» New Products

Automotive Wires With the World's Highest Level of Wear Resistance

1. INTRODUCTION

It is said that the automotive industry is currently in once-in-a-century revolutionary time. The automotive electrification and the self-driving are certainly advancing. The number of wires used for the wire harnesses in a car are by the thousands and are still increasing with the automobile electronification. Since it is possible to have damages on the wires because of their contacts with metal or resin parts, the wires which might be damaged are protected by a tube covering them. The wire harness, known as the nerves of the automobile, is a bundle of wires which has many functions such as transmitting signals of engine controlling or of data from the several sensors, or supplying electricity to the lamps, and it can be estimated that the automotive electrification and the self-driving will make its functions more complex and important. Therefore, the wire harness will require further weight reduction, downsizing, and also resource saving for environmental considerations.

With our material technology developed over the years and our unique new chemical cross-linking technology, we have developed the automotive heat resistant wire, with a very high wear resistance compared to conventional products, which complies with The Japanese Automotive Standards Organization(JASO) Standards. This developed wire has a wear resistance which is 8 times higher than the JASO Standard value and also has excellent performances even under the severer conditions. With these characteristics, it makes it possible to reduce the protective tube used for the wire harnesses and it can be expected not only the weight reduction, the downsizing, and the resource saving of the wire harnesses but also the reduction of the numbers of assembling works.

2. THE WEAR RESISTANCE OF THE WIRE

The wire is exposed to the vibration of driving or of the engine over its usage lifetime. Therefore it is critically required to be wear resistant.

There are many different types of wears. One example of them is the abrasive wear, a wear form where the surface of the wire is scraped off mainly by foreign objects developed on the frictional interface, as shown in Figure 1. It is considered that this type of wear is a major cause of the wear in a tape test.

Another type is the adhesive wear, shown in Figure 2, a wear form where the material is sheared on the frictional interface and then the part of the sheared material develops friction particles.

For example, in the scrape test for wear resistance, which testing machine is shown in Figure 3, as the round wire moves back and forth across the surface of the wire (test sample), the wear is developed in a complex form which has effects of an abrasive wear and also an adhesive wear.

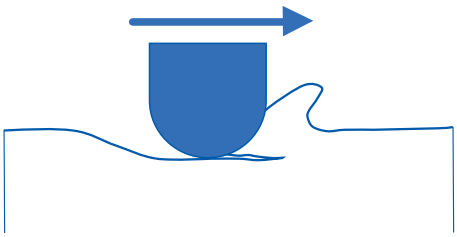

Figure 1 The wear type: the abrasive wear.

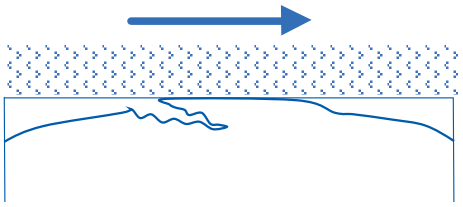

Figure 2 The wear type: the adhesive wear.

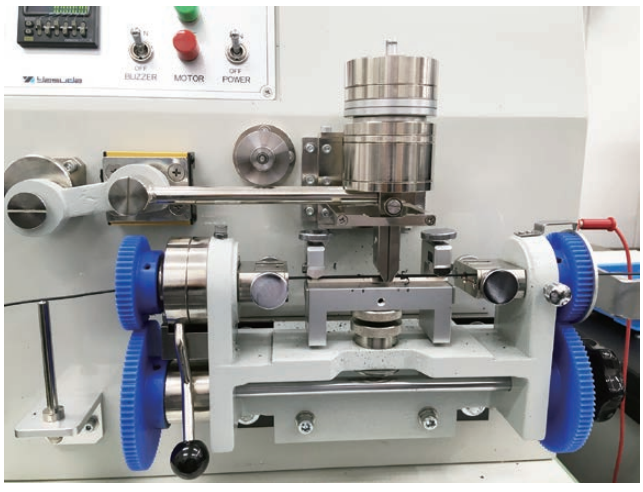

Figure 3 The scrape testing machine for wear resistance.

The JASO Standards defines the wear properties for the tape and the scrape for the wear property of wires used for the wire harnesses. The wear property test for the tape consists of the tape which has a frictional surface with a defined size and a hardness of the particle is moved in one direction and the wear resistance of the wire jacket is evaluated. The wear property test to the scrape is that round wire is moved back and forth on the test sample wire under constant load and the wear resistance is measured.

3. DEVELOPMENT OF THE AUTOMOTIVE WIRES WITH WEAR RESISTANCE

With the material development in consideration of the types of the wear described above, we have developed the automotive wires which have the world's highest level of wear resistance. Our new cross-linking technology features the strong binding of resin's molecular chain. With this technology, we have succeeded in improving the resistance dramatically against the stress received repeatedly from the frictional interface. Moreover, we have achieved the prevention of deformities on the surface layer by enhancing the cohesion of components and withstanding the wear by reducing friction.

As shown in Figure 4, we have achieved the strength of 8 times the standard value required by the JASO D 625-3 standard for the scrape wear performance.

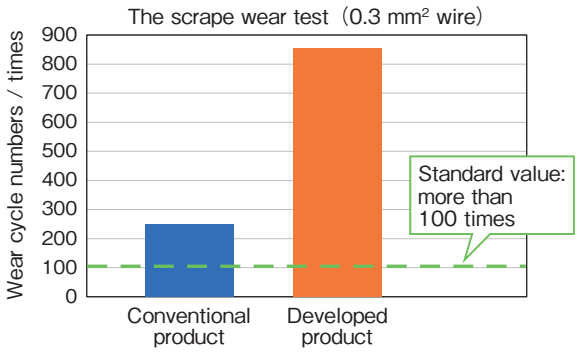

Figure 4 The scrape strength comparison.

4. FOGGING OF THE WEAR RESISTANCE WIRE

The developed automotive wire achieves high fogging resistance by reducing volatile portions of low-molecular-weight materials.

The fogging test is measured in accordance with the procedure defined in JASO 6452. As shown in Figure 5, specimens of the wire jacket material are set in a glass container and covered it with a glass plate. The glass container is heated up to 100℃ in the oil tank, while the glass plate lid is cooled down and the degree of the fogging of the glass is measured after 3 hours.

It is confirmed that the degree of the fogging of the glass in the developed wire is quite little and its transparency is maintained. It is less likely to fog the front glass or the resin components which are requiring transparency, it can be said that this wire product is usable irrespective of the location.

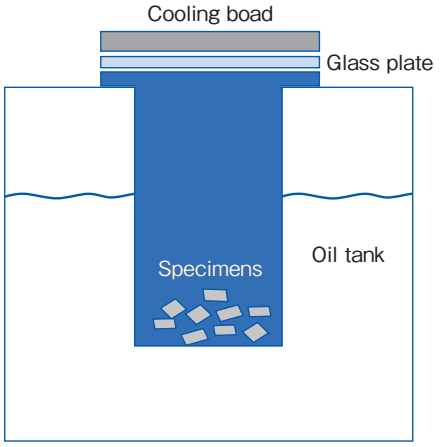

Figure 5 Fogging test.

5. JASO EVALUATION OF THE WEAR RESISTANCE WIRE

The characteristic of the developed wire is shown in Table 1. With all items of this characteristic, such as not only the wear resistance and fogging resistance but also the mechanical strength, the heat resistance, the environment resistance and others, it is obvious that this wire satisfies the characteristic required by the JASO D 625 standard.

Table 1 JASO D 625 standard evaluation result.

Item	Test condition	Developed product (0.3mm²)
Insulation resistance	70℃ for 2 hours, 4.5 m	3×10^{16} Ω mm
Tensile strength	50 mm, 200 mm/min	22.6 MPa
Elongation	—	234%
Heat deformation	120 ℃ for 4 hours	Pass
Sticking force	50 mm, 250 mm/min	23N
Low temperature winding	-40℃ for 4 hours	Pass
Low temperature Impact	-15℃, load 100 kgf	Pass
Scrape wear	7 N, SUS wire	856 times
Heat resistance 1B	150℃ for 10 days	Pass
Heat resistance 1C	Self diameter winding 200℃ for 30 min	Pass
Heat shrink	150℃ for 15 min	0.1 mm
Immersion	Gasoline Light diesel oil Engine oil Ethanol Power steering oil Automatic transmission fluid oil Long life coolant	Pass Pass Pass Pass Pass Pass Pass
Battery liquid resistance	—	Pass
Flame retardant	Horizontal firing	Pass
Degree of cross-linking	Xylene 120℃ for 24 min	55%

Compared with the characteristics of conventional automotive wires, the developed wire has no inferiority point on its each characteristic and it is obvious that it has excellent characteristic with respect to its wear resistance.

6. CONCLUSION

The wire which we developed this time is achievable, with its high wear resistance, with the aim of reducing the protective tube component of wire harnesses (Figure 6). Therefore, it makes the components simplified and reduced their weight. In the future, with the advantages of this high wear and heat resistance wires, we consider that we can contribute to a reduction of the space by thinning the wire diameter.

In conclusion to this article, our new cross-linking technology used for this developed product achieves not only the resource saving of the components by improving its wear resistance but also reducing the electricity required in the cross-linking process.

By reducing CO_2 emissions in the manufacturing process also, we will extend this manufacturing technique of the heat-resistant wire with the wear resistance, which lead to the reduction of impact on climate change, over the manufacturing of other products.

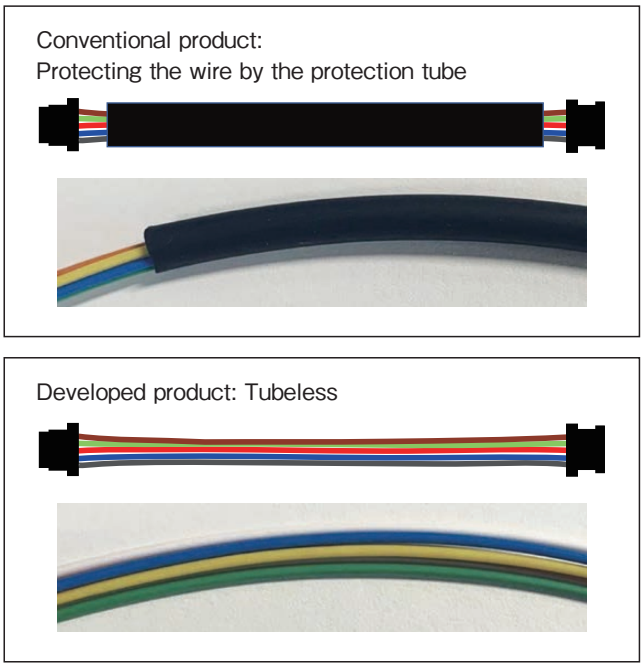

Figure 6 Tubeless wire harness.

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