

## CF III cable + Plug-in Connector

### 1. INTRODUCTION

As construction of large-scale data centers and regional power grids progresses, the number of construction companies is decreasing, additionally, the construction workforce is aging and the number of foreign workers is rapidly increasing. Based on this background, it is desired that the industrial wires and cables to be easy to handle and to require no skills for a terminal processing or for a connection work. In addition, in response to the increasing risk of disasters on a global scale these days, there are growing expectations for an emergency recovery work to be labor-saving, speedy, and to require no skills after a disaster occurrence.

Therefore, in addition to a flexible cable that is easy to bend and that can be wired even in tight spaces, we have developed a high flame retardant flexible cable with a plug-in connector (CF III cable + plug-in connector) that has a connector attached to it and that can be easily attached and detached by anybody.

### 2. FEATURES

#### 2.1 Flexibility

The newly developed high flame-retardant flexible cable (CF III cable) has excellent flexibility, so it is possible to have an allowable bending radius of  $4d$  ( $d$ : overall diameter), which allows it to be bent and wired tighter than the conventional CV cables or the 2PNCT cables (Figure 1, 2). Therefore, it contributes to solving workability issues such as “cables are hard and difficult to work with” and “wiring cannot be done in narrow spaces.” In addition, since the need for excavation and elevation work to secure wiring space can be reduced, it is becoming possible to shorten the construction period and to reduce the construction costs (Figure 3).



Figure 1 The flexibility of 600V CF III cable.

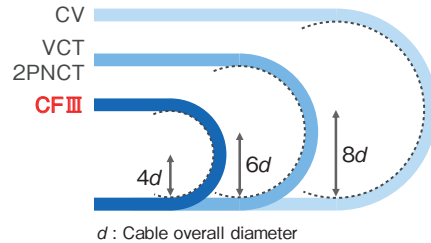


Figure 2 Comparison of bending radius between CF III cable and conventional cables.

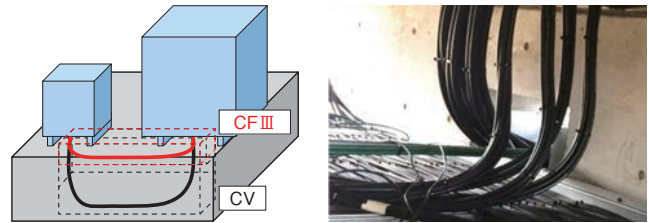


Figure 3 Wiring picture of a CF III cable.

#### 2.2 Simplification of a Terminal Connection Work

Previously, there were various issues with a terminal connection work, such as the need for a qualified electrical worker to restore power outages in the event of a disaster. The terminal of the developed CF III cable has a plug-in connector pre-installed, and the installation and removal work can be completed by simply inserting and removing the connector (Figure 4). This has made it possible to save labor, to speed up a terminal connection work, and requires no skills, as well as preventing electric shocks. Furthermore, the plug-in connector is equipped with the following mis-insertion prevention mechanism\*, which prevents connection errors and accidents from occurring.

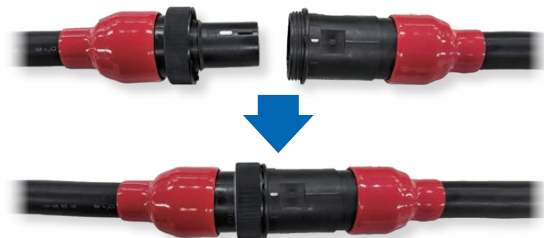


Figure 4 Connection via a plug-in connector.

- Screw type lock structure

The completion of the connection can be easily confirmed by the tightening indicator line and the feeling of the lock structure riding up.

- Mechanism to prevent incorrect insertion into another polarity

It uses a mechanism to prevent an erroneous insertion due to the concave and convex shape of the keyway, which has four different patterns. This helps prevent electric shocks and short circuit accidents caused by construction errors.

\*This mechanism has been jointly patented by NTT Anode Energy Corporation and Furukawa Electric Power Systems Co., Ltd. (JP 5812525 and JP 5515176)

### 2.3 High Flame Retardancy

Since CF III cable we developed this time has a high flame-retardant property that meets the vertical tray flame test of the IEEE std. 383, the spread of fire can be kept to a minimum in the event of a fire. Additionally, the amount of smoke emitted when the cable burns complies with ASTM E662 (NBS Smoke Chamber test), which contributes to preventing delays in evacuation in the event of a fire.

## 3. WORKABILITY IMPROVEMENT IMPACT AND DELIVERY RECORD

When working in places such as data centers where it is necessary to connect terminals inside narrow equipment, using a high flame-retardant flexible cable with a plug-in connector allows the connection point to be placed outside the device, making it possible to perform the connection quickly and reliably. In addition, in disaster recovery applications, anyone can perform the work, facilitating for early recovery (Figure 5). In order to verify the effectiveness of the workability improvement, the workers who were involved in data center wiring switching system used the high flame-retardant flexible cables with plug-in connectors, and as a result, the work time was reduced from about 60 minutes to about 10 minutes. It has been demonstrated that this method has the effect of reducing work time by 80% (Figure 6). This workability has been highly praised, and we have actually started delivering the products.

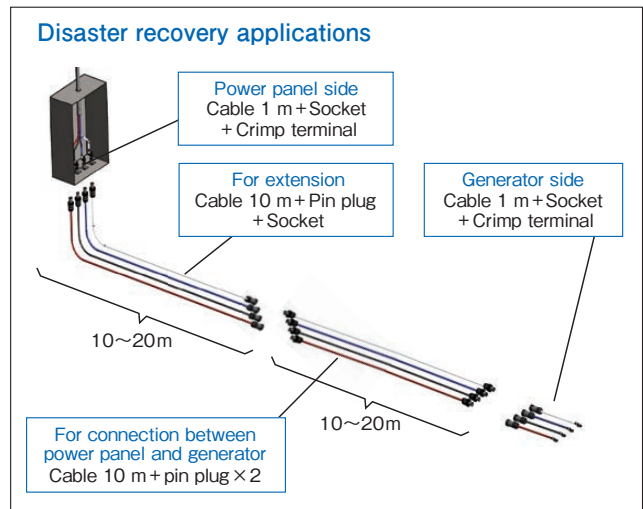
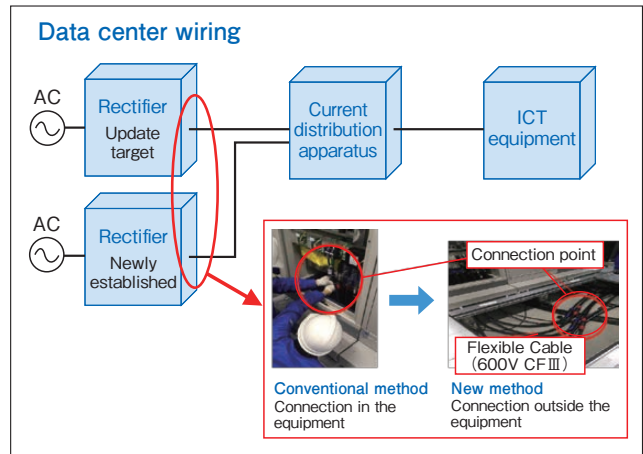


Figure 5 Application examples of CF III cable + a plug-in connector.

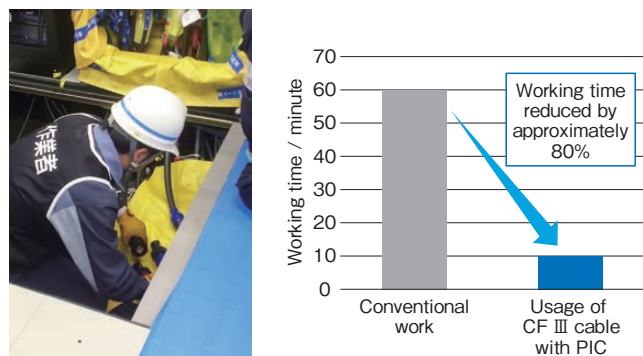


Figure 6 Workability verification and impacts of workability improvement.

## 4. PRODUCT SPECIFICATIONS

Table 1 shows the product specifications of the main 600V CF III cables. We offer a variety of conductor sizes ranging from 14 mm<sup>2</sup> to 325 mm<sup>2</sup>.

**Table 1 Specifications of 600 V CF III cable.**

Conductor (TA)			Insulation thickness Black flame retardant cross-linked polyethylene mm	Sheath thickness Black flame retardant cross-linked polyethylene mm	Overall diameter approx. mm	Approximate mass (reference value) kg/km	Electrical properties		
Nominal cross-section area mm <sup>2</sup>	Composition No./mm	Outer diameter approx. mm					Max. conductor resistance at 20°C Ω/km	Test voltage V·1 min.	Min. insulation resistance MΩ·km
14	88/0.45	4.7	1.0	1.8	10.3	210	1.39	3000	1500
22	7/20/0.45	6.4	1.2	1.9	12.6	325	0.892	3000	1500
30	7/27/0.45	7.4	1.2	1.9	13.6	415	0.661	3000	1500
38	7/34/0.45	8.4	1.2	2.1	15.0	505	0.525	3000	1500
50	19/16/0.45	9.6	1.5	2.1	16.8	635	0.411	3000	1500
60	19/20/0.45	10.7	1.5	2.2	18.1	760	0.329	3000	1500
80	19/27/0.45	12.4	2.0	2.4	22	1030	0.243	3000	1500
100	19/34/0.45	13.9	2.0	2.5	23	1260	0.193	3000	1500
125	19/42/0.45	15.5	2.0	1.6	23	1420	0.156	3000	1500
150	27/34/0.45	17.1	2.0	1.7	25	1610	0.136	3000	1000
200	37/34/0.45	19.5	2.5	1.8	29	2190	0.0993	3000	1500
250	37/42/0.45	21.6	2.5	1.9	31	2650	0.0803	3000	1000
325	37/55/0.45	24.7	2.5	2.0	34	3640	0.0614	3000	900

\*14-100mm<sup>2</sup> complies with the Electrical Appliance and Material Safety Act Flame resistant cross-linked polyolefin flexible cable.

## 5. CONCLUSION

We introduced a high flame retardant flexible cable + plug-in connector that contributes to labor-savings for construction companies by being flexible and easy to connect. In the future, we would like to contribute to the product that saves labor and provides safety and security in a wider range of applications, such as simple construction of ship repair docks, temporary evacuation shelters, and outdoor event venues.

CF III cable was developed by Furukawa Electric Industrial Cable Co., Ltd., and the plug-in connector and high flame-retardant flexible cable + plug-in connector were developed by Furukawa Electric Power Systems Co., Ltd. This is a jointly developed product between Furukawa Electric Co., Ltd., Furukawa Electric Industrial Cable Co., Ltd. and Furukawa Electric Power Systems Co., Ltd.

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