with the best performance, able to satisfy most of the customer's requirements and needs. In practice, with the aim of simplifying the parameters to be analysed in the choice and according to the application need, we need a material which:

## INCREASED PERFORMANCE

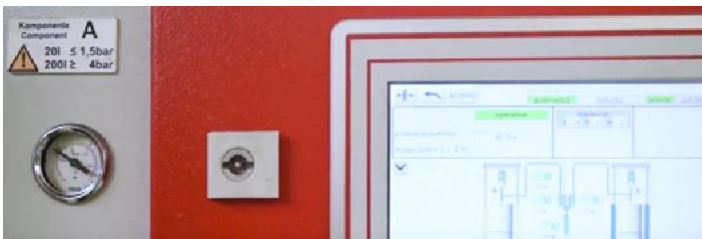


Doesn't deteriorate over time

Is resistant to atmospheric and environmental agents

Has mechanical properties suitable for the specific application

## COST CONTAINMENT



It is therefore essential that the aforementioned material can be used in various applications and can be produced on a large scale, in order to reduce production costs and make a cheaper end product.

The purpose of these application notes is to provide some technical details and suggestions on the use of TPE and silicone.

This will allow you to understand which connector - with TPE components or with silicone components - is the most suitable for your application.



## 2. Materials



### SILICONE (LSR - LIQUID SILICONE RUBBER)

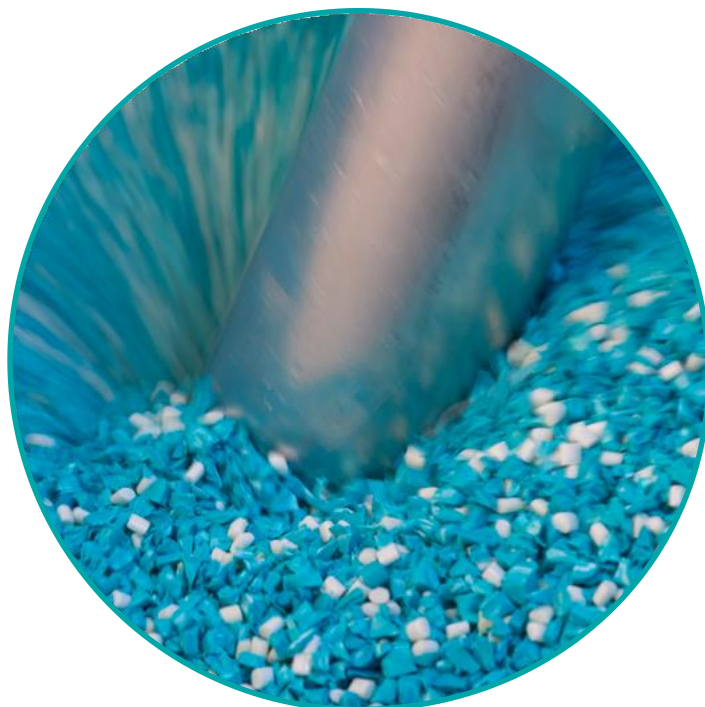
This is a two-component liquid silicone rubber for the production of items through the injection moulding process. It is durable and highly resistant, made of silicone (polymer) containing silicon, along with other molecules such as carbon, hydrogen and oxygen.

Silicone rubbers can be vulcanised to produce objects with a defined shape. **It is not reactive, it is stable and resistant to extreme temperatures**, while maintaining its properties. For this reason it is used in various applications.

### THERMOPLASTIC ELASTOMERS (TPE)

This is a class of copolymers or a physical blend of polymers which consists of materials with both thermoplastic and elastomeric properties. TPE has the typical advantages of both rubbery and plastic materials.

To qualify as a thermoplastic elastomer, a material must have: **the ability to stretch under stress and, after the stress has been removed, to return to almost its original shape**. These materials have plenty of applications in the automotive, electrical and household appliance sectors.



# 3. Properties, Pros and Cons

TECHNICAL SPECIFICATIONS	SILICONE	TPE
<b>RESISTANCE TO TEMPERATURES</b>	More resistant than TPE to extreme temperatures (from -55°C up to 300°C), without changing its performance	Permanent deformation at low temperatures; the higher the temperature, the higher the percentage of deformation: At 23°C: recovers 70% At 70°C: recovers 22% At 100°C: recovers 14% Some medical products withstand temperatures above 90°C for PCR or 130°C for autoclaving
<b>ELASTICITY</b>	Excellent springback	Good springback
<b>TEST OF RESISTANCE TO THE ENVIRONMENT</b>	Resistant to humidity but degrades in the presence of water vapour. Resists UV rays and atmospheric agents	Stability under UV rays and good resistance to atmospheric agents, steam and water
<b>RESISTANCE TO CHEMICAL AGENTS</b>	Resistance to weak acids and alkalis and good chemical resistance to a range of detergents and other solvents. In addition, it is easily washable and sterilised. Acute and sensitive to substances containing strong acids and bases. It has a tendency to swell in contact with hydrocarbons	Degrades if it comes into prolonged contact with organic solvents, oils and fuels. It has good chemical resistance to a wide range of detergents and other solvents
<b>OTHER PROPERTIES</b>	Poor resistance to tearing (cutting). Softness and flexibility which it maintains together with its elastomeric characteristics. High tear stress and biocompatibility.	Softness and flexibility which it maintains together with its elastomeric characteristics. High tear stress and biocompatibility. Excellent adhesion; therefore it is suitable for overmoulding and co-moulding. It has a UL-94 HB certification.

# 4. Applications

## SILICONE

As well as applications in the medical sector and in outdoor environments, silicone is used in the automotive, food, aerospace, transport, electronics and construction sectors. It is also used for cable glands and accessories in electrical products.



## TPE

TPE is used in the electrical engineering, automotive and home appliance sectors and in many industrial applications. It is frequently used in the food sector, especially with materials approved for contact with food (e.g. bottle caps, baby bottles).



# More and more reliable connectors over time with silicone accessories

Problems caused by varying atmospheric conditions and by cabling of dubious quality can be solved with special accessories, such as cable seals made of silicone rubber.



## CAPACITY TO ADAPT

As the humidity and temperature conditions in the room vary, the coatings of many cables tend to change their size: a silicone rubber seal, inserted in a cable gland, **adapts its shape** to compensate for these variations, **improving the performance of the connection in terms of impermeability to water and dust.**

This happens thanks to:

- The extreme elasticity of silicone rubber
- Its resistance to harsh environmental conditions and to compression over wide temperature ranges (from 55°C up to 300°C degrees)
- The good springback, which improves IP66, IP68 and IP69K performance



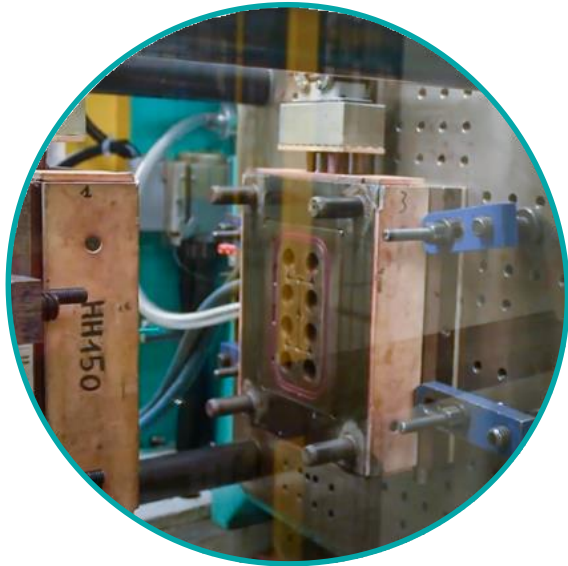
## OTHER RECURRING PROBLEMS

Silicone grommets are also useful in cases where the quality of the cable is doubtful, as well as for **installations in the underground Junction box**, where the cable and the connector are subjected to greater mechanical stress, such as for example the bending of the cable with greater stress on the closing point between the cable and the cable gland.



## 5. Production processes

### The production cost of silicone is higher than TPE



The production cycle of a silicone component is longer than that of a similar TPE component. The production equipment (moulds, machines, etc.) is more expensive. **The investment can be offset by the production volume**, as it is suitable for large-scale production by injection moulding.

## 6. Conclusions

Silicone and TPE have some characteristics in common, such as **good elastic properties**, and for some types of applications both can be used.

When you want an electrical connection solution which is suitable for working in an extended temperature range (below  $-20^{\circ}\text{C}$  and above  $+80^{\circ}\text{C}$ ) or with high mechanical stress levels (vibrations, folds, cable insulation materials), silicone is the best choice to guarantee and maintain the functionality of the electrical connection over time.

### **SUMMARY OF SILICONE PLUS**

- Resistant to extreme temperatures
- Hypoallergenic
- Resistant to external and atmospheric agents
- UV resistant
- Better elastic properties than TPE
- Biocompatible
- Stress resistance: it returns to its initial position after mechanical deformation.