

## HIGH TEMPERATURE SILICONE ELASTOMERS FOR ROLLING STOCK CABLES

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### ABSTRACT

*In Rolling Stock application the need to reduce both size and weight requires the development of high temperature cables with enhanced performance. In this purpose there is an increasing use of silicone compounds as insulation and sheathing material for power cables. Beside the thermal endurance properties, the silicone material has to meet many other properties such as oil, acid and alkali resistance, low temperature flexibility and tear resistance. In this paper, the outstanding performances of a new silicone elastomer will be presented: general technical requirements, R&D methodology and performances of the silicone rubbers are developed.*

### KEYWORDS

Rolling stock, power cables, silicone elastomers, thermal endurance, design of experiments.

### INTRODUCTION

The railway cable market is traditionally divided between the railway infrastructure applications (including signaling, power and telecommunication equipments for the railway infrastructure) and the vehicles used on a railway (coaches, locomotives, metro cars etc.) called Rolling Stock application. In the latter market, there are different types of cables used:

- control and data cables to assure all command and surveillance functions, like doors and lighting in the passenger wagons, and for controlling converters, transformers and the motor from the train driver's desk,
- power cables for power needs of locomotives and drives,
- jumpers to carry information and energy between coaches,
- HV connection cables, to carry electricity from the roof-mounted pantograph to the locomotive's transformer.

The silicone elastomers are used as insulation and sheathing material in power cables and jumpers when high operating temperature is required (i.e. 120°C to 150°C). The higher requirement in term of comfort in the passenger's coaches including real-time travel information, video-on-demand and internet increase the demand in cables and as a consequence there is less and less room available for power cables. Thus, the Rolling Stock manufacturers ask for reduction of the size and the weight of cables while increasing the power demand. A direct consequence is the increase of temperature of the metallic conductor and the requirement of an insulation material with higher thermal resistance.



Figure 1 : example of Rolling-stock cable.

A new generation of light, compact silicone cables which can operate in temperatures from 45° C to 150° C has been developed. For high-voltage machines, transformers, motors and generators, where high temperatures prevail and flexibility is required, silicone cables with good abrasion resistance and high tear-resistant performance have also been developed. These cables are lighter and more flexible than traditional rubber cables and will endure higher temperatures.

### TECHNICAL REQUIREMENTS

For all the cable developed, compliance to national and international standards is ensured. Concerning silicone insulated cables the main standards in the Rolling Stock applications are the European standard EN 50382 [1] and the French standard NF F 63-827 [2].

The requirements concerning the insulation material include :

- Initial mechanical properties (tensile strength and elongation at break)
- Ageing tests at 200°C, to ensure operating temperature at 120°C
- Ozone resistance
- Mineral oil resistance (IRM 902)
- Acid (hydrochloric and oxalic) and alkali (sodium hydroxide) resistance
- Halogen free
- Low temperature resistance (down to - 40°C)
- Dielectrical properties.

Additionally, there are some other properties, not included in the former standards, which are required by customers such as tear resistance and abrasion resistance. The tear resistance is particularly important during the installation of the cables in the coaches.