

Under-Floor Pipe Harness for Hybrid Electric Vehicles

1. Outline

Aiming to counter the problem of global warming caused by recent increase in CO₂ emissions, automobile manufacturers have actively devoted themselves to the development of hybrid and other types of electric vehicles. A hybrid electric vehicle combines an internal combustion engine and an electric drive train consisting mainly of a battery, inverter, and motors. The hybrid electric vehicle maximizes its fuel economy by selecting either the engine or electric drive train, depending on the running condition of the moment.

An under-floor pipe harness is used to transmit a large electric current between a battery and inverter (Fig. 1). This wiring harness is made by passing electric wires through an aluminum pipe that protects the wires from stone chipping and shield the wires against electromagnetic noise. A connector is fitted to one end of the harness to facilitate its connection to the inverter.

Sumitomo Wiring Systems, Ltd. and AutoNetworks Technologies Ltd., both of which are Sumitomo Electric group members, have jointly developed a new PN connector*¹ and aluminum under-floor pipe harness (Photo 1). The new wiring harness fitted with the new PN connector was first used in the Toyota Prius that was released in December 2015.

2. Features

2-1 PN connector

A large-diameter electric wire having a large electric current capacity is used for an under-floor pipe harness. When a vehicle is driven, the large wires installed in the vehicle vibrate in association with the vibration of the vehicle. The connectors also vibrate together with the wires. This could cause abrading of the electrical contacts of the connectors. Vibration of the wires and connectors can be prevented by fixing them securely to the inverter. However, this measure may accelerate the abrasion of the electrical contacts due to thermal expansion and contraction. To eliminate such adverse effect, the newly developed PN connector is constructed so that it can be fixed securely to a surrounding structure and, at the same time, a flexible conductor is used in the connector to absorb the dimensional change of the connector components due to thermal expansion and contraction (Fig. 2). The construction of the new PN connector has been modified from conventional bolted construction to one-touch construction. As a result, the new PN connector has enhanced functional reliability

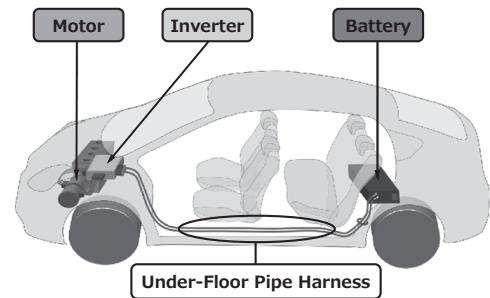


Fig. 1. Hybrid electric system and under-floor pipe harness

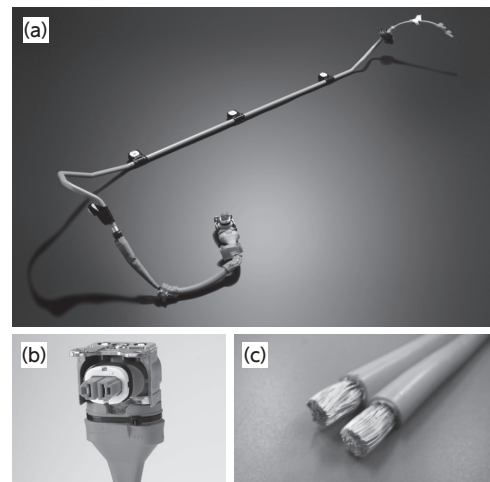


Photo 1. (a) External appearance of under-floor pipe harness, (b) PN connector, (c) Aluminum wire

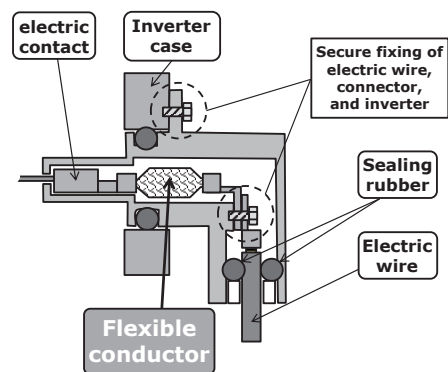


Fig. 2. Absorption of PN connector's dimensional change

and allows easier connection of the wiring harness to the inverter.

2-2 Aluminum electric wire

The newly developed aluminum electric wire is used to minimize any increase in wire weight resulting from an increase in wire diameter. The aluminum material used in this wire has high conductivity, with sufficient flex resistance to withstand vibration. This cable is far lighter in weight than a copper wire.

*1 PN connector: A two-pole (positive & negative) connector used to connect the positive and negative poles of a battery to an inverter