New Direct Core Monitoring Fusion Splicer TYPE-71C+

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With a rapid progress in optical fiber network construction all over the world, fusion splicer users are increasing particularly in newly industrializing countries. They require a fusion splicer with easy operation and high maintainability in any operational environments. We have developed a new core alignment fusion splicer "TYPE-71C+." It reduced by 43% in size and by 34% in weight compared with the current model and improved in performance under more harsh environments. It achieves 20 seconds of total splice and heat cycle time, which is faster by 55% than the current model. Moreover, TYPE-71C+ is the first and only fusion splicer in the industry that features wireless LAN function. We have also developed "SumiCloud" system, which manages fusion splicers via internet.

Keywords: fusion splicer, compact and lightweight, high-speed heating process, wireless LAN, fusion splicer management system

1. Introduction

With the rapid deployment of optical access networks worldwide, fusion splicers are being increasingly used in a variety of applications, such as backbone network construction, FTTx network construction, and optical component assembly. As fusion splicer users increase in both industrialized and newly industrializing countries, there is an increasing need for fusion splicers that offer ease of use in all environments and with minimal maintenance.

To meet these needs, we have developed a core-alignment fusion splicer "TYPE-71C+" with the concept of "a fusion splicer easy to use by anyone in the world." Its features include compact and lightweight design, high speed splice, and a maintenance function based on information and communication technologies such as wireless LAN and the Internet.

2. Overview

Photo 1 shows an external view of the core-alignment fusion splicer. **Table 1** shows the main specifications.

Photo 1. External view of the "TYPE-71C+"

Table 1. Specifications for the core-alignment fusion splicer

	Item	New Model TYPE-71C+	Existing Model TYPE-39
Size & Environmental Resistance Properties	Dimensions	120 (W) mm 154 (D) mm 130 (H) mm	150 (W) mm 170 (D) mm 150 (H) mm
	Weight	2.1 kg	3.2 kg
	Impact resistance (76 cm drop)	5 surfaces excluding the top surface	Bottom surface
	Dust/drip proof	IP52	—
	High-altitude performance	6,000 m	5,000 m
Splicing & Heating Properties	Splice loss	SMF: 0.02 dB	SMF: 0.02 dB
	Splice time	Approx. 6 s	Approx. 9 s
	Heat shrink oven type	Dual	Dual
	Heating time	Approx. 14 s	Approx. 35 s
	Splice/heat cycles per battery	Approx. 230	Approx. 200
Ease of Use/Ease of Maintenance	Input operation	Touchscreen	Key pad
	Wireless LAN	Provided	—
	Fusion splicer management system SumiCloud	Splice data management	—
		Work report generation	—
		Help video	—
		Splicer health monitor	—

3. Features

Described below are the features of the new core-alignment fusion splicer and the fusion splicer management system.

3-1 Compact and lightweight design

Figure 1 shows a comparison of the overall size of

the existing and new splicers. **Table 2** shows the reduction in volume and weight of the main components. The components inside the housing of the new splicer are made of resin to reduce weight and are integrated into one piece to reduce the number of parts. A touchscreen is used for input operations, making it possible to operate the splicer in an intuitive and easy-to-understand way and to reduce its size. The use of a newly developed arc circuit board, a high-magnification microscope, and a lightweight lithium-ion battery make it possible to reduce the volume and weight of the main body of the fusion splicer by 43% and 34%, respectively, over the existing model.

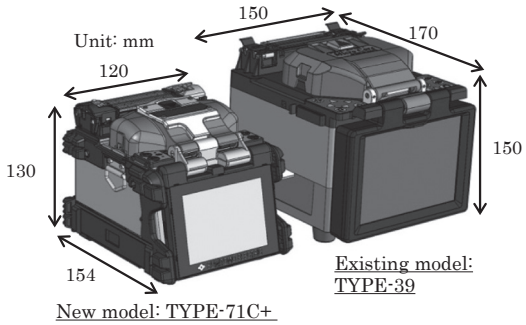

Fig. 1. Comparison of the overall size

Table 2. Volume and weight reduction of main components

Component	Percentage of reduction over existing model		Remarks
	Volume	Weight	
Internal components	34%	47%	Use of resin, downsizing, integration
Monitor	66%	41%	Use of a touchscreen
Battery	72%	78%	Compact, lightweight battery

3-2 Improvements in environment resistance properties

A fusion splicer is a device that can be used even in harsh environments and requires an improvement in environmental resistance properties such as impact resistance, being dust- and drip-proof, and high-altitude performance.

The splicer is downsized, resulting in a reduction in impact energy from its own weight. In addition, parts are integrated into one piece, resulting in the elimination of joints between heavy parts. As a result of these improvements, the impact resistance of the splicer is improved over the existing model.

The material of the windshield, an exterior component, is changed from resin, which were used for the existing windshield, to die-cast metal to improve the robustness. Its thickness is reduced to avoid an increase in weight.

As shown in **Fig. 2**, there is an elastic cushion component attached to the exterior of the housing. With the cushion component, the splicer passes a 76 cm drop test on the five surfaces excluding the top surface, while the existing model passed the test only on the bottom surface. **Photo 2** shows the 76 cm drop test conducted in-house.

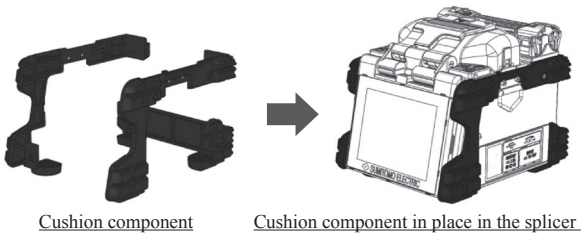

Fig. 2. Cushion component

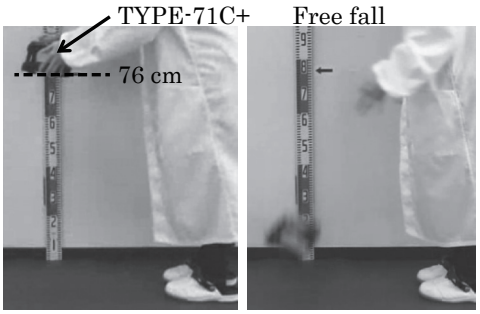

Photo 2. Drop test conducted

Due to the improved airtight design of the housing, the splicer is dust- and drip-proof equivalent to international protection class IP52. **Table 3** shows the details of the dust and drip proof performance. **Photo 3** shows the dust and drip test conducted.

Table 3. Details of the dust and drip proof performance

Attribute	Class	Description
Dust proof	IP5X	Required performance and safety are ensured when dust (diameter: 75 μm) for dust proof testing enters the product.
Drip proof	IPX2	The housing is protected against water dripping vertically from the top of the product when it is tilted 15°.

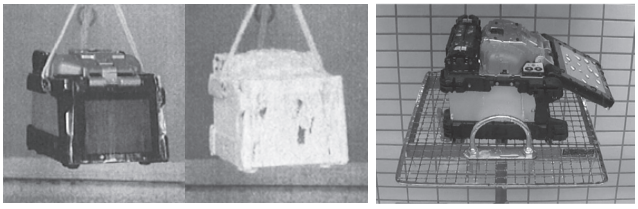

Photo 3. Dust and drip proof test conducted

As for high-altitude performance, the improved output performance of the newly developed arc circuit board makes stable fusion splice possible at a low atmospheric pressure at an elevation of 6,000 m above sea level. **Photo 4** shows the field test conducted on the summit of Mt. Fuji.

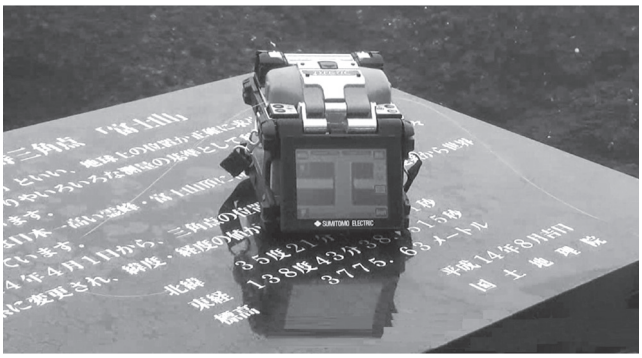

Photo 4. Field test conducted on the summit of Mt. Fuji

3-3 Fusion splicing characteristics

A compact, high-magnification microscope is developed for the new model to increase the accuracy of image processing. The splicer has a function to automatically identify the bend insensitive optical fiber compliant with ITU-T G.657, which is increasingly being used in FTTx network construction, and select a suitable splice program for the fiber. Thus, it achieves stable fusion splicing quality. In addition, the splice time is decreased as a result of improving the efficiency of the optical fiber alignment algorithm and optimizing splice programs. The splice time is 6 seconds, 3 seconds faster than that of the existing model.

3-4 High-speed and power saving heat shrink oven

Figure 3 shows a comparison of the heater structure between the existing and new models. To reduce the heat-up time, the new model has film heaters with a faster heating response around the bottom and side of a protection sleeve. To increase heating efficiency, the shape of the heater is changed to increase the area of contact with the protection sleeve, and a heating control system most suitable for the new heater is introduced. As a result of these improvements, as shown in **Fig. 4**, the heating time is 14 seconds, a reduction of 60% over the existing model. As with the existing model, the new model has dual heater systems, making it possible to reduce the bottleneck of heat shrinking process.

The heat shrink oven of the new model is compatible with a variety of protection sleeves to reinforce a splice point of drop cables and field assembly connectors Lynx-CustomFit, and makes it possible to use the fusion splicer in a variety of applications.

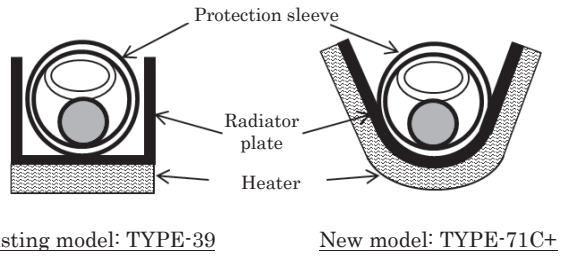

Fig. 3. Comparison of heater construction

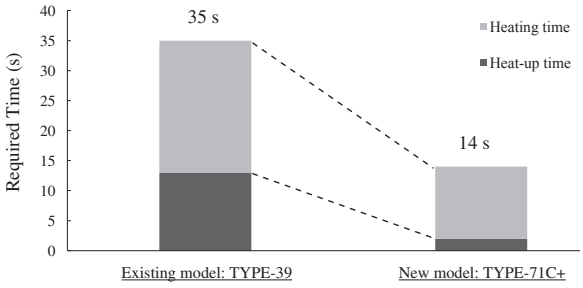

Fig. 4. Reduction in heating time

Figure 4 shows splice and heat cycles with a fully charged battery. Power consumption is reduced by reducing the heat-up time of the heating process and improving heating efficiency. As a result of reducing the power consumption of electrical components, the splice and heat cycles for the new model is the same as in the existing model even when a small battery that has less than half capacity of the battery for the existing model is used. The new model has an eco-mode (power saving setting) to reduce battery consumption, achieving about 230 cycles.

Table 4. Comparison of splice and heat cycles per battery

Item	Existing model TYPE-39	New model TYPE-71C+
Splice and heat cycles per battery	Approx. 200	Approx. 230
Battery capacity	119 Wh	49 Wh

3-5 New storage case

Figure 5 shows an external view of the newly developed storage case. The storage case for the existing model was intended for carrying a set of tools, such as a fusion splicer and an optical fiber cleaver. The storage case for the new model can be used as a work table as well. An easy-to-attach and -remove work tray is placed on top of the storage case to provide a large working space.

For ease of carrying, the new storage case is about 13% smaller in size than the existing one, while providing the same inner volume as the existing one.

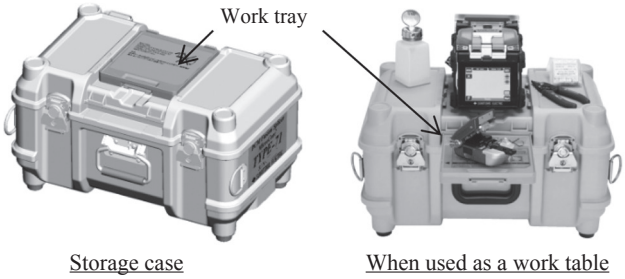

Fig. 5. External view of the new storage case

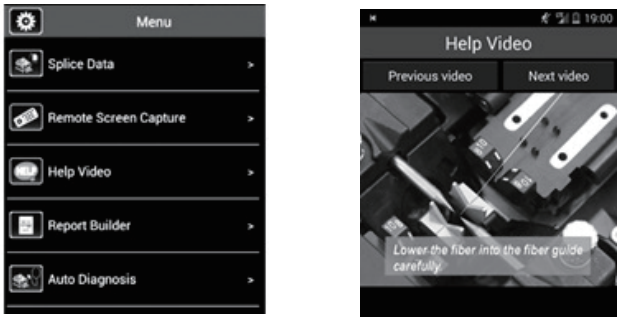

Fig. 7. An example screen display of the smartphone application

3-6 Fusion splicer management system SumiCloud

With the recent rapid deployment of information and communication technologies, such as the Internet, the Internet of Things is increasingly drawing attention around the world.

For the first time in the industry, we have developed a fusion splicer with wireless LAN functionality and the SumiCloud system to manage fusion splicers via the Internet.

As shown in **Fig. 6**, this system is configured by a smartphone application connected by wireless LAN communication to the fusion splicer and a cloud server.

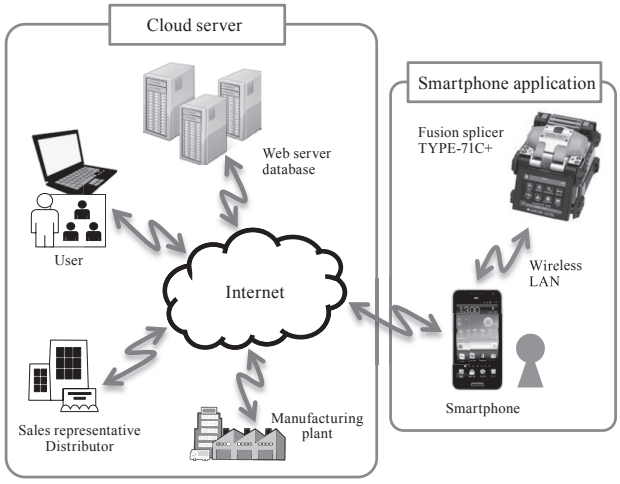

Fig. 6. Schematic of the SumiCloud system configuration

Figure 7 shows an example screen display of the smartphone application. The smartphone application improves the convenience of data management with features such as sending and receiving splice data, adding location information, and generating work reports. The application offers maintenance features such as help videos for the fusion splicer and splicer health monitor, which are useful to a worker who has a problem in the field.

The cloud server stores information sent from the fusion splicer in the database and manages the database. Using the features of the cloud server, a manager of the fusion splicer can obtain information in real time on work history and splicer condition via the Internet. Thus, the new system can give extensive support to splicer management work.

4. Conclusion

We have developed a new core alignment fusion splicer, TYPE-71C+, which is compact, lightweight, and with improved environmental resistance. We have reduced the work time required for splicing and heat shrinking processes from the existing model. We have also developed the SumiCloud system to manage fusion splicers via the Internet.

- Lynx-CustomFit is a trademark or registered trademark of Sumitomo Electric Industries, Ltd. and SEI Optifrontier Co., Ltd.
- SumiCloud is a trademark or registered trademark of Sumitomo Electric Industries, Ltd.

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