Connector and Cable for EV Quick Charger

1. INTRODUCTION

Nowadays, the reduction of the greenhouse gas is mandatory in order to preserve global environment. The transport sector occupies approx.50% of the internal total CO_2 emission amount. And the CO_2 emission amount from automobiles occupies approx.90% of the transport sector. Countermeasures to reduce CO_2 emission are indispensable in automotive-related industries.

EVs (Electric Vehicles) use electrical motors for its driving source, therefore the CO_2 emission amount including the charge power of EVs is estimated at approx.1/4 of the amount of the gasoline cars.(JHFC: Japan Hydrogen & Fuel Cell Demonstration Project report).

And so EVs are expected to become a big asset in the reduction of the CO_2 emission in the transport sector. On the other hand, EVs' battery charge during driving decreases and approaches run-out called "power out". Drivers' worries about battery remaining charge have to be addressed. Therefore it is very important to install an infrastructure of EV quick chargers, where in public places EVs' drivers can charge in short time.

From above backgrounds, electric power companies and automotive companies started up together the CHAdeMo Association, that is, an industrial association for the promotion of the building of an infrastructure of EV quick chargers which are going to become popular year after year.

Furukawa Electric Co., Ltd. (FEC) participates in the CHAdeMo Association as a regular member and has developed the connector and the cable for EV quick chargers and expected for its wide applications in near future.

2. CONSTRUCTION

FEC has developed the connectors for insert into EVs' outlet called inlet and its lead cable to connect with EV quick chargers.

2.1 Connector

The specifications of connectors FEC has developed are based on the recommendations of the CHAdeMo Association standards and are also available for EVs sold presently from local automotive manufacturers.

Figure 1 illustrates the connector FEC has developed and its characteristic is shown below.

(1) Intuitive operation

It is easy to understand the operation with an intuitive feeling without complicated lever operations because of a push-on method. In an insert case, push-in during grasping a grip; and in a release case, pull the grip while pushing a release button. The very simple operation has a valuable merit (Figure 2)

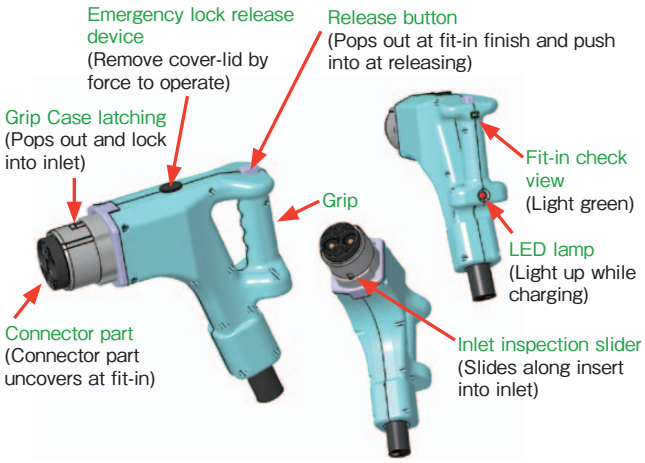


Figure 1 Connector construction.

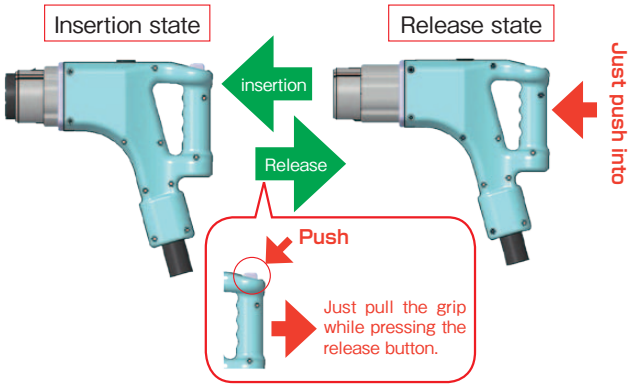


Figure 2 Operation method.

(2) Low insert force

In order to reduce the charging force operation irrespective of age or sex, lever devices are stored inside the connector so that a large insert force can be gained from a small actuating force. A connector with a small insert actuating force is regarded as the top-class lightness in the industries.

(3) Safety countermeasure
In a quick charge case a large current above 100 A DC flows. When a connector is not inserted perfectly, a dangerous condition may happen due to a leaking current.
A micro-switch for the inspection of a connection condition is set inside the connector. In a semi-insert case, it is impossible to charge. The adoption of a release button lock mechanism prevents to release the connector incidentally during charge by means of electromagnetic solenoid, therefore, even if the release button were pushed during charge, the control circuit would cut automatically and the charging stops with a fail safe mechanism.

(4) Superior strength
In order not to destroy the connector under a tread-pressure of 2 tons weight vehicles, a metal reinforcement is partially used as armors in an inner and an outer side of the connector. And in a non-insert condition when the connector is dropped, the outer case can guard the connector head part from the damage.

(5) Forced release mechanism
After insert the connector into the inlet, even if an emergency happened and the connector cannot release from the inlet, it would be able to release the connector by force by operating the emergency lock release device with available tools.

2.2 Cable

A cable for EV quick chargers is a complex cable comprised of a power line, a communication line and an earth line. The cable needs safety and ease of operation for a superior handling property by typical urban drivers. The cable, FEC has developed, possesses a cab-tire cable construction which had a lot of application in power supply cables of moving bodies. A high flexibility has already been gained by a material composition and with a proper design, as shown below.

①Smaller diameter wires of 0.16 mmΦ are used in comparison with available wires of 0.45 mmΦ for cabtire cables.

②A high flexible soft vinyl material that FEC has developed is applied as an insulation and a sheath.

③The best twisting mode of a power wire and a communication wire is chosen.

The cable satisfies a 600 V vinyl-insulated vinyl-sheath cabtire cable of JIS C 3312, and possesses the required properties for low-voltage cables.

And a flexibility, a twist-fatigue and an impact-resistance properties which are important items from users' points are proven superior in each test of these properties.

Table 2 shows the cable properties.

3. CONCLUSION

The connector and the cable for EV quick charger that FEC has developed are a possible product to solve a difficult and complicated operation that EV drivers feel during the charge operation.

Next, FEC and its groups intend to promote wide applications helped by the advantages of their proper technology for the battery charger infrastructure-related markets.

For more information, please contact:
Engineering Department Energy-Backcast Team
Energy Division
Energy-Industrial Products Company
Furukawa Electric Co., Ltd.
TEL: +81-45-311-1736 FAX: +81-45-311-1850

Table 1 Sectional view and construction of the 6600 V XLPE power cable.

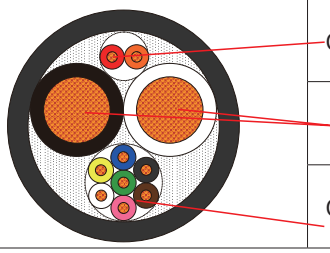
Sectional view	Wire type	Wire core no.×Cross sectional area	Finish diameter	Weight
	Communication line	1 pair×0.75 mm^2	Approx.32 mm	Approx.1400 g/m
	Power supply line	2 cores×34 mm^2		
	Communication line	7 cores×0.75 mm^2		

Table 2 Cable characteristics.

Performance evaluation Items	Wire type	Performance of the developed product	Testing standard
Conductor resistance (20℃)	Power line (34 mm^2)	Below 0.566 Ω/km	JIS C 3312 ※
	Communication line (0.75 mm^2)	Below 25.9 Ω/km	
Insulation resistance (20℃)	Power line (34 mm^2)	Above 50 MΩkm	
	Communication line (0.75 mm^2)	Above 30 MΩkm	
Withstand voltage		No failure at 3000 V/1 min.	

※600 V vinyl-insulated vinyl-sheath cabtire cable.