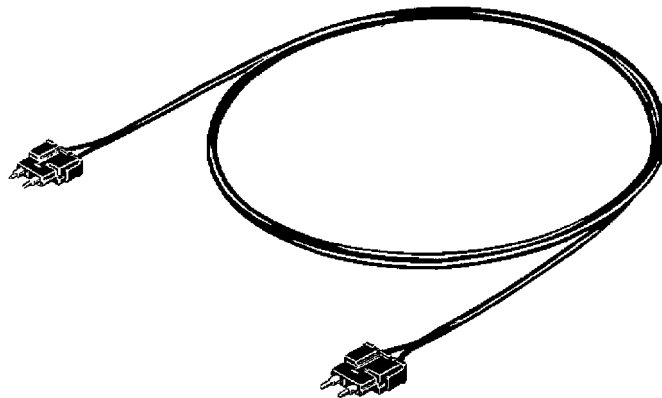


# **SYSMAC**

## **H-PCF Optical Fiber Cables**

### **Installation Guide**

*Revised July 1993*





## **Notice:**

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

**DANGER!** Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

**WARNING** Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

**Caution** Indicates information that, if not heeded, could result in relative serious or minor injury, damage to the product, or faulty operation.

## **OMRON Product References**

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation "Ch," which appears in some displays and on some OMRON products, often means "word" and is abbreviated "Wd" in documentation in this sense.

The abbreviation "PC" means Programmable Controller and is not used as an abbreviation for anything else.

## **Visual Aids**

The following headings appear in the left column of the manual to help you locate different types of information.

**Note** Indicates information of particular interest for efficient and convenient operation of the product.

**1, 2, 3...** 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

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No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.



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## ***About this Manual:***

This manual describes the installation of hard-clad PCF (H-PCF) Optical Fiber Cords and Cables and includes the sections described below. Information concerning individual components of the SYSMAC NET LINK, SYSMAC NET, SYSMAC BUS, SYSMAC BUS/2, and SYSMAC Host Link Systems can be found in their respective manuals.

Please read this manual carefully and be sure you understand the information provided before attempting to install Optical Fiber Cords or Cables.

**WARNING** Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

**Section 1** introduces the special characteristics of Optical Fiber Cord and Cable and compares H-PCF optical fiber to earlier varieties.

**Section 2** describes the components of H-PCF Optical Fiber Cords and Cables and provides specifications for the cords and cables.

**Section 3** provides information on the dimensions, assembly, and testing of Optical Connectors used with H-PCF Optical Fiber Cords and Cables.

**Section 4** describes how to install H-PCF Optical Fiber Cord and Cable in buildings and around equipment at building sites.

**Appendix A** provides ordering information for Optical Fiber Cords, Optical Fiber Cables, and related equipment.

# SECTION 1

## Introduction

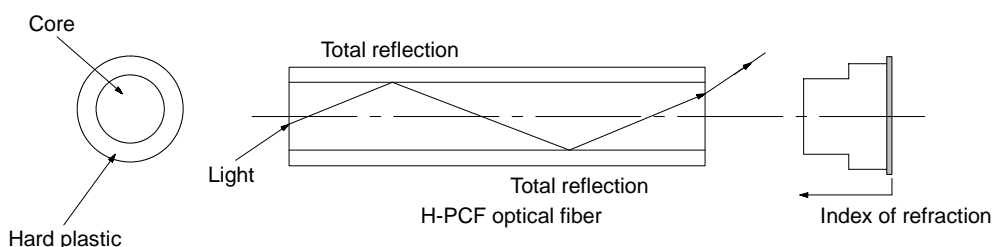
This section introduces the special characteristics of Optical Fiber Cords and Cables and compares H-PCF optical fiber to earlier varieties.

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## 1-1 Introduction to H-PCF Optical Fiber Cables

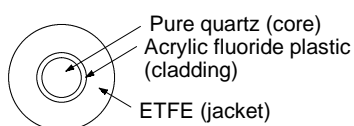
On the outside, Optical Fiber Cords and Cables look like electrical cords and cables. However, instead of metal wires carrying electrical signals, Optical Fiber Cords and Cables use quartz-glass fibers with a hard-clad coating (hard acrylic fluoride plastic) to carry light signals. Optical signals travel through the glass fiber for distances up to 1 km. Though the plastic coating protects the glass fiber, Optical Fiber Cords and Cables require much greater care during handling and installation than conventional electrical cords and cables. It is very important to protect the cord and cable from impact, and care should be taken to avoid excessive bending or twisting of the cord and cable. The Optical Fiber Cords are intended for indoor use while the Optical Fiber Cables are intended for outdoor use.

The following diagram shows the construction of the SI-type (step index type) multimode optical fiber used in H-PCF Optical Fiber Cables. The optical fiber shown below consists of a quartz-glass fiber with a hard plastic coating.

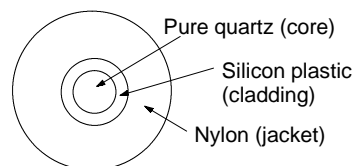


The H-PCF optical fiber's mechanical strength and resistance to temperature changes is increased by its soft fluoroplastic (ETFE) jacket. The following diagram compares the construction of the H-PCF hard-clad fiber (HC-20/07) to the older PCF silicon-clad fiber (PC-20/07).

**HC-20/07 Hard-clad Fiber**



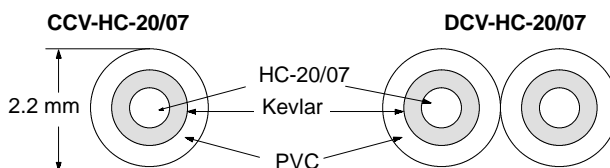
**PC-20/07 silicon-clad fiber**



The following table compares the dimensions of H-PCF optical fiber (HC-20/07) to the older PCF optical fiber (PC-20/07).

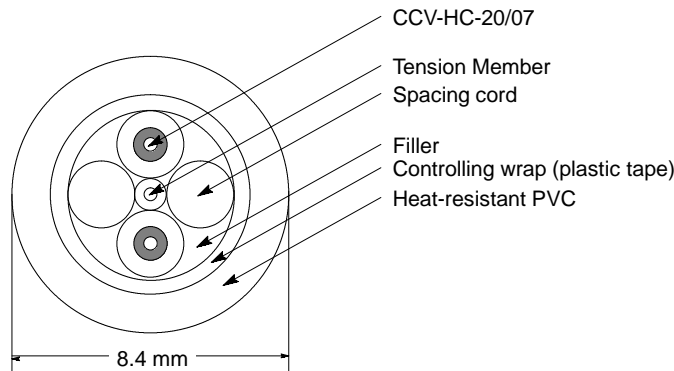
| Item                         | HC-20/07    | PC-20/07    |
|------------------------------|-------------|-------------|
| Core diameter                | 200 $\mu$ m |             |
| Plastic cladding diameter    | 230 $\mu$ m | 300 $\mu$ m |
| Plastic cladding thickness   | 15 $\mu$ m  | 50 $\mu$ m  |
| Total diameter (with jacket) | 0.5 mm      | 0.9 mm      |
| Numerical aperture (NA)      | 0.4         | 0.35        |

The following diagram shows the construction of single and dual-fiber cords:





The following diagram shows the construction of the 2-C-V (2×CCV-HC-20/07):

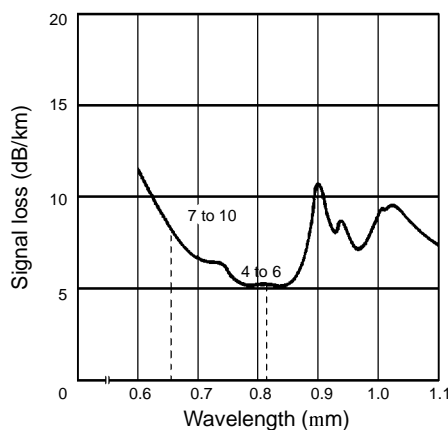


## 1-2 Features of H-PCF Optical Fiber

This section describes the basic features of H-PCF Optical Fiber Cables.

**Signal Loss vs. Wavelength** H-PCF optical fibers have a stable signal loss at a wavelength of about 0.8 mm. The signal loss for H-PCF is equal to or better than the low loss levels of the older PCF optical fibers (about 4 to 6 dB).

The following graph shows signal loss vs. wavelength for a 1 km CCV-HC-20/07 H-PCF Optical Fiber Cord at a temperature of 25°C (77°F).

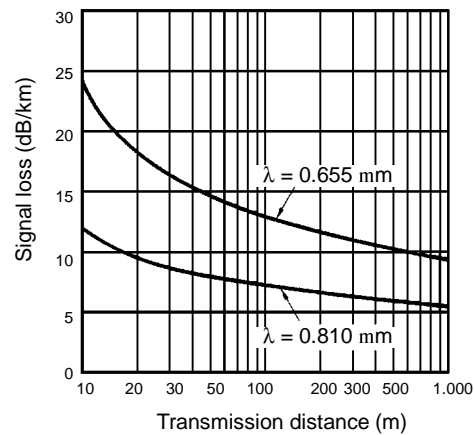


**Signal Loss vs. Distance** The maximum signal loss ( $\alpha$ ) for a given length ( $L$ ) of two-fiber DCV-HC-20/07 optical fiber can be calculated from the following equations. Equation 1 is for a wavelength of 0.810 mm at a temperature of 25°C (77°F), and equation 2 is for a wavelength of 0.655 mm at a temperature of 25°C (77°F).

$$1) \alpha(L) \leq (7 - 4 \times \log(L)) \times L \text{ dB (for } \lambda = 0.810 \text{ mm and } T = 25^\circ\text{C)}$$

$$2) \alpha(L) \leq (15 - 4 \times \log(L)) \times L \text{ dB (for } \lambda = 0.655 \text{ mm and } T = 25^\circ\text{C)}$$

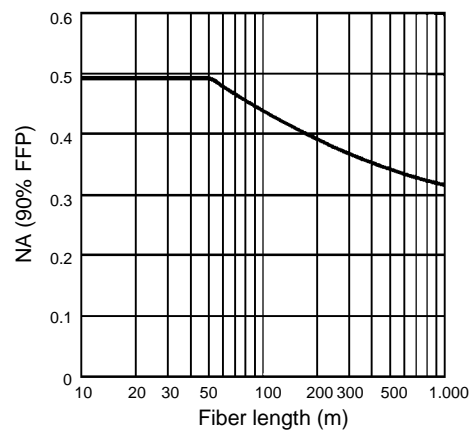
The following graph shows the signal loss vs. distance characteristics given by the equations above.



### Numerical Aperture vs. Fiber Length

The H-PFC optical fibers have a high NA value that the older PFC optical fibers lacked, as well as more efficient light sources and connectors.

The following graph shows NA vs. distance for DCV-HC-20/07 H-PCF Duplex Optical Fiber Cord with EIA FOTP-47 (intensity method B) and a DF-1700 transmitter ( $\lambda = 0.81 \text{ mm}$ ).



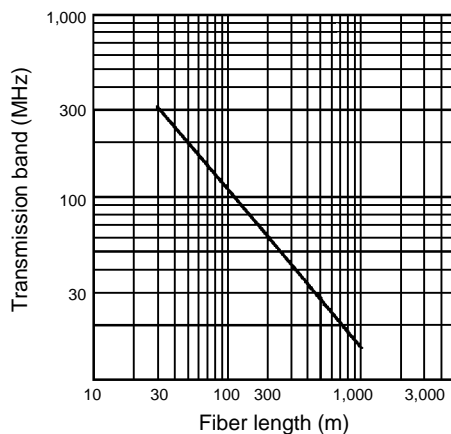
### Band vs. Fiber Length

The following equation expresses the baseband frequency characteristics  $f(L)$  in MHz for a given fiber length ( $L$ ) in km.

$$f(L) = 14.5 \times L^{-0.89} \text{ MHz}$$

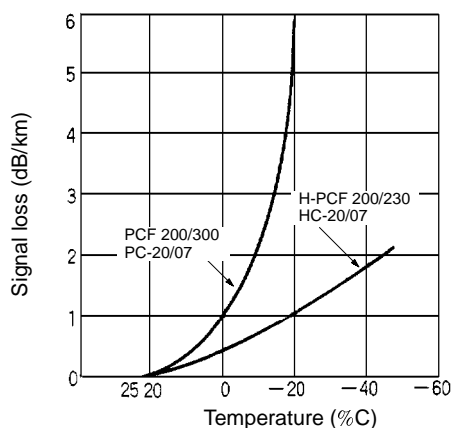
(for 0.85 mm, NA=0.4, and spot size  $\leq 200 \text{ mm}$  min. full mode excitement)

The following graph shows transmission band vs. fiber length for DCV-HC-20/07 H-PCF Duplex Optical Fiber Cord with an LED light source of  $\lambda = 0.85$  mm and full mode excitement.



### Signal Loss vs. Temperature

The following graph shows signal loss vs. temperature for the older silicon-clad PCF optical fibers (PC-20/07) and the H-PCF optical fibers (HC-20/07). Low temperature signal loss, which was a problem with the older PCF optical fibers, has been greatly reduced. A DF-1700 light source ( $\lambda = 0.81$  mm) was used.



### H-PCF Optical Fiber Connectors

Since the H-PCF optical fibers are hard-clad, it is possible to use crimp connectors as well as the older style that requires gluing and polishing. This is the most important characteristic of H-PCF optical fibers, and greatly simplifies the attachment of connectors.

## SECTION 2

# H-PCF Cord and Cable Specifications

This section describes the components of H-PCF Optical Fiber Cords and Cables and provides specifications for the cords and cables.

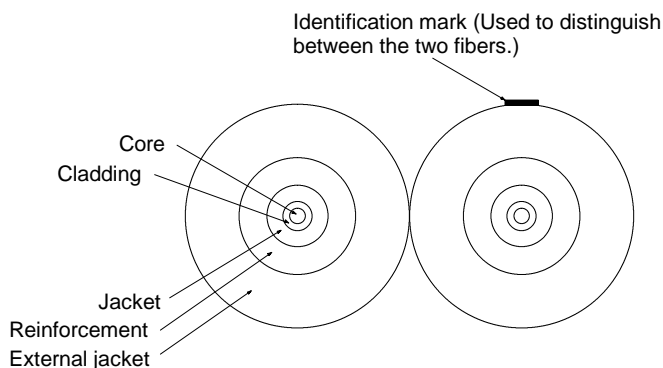
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## 2-1 Component Materials and Dimensions

These specifications apply to two-fiber H-PCF (hard plastic-clad optical fiber) Optical Fiber Cords and metallic-construction Optical Fiber Cables. Refer to *Appendix A Standard Models* for ordering information.

### Two-fiber Optical Fiber Cord

The following diagram shows the construction of the two-fiber H-PCF Optical Fiber Cord. The quartz core diameter is 200  $\mu\text{m}$  and the fiber diameter (including the hard plastic cladding) is 230  $\mu\text{m}$ . Signal loss is 7 dB over 1 km.

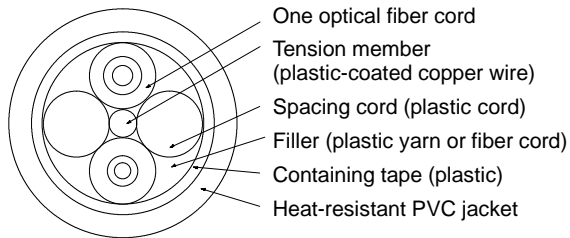


| Component       | Item                    | Specification                              |
|-----------------|-------------------------|--|
| General         | Fiber type              | Plastic-clad multimode optical fiber       |
|                 | Numerical aperture (NA) | Approximately 0.4                          |
|                 | Signal loss             | 7 dB over 1 km                             |
|                 | Weight                  | 8 kg/km                                    |
| Core            | Material                | Quartz glass                               |
|                 | Diameter                | 200 $\pm$ 5 $\mu\text{m}$                  |
|                 | Circular eccentricity   | 6% max.                                    |
| Cladding        | Material                | Acrylic fluoride plastic                   |
|                 | Diameter                | 225 $\pm$ 5 $\mu\text{m}$                  |
|                 | Eccentricity            | 6% max.                                    |
| Jacket          | Material                | Fluoride plastic                           |
|                 | Diameter                | 0.5 $\pm$ 0.1 mm                           |
| Reinforcement   | Material                | High-tensile-strength aromatic fiber       |
| External jacket | Material                | Heat-resistant PVC (black)                 |
|                 | Diameter                | 2.2 $\pm$ 0.2 mm $\times$ 4.4 $\pm$ 0.4 mm |

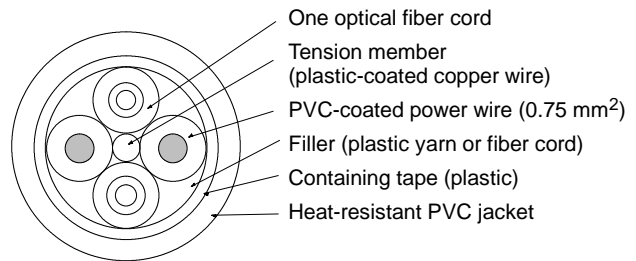
## Two-fiber Optical Fiber Cable

The following diagram shows the construction of the two-fiber H-PCF Optical Fiber Cable. The diagram on the left shows the S3200-HCC\_\_\_\_ cables, which do not have power supply wires. The diagram on the right shows the S3200-HCL\_\_\_\_ cables, which have power supply wires.

S3200-HCC\_\_\_\_

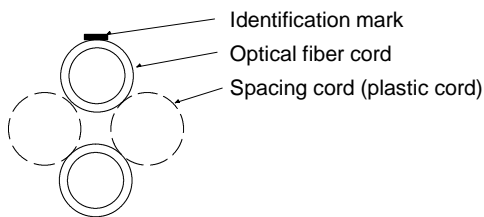


S3200-HCL\_\_\_\_

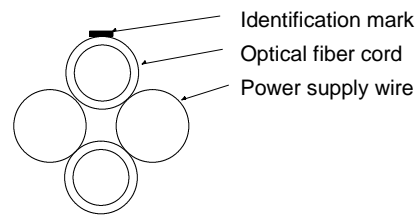


As shown in the following diagrams, one of the optical fiber cords in the cable is marked so that the user can distinguish between the cords. In the S3200-HCL\_\_\_\_ cables, one power wire is white and the other is red.

S3200-HCC\_\_\_\_



S3200-HCL\_\_\_\_



### S3200-HCC\_\_\_\_ Cables

The following table shows the specifications for S3200-HCC\_\_\_\_ cables, which do not have power supply wires.

| Component          | Item  | Specification              |
|--------------------|---|----------------------------|
| General            | Cable diameter  | 8.4+1.0 mm                 |
|                    | Weight  | 70 kg/km                   |
| Optical fiber cord | Refer 2-2 <i>Specifications</i> for details on optical fiber cord specifications. |                            |
| Tension member     | Material  | Plastic-coated copper wire |
|                    | Diameter  | Approx. 1.5 mm             |
| Spacing cord       | Material  | Plastic                    |
|                    | Diameter  | Approx. 2.2 mm             |
|                    | Total diameter across both cords  | Approx. 5.9 mm             |
| External jacket    | Material  | PVC                        |
|                    | Thickness   | 1.2 mm                     |

**S3200-HCL\_\_\_ Cables**

The following table shows the specifications for S3200-HCL\_\_\_ cables, which have power supply wires.

| Component          | Item   | Specification              |
|--------------------|--|----------------------------|
| General            | Cable diameter   | 8.6+1.0 mm                 |
|                    | Weight   | 85 kg/km                   |
| Optical fiber cord | Refer to 2-2 <i>Specifications</i> for details on optical fiber cord specifications. |                            |
| Power wire         | External diameter  | 2.3 mm (approximate)       |
|                    | Conductor cross-sectional area   | 0.75 mm <sup>2</sup>       |
|                    | Conductor composition  | 30/0.18 strands/mm         |
|                    | Conductor diameter   | Approx. 1.1 mm             |
|                    | Insulator material   | PVC                        |
|                    | Insulator thickness  | 0.6 mm                     |
|                    | Total diameter across both wires   | Approx. 6.1 mm             |
| Tension member     | Material   | Plastic-coated copper wire |
|                    | Diameter   | Approx. 1.5 mm             |
| External jacket    | Material   | PVC                        |
|                    | Thickness  | 1.2 mm                     |

## 2-2 Specifications

These specifications apply to two-fiber H-PCF (hard plastic-clad optical fiber) Optical Fiber Cords and metallic-construction Optical Fiber Cables. Refer to *Appendix A Standard Models* for ordering information.

### Mechanical Characteristics

| Item                          | Specification  |                            |                                | Comments                               |
|-------------------------------|--|----------------------------|--------------------------------|--|
|                               | DCV-HC-20/07<br>(Two-fiber cord)   | 2-C-V<br>(Two-fiber cable) | 2-C-2V-V<br>(Two-fiber cable*) |  |
| Operating temperature         | -20°C to 70°C  | -20°C to 70°C              | -20°C to 50°C                  | ---                                    |
| Storage temperature           | -40°C to 70°C  | -40°C to 70°C              | -40°C to 70°C                  | ---                                    |
| Maximum tensile load          | 25 kgf   | 75 kgf                     | 75 kgf                         | Temporary tensile load.                |
| Minimum bend radius           | 15 mm  | 25 mm                      | 25 mm                          | Unintentional temporary bend, no load. |
| Crush resistance              | 200 kgf/50 mm  | 200 kgf/50 mm              | 200 kgf/50 mm                  | Temporary load.                        |
| Repetitive bend resistance    | Cord: Mandrel diameter: 50 mm, 1 kg load, 180% bend 500,000 times<br>Cable: Mandrel diameter: 100 mm, 1 kg load, 180% bend 500,000 times |                            |                                | No breaks                              |
| Repetitive twist resistance   | Cord: 200 mm, +90% twist 500,000 times<br>Cable: 100 mm, +45% twist 500,000 times  |                            |                                |  |
| Repetitive squeeze resistance | Cord: Mandrel diameter: 100 mm, 2 kg load, 1 m, 500,000 times<br>Cable: Mandrel diameter: 100 mm, 5 kg load, 0.5 m, 500,000 times        |                            |                                |  |
| Compressive impact resistance | Columnar weight (25 mm dia., 2 lb), height: 1 m  |                            |                                |  |

**Note** \*The 2-C-2V-V cables have two optical fibers and power supply wires.

## Transmission Characteristics

| Item                                   | Ambient temp.   | Wavelength               | Fiber length             | Specification  |
|--|-----------------|--------------------------|--------------------------|--|
| Signal loss                            | 25°C            | l=0.81 mm (DF-2700 LED)  | Lf=1 km                  | 7 dB/km max.   |
|  |                 | l=0.85 mm (DF-2200 LED)  | $0.1 \leq L_f \leq 1$ km | $7-4 \times \log(L_f)$ dB/km max.  |
|  |                 | l=0.655 mm (DF-2701 LED) | Lf=1 km                  | 15 dB/km max.  |
|  |                 |                          | $0.1 \leq L_f \leq 1$ km | $15-4 \times \log(L_f)$ dB/km max.   |
| Transmission band                      | ---             | l=0.85 mm LED            | Lf=1 km                  | Approx. 14 MHz   |
| Signal loss at low temp.               | -20°C           | l=0.81 mm                | Lf=1 km                  | Up to two times the signal loss (in dB) at 25°C.                                 |
| Signal loss at high temp.              | 25°C            |                          |                          | Up to 1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C.         |
|  | -20°C (example) |                          |                          | Up to 1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C.         |
| Signal loss at high temp. and humidity | 25°C            |                          |                          | Up to 1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C and 95%. |

## Crimp Connector Specifications

| Item  | Specification   | Comments   |
|---|---|--|
| Increase in signal loss (dB) due to crimp connection              | Approx. 1.5 times higher with crimp connection.                             | $\lambda=0.81$ mm  |
| Maximum tensile load  | 5 kgf   | Unintentional temporary tension between the connector and cord at 25°C.  |
| Signal loss (dB) at high temp.                                    | +1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C.         | Signal loss:<br>The increase in signal loss (dB) compared to the initial value with $\lambda=0.81$ mm and $T=25^\circ\text{C}$ at both ends.<br><br>Expansion:<br>The change in the protrusion between the core and ferrule tip compared to the initial value. |
| Expansion at high temp.   | +15 mm protrusion after 1,000 hrs at 70°C.                                  |  |
| Signal loss (dB) at high temp. and humidity                       | +1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C and 95%. |  |
| Expansion at high temp. and humidity                              | +15 mm protrusion after 1,000 hrs at 70°C and 95%.                          |  |
| Signal loss (dB) from 100 sudden temperature changes (70°C/-40°C) | +1.5 times the initial signal loss (in dB) after 1,000 hrs at 70°C and 95%. |  |
| Expansion from 100 sudden temperature changes (70°C/-40°C)        | +15 mm protrusion after 1,000 hrs at 70°C and 95%.                          |  |
|   |   |  |

## Electrical Characteristics

| Item  | Specification        |
|---|----------------------|
| Cross sectional area of power supply wire's conductor | 0.75 mm <sup>2</sup> |
| Maximum conductor resistance                          | 26.1 W/km (at 20°C)  |
| Dielectric strength                                   | 1000 V for 1 minute  |
| Minimum insulator resistance                          | 5 MW km (at 20°C)    |
| Maximum current                                       | 5 A/conductor        |



## 2-3 Factory Inspection

The items listed in the following table are checked at OMRON before shipping.

| Item                             | Rating  | Inspection method  |
|----------------------------------|---|--|
| Cladding diameter                | Refer to the tables in <i>2-1 Component Materials and Dimensions</i> .                                | Microscopic inspection of each production lot.   |
| External cord diameter           |   | Inspection of each production lot according to JIS.C.3005 section 5 guidelines.              |
| Insulator thickness              |   |  |
| Jacket thickness                 |   |  |
| External cable diameter          |   |  |
| Signal loss ( $\lambda=0.81$ mm) | The 25%C ratings listed under the heading Transmission Characteristics in <i>2-2 Specifications</i> . | Inspection of each production lot by the cutback method with $\lambda=0.81$ mm. (see note 1) |
| Max. conductor resistance        | The ratings listed under the heading Electrical Characteristics in <i>2-2 Specifications</i> .        | JIS.C.3005 section 6 guidelines  |
| Dielectric strength              |   | JIS.C.3005 section 8(2) guidelines   |
| Min. insulator resistance        |   | JIS.C.3005 section 9.1 guidelines  |

- Note**
1. The results of the production lot inspections are used when lengths shorter than 0.1 km are shipped.
  2. The insulator thickness, max. conductor resistance, dielectric strength, and min. insulator resistance inspections are not performed on cables that do not have power supply wires.

## SECTION 3

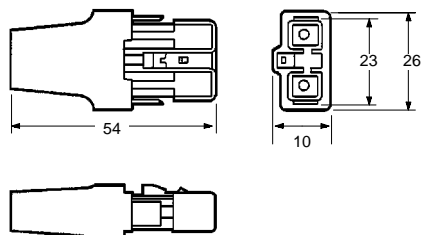
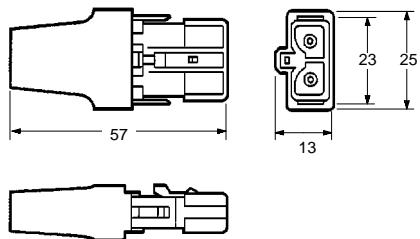
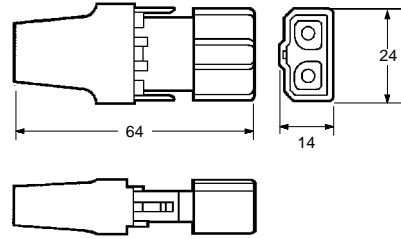
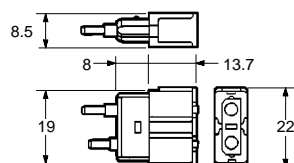
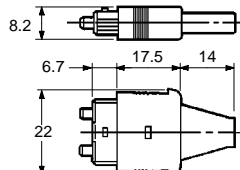
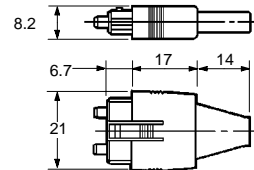
# Connectors for H-PCF Optical Fibers

This section provides information on the dimensions, assembly, and testing of Optical Connectors used with H-PCF Optical Fiber Cords and Cables.

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## 3-1 Connectors

The following diagrams show the OMRON crimp connectors used with H-PCF Optical Fiber Cords and Cables. All dimensions are in millimeters.

**S3200-COCH62M****S3200-COCF62M****S3200-COCF62F****S3200-COCH82****S3200-COCF2511****S3200-COCF2011**

The following table lists the applications and applicable models for each of the OMRON crimp connectors shown above.

| Model Number                      | Application  | Applicable Models   | Connection |
|-----------------------------------|--|---|------------|
| S3200-COCH62M                     | SYSMAC NET Link nodes                                    | S3200-LSU03-01E Line Server, C500-SNT31-V4 SYSMAC NET Link Unit, S3200-NSUG4-00E Bridge, S3200-NSUA1-00E NSU, S3200-NSB11-E NSB for IBM PC-ATs, FIT10-IF401 NSB for FITs  | Full lock  |
| S3200-COCF62M                     | SYSMAC NET Link repeaters                                | Used in pairs with the S3200-COCF62F  | Full lock  |
| S3200-COCF62F                     | SYSMAC NET Link repeaters                                | Used in pairs with the S3200-COCF62M  | Full lock  |
| S3200-COCH82                      | SYSMAC BUS and Host Link nodes                           | C500-RM001-(P)EV1, C120-RM001-(P)-E, C200H-RM001-PV1, C500-RT001-(P)EV1, C500-RT002-(P)EV1, C200H-RT001-P, C200H-RT002-P, C500-LK010-(P)-E, C120-LK010-(P)-E, 3G2C7-LK011-(P), 3G5A2-___-PE, C500-LK103-(P), C500-LK101-(P)EV1, C200H-LK101-P, 3G2A6-LK101-(P)EV1 | Half lock  |
| S3200-COCF2511                    | SYSMAC NET Link, SYSMAC LINK, and SYSMAC BUS/2 nodes     | C200H-SNT31, CV500-SNT31, C200H-SLK11, C1000H-SLK11, CV500-SLK11, CV500-RM211, CV500-RT211  | Half lock  |
| S3200-COCF2011                    | SYSMAC NET Link, SYSMAC LINK, and SYSMAC BUS/2 nodes     | CV500-SNT31, C1000H-SLK11, CV500-SLK11, CV500-RM211, CV500-RT211  | Full lock  |
| S3200-COIAT2000<br>Inline Adapter | SYSMAC NET Link, SYSMAC LINK, and SYSMAC BUS/2 repeaters | Inline Adapter  | ---        |

### Maximum Transmission Distance

The maximum transmission distance between nodes connected with crimp connectors is 800 m. It is possible to produce low-signal-loss glued and polished connectors for predetermined optical fiber lengths or internode distances exceeding 800 m.

**Applicable Connectors**

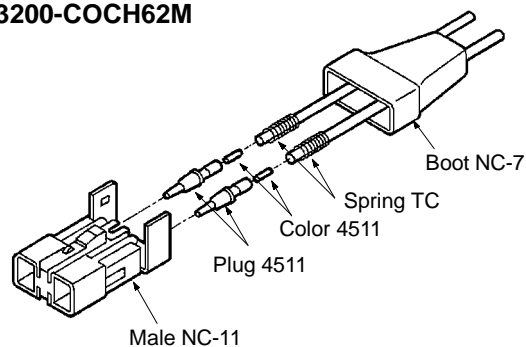
The following table lists the Units that can use crimp connectors and their applicable connectors.

| Model              | Connector                        |
|--------------------|----------------------------------|
| S3200-LSU03-01E    | S3200-COCH62M                    |
| S3200-NSUG4-00E    | S3200-COCH62M                    |
| S3200-NSUA1-00E    | S3200-COCH62M                    |
| S3200-NSB11-E      | S3200-COCH62M                    |
| C500-SNT31-V4      | S3200-COCH62M                    |
| C500-RM001-(P)EV1  | S3200-COCH82                     |
| C500-RT001-(P)EV1  | S3200-COCH82                     |
| C500-RT002-(P)EV1  | S3200-COCH82                     |
| C500-LK010-(P)-E   | S3200-COCH82                     |
| C500-LK103-(P)     | S3200-COCH82                     |
| C500-LK101-(P)EV1  | S3200-COCH82                     |
| C200H-RM001-PV1    | S3200-COCH82                     |
| C200H-RT001-P      | S3200-COCH82                     |
| C200H-RT002-P      | S3200-COCH82                     |
| 3G2C7-LK011-(P)    | S3200-COCH82                     |
| C200H-LK101-P      | S3200-COCH82                     |
| C200H-SNT31        | S3200-COCF2511                   |
| C200H-SLK11        | S3200-COCF2511                   |
| C120-RM001-(P)-E   | S3200-COCH82                     |
| C120-LK010-(P)-E   | S3200-COCH82                     |
| 3G2A6-LK101-(P)EV1 | S3200-COCH82                     |
| CV500-SNT31        | S3200-COCF2511<br>S3200-COCF2011 |
| CV500-SLK11        | S3200-COCF2511<br>S3200-COCF2011 |
| CV500-RM211        | S3200-COCF2511<br>S3200-COCF2011 |
| CV500-RT211        | S3200-COCF2511<br>S3200-COCF2011 |
| C1000H-SLK11       | S3200-COCF2511<br>S3200-COCF2011 |
| 3G5A2-__-PE        | S3200-COCH82                     |
| FIT10-IF401        | S3200-COCH62M                    |

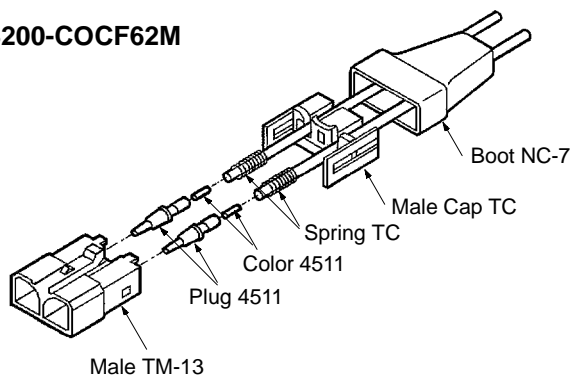
## 3-2 Connector Components

The following diagrams show the construction of the OMRON crimp connectors used with H-PCF Optical Fiber Cords and Cables.

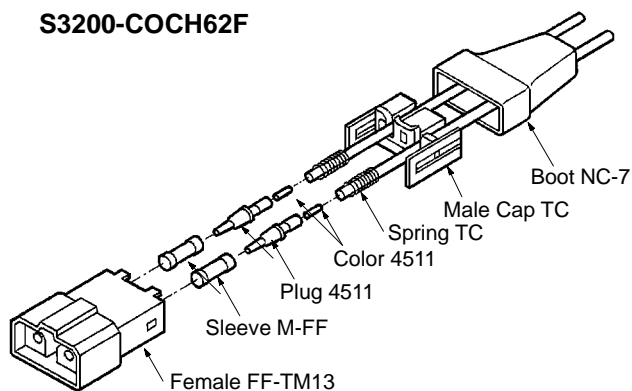
**S3200-COCH62M**



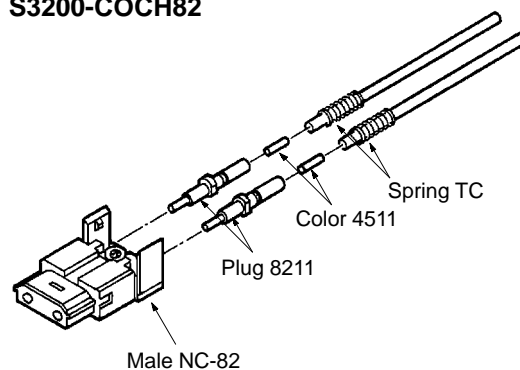
**S3200-COCF62M**



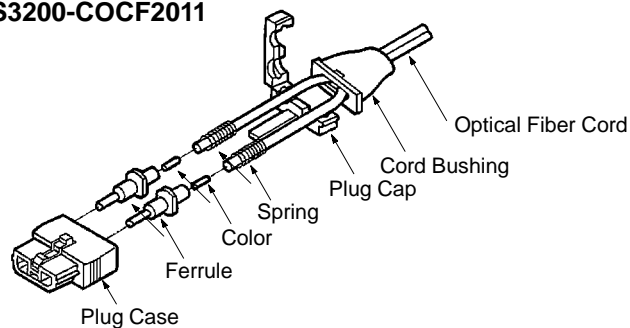
**S3200-COCH62F**



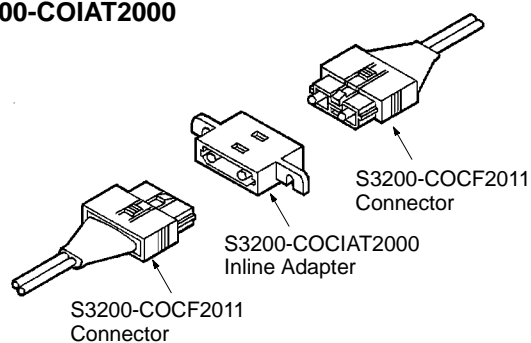
**S3200-COCH82**



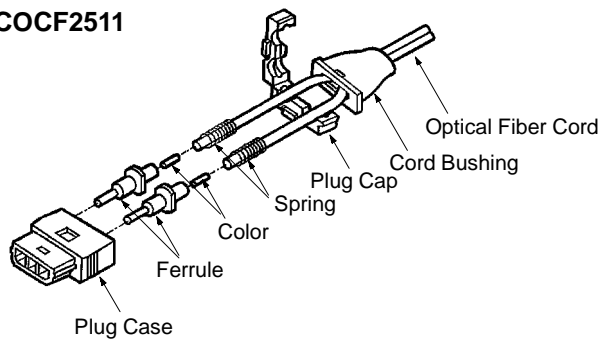
**S3200-COCF2011**



**S3200-COIAT2000**



**S3200-COCF2511**



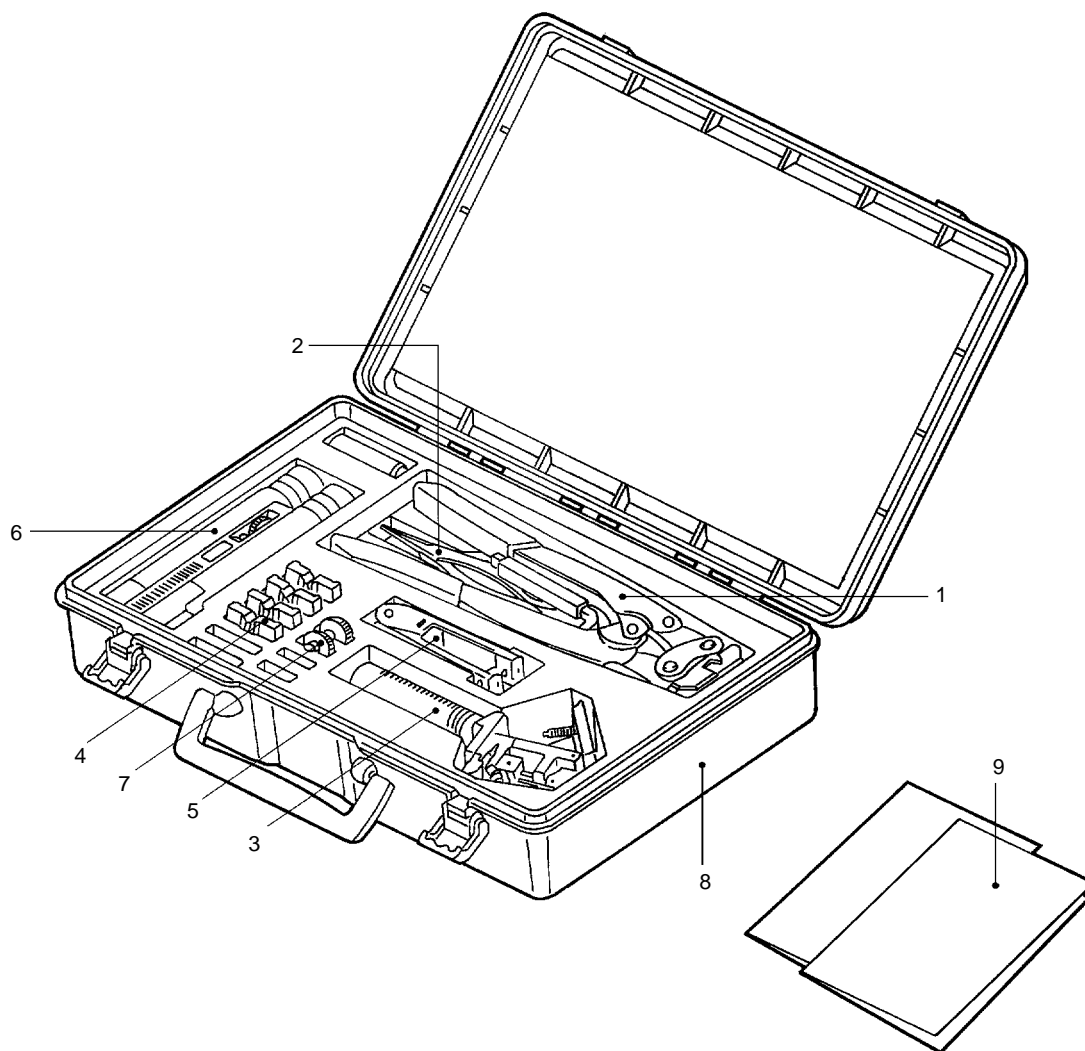
### 3-3 Connector Assembly

The specialized connector assembly tools needed to attach connectors to the H-PCF Optical Fiber Cord or Cable on site must be purchased separately. All of the required tools are included in the Optical Connector Assembly Tool Kit in a compact carrying case. Refer to *Appendix A Standard Models* for ordering information.

In the past, attaching connectors to the optical fiber required time-consuming gluing and polishing, but crimp connectors can be attached quickly and easily using a ferrule crimper and optical fiber cutter. Refer to *3-4 Optical Power Testing* for details on testing light transmission through the connector/fiber junction with an Optical Power Tester.

### Optical Connector Assembly Tool Kit

The Optical Connector Assembly Tool Kit includes all of the tools required to attach the six optical connectors described in 3-1 *Connectors*. The following diagram shows the Optical Connector Assembly Tool Kit and the following table identifies the tools.



| Number | Tool Name                     | Model Number               | Quantity |
|--------|-------------------------------|----------------------------|----------|
| 1      | Ferrule Crimper               | FK-22                      | 1        |
| 2      | Scissors                      | ---                        | 1        |
| 3      | Optical Fiber Cutter          | FC-200                     | 1        |
| 4      | Optical Fiber Cutter Adapters | 7155                       | 1        |
|        |                               | 4511                       | 1        |
|        |                               | 8211                       | 1        |
|        |                               | FCST                       | 1        |
| 5      | Jacket Remover                | JR-2205                    | 1        |
| 6      | Magnifier (with battery)      | CAT-100X                   | 1        |
| 7      | Magnifier Adapters            | 180-FC                     | 1        |
|        |                               | 180-S                      | 1        |
| 8      | Carrying Case                 | ---                        | 1        |
| 9      | Instruction Booklets          | Sankougishi 1006 (English) | 1        |

## 3-4 Optical Power Testing

### 3-4-1 Optical Power Testers

The Optical Power Testers and applicable units/boards are listed in the following table. One of the Master Fiber Sets listed in the next table is needed to test light output with an Optical Power Tester Set.

| Power Tester Set | Head Unit     | Applicable Unit/Board   | Applicable Optical Connector                |
|------------------|---------------|---|---|
| S3200-CAT3200    | S3200-CAT3202 | C500-SNT31-V4, SYSMAC NET Link nodes  | S3200-COCH62M, S3200-COCF62M, S3200-COCH62F |
| S3200-CAT2000    | S3200-CAT2002 | C200H-SNT31, CV500-SNT31, SYSMAC NET Link nodes   | S3200-COCF2511, S3200-COCF2011              |
| S3200-CAT2700    | S3200-CAT2702 | C200H-SLK11, C1000H-SLK11, CV500-SLK11, CV500-RM211, CV500-RT211                        | S3200-COCF2511, S3200-COCF2011              |
| S3200-CAT2820    | S3200-CAT2822 | C500-RM001-(P)EV1, and other C-series Host Link, Optical Remote I/O, and I/O Link Units | S3200-COCH82                                |

- Note**
1. All parts in the Power Tester Sets are compatible except the Head Units.
  2. Refer to the table on page 15 for a complete list of units, boards, and their applicable Optical Connectors.

#### Master Fiber Sets

A Master Fiber Set is needed when testing light output with an Optical Power Tester Set. The required Master Fiber Set depends on the Head Unit, as shown in the following table.

| Head Unit Set | Master Fiber Set |
|---------------|------------------|
| S3200-CAT3202 | S3200-CAT3201    |
| S3200-CAT2002 | S3200-CAT2001H   |
| S3200-CAT2702 |                  |
| S3200-CAT2822 | S3200-CAT2821    |

Refer to the Master Fiber Set's instruction booklet for details on using the Master Fiber Set.

### 3-4-2 Optical Power Testing Tools

Use the S3200-CAT2000 or S3200-CAT2700 Optical Power Tester Set to test light transmission through the connector/fiber junction.

#### Optical Power Tester Set and Head Unit Set

The following tables provide information on the Optical Power Tester Sets and Head Unit Sets.

| Optical Power Tester Set | Head Unit Set | Wave-length | Applicable Optical Module                                 | Applicable Optical Connectors                              |
|--------------------------|---------------|-------------|---|--|
| S3200-CAT2000            | S3200-CAT2002 | 850 nm      | DF-1100<br>DF-2100<br>DF-2200                             | CF-2001H,<br>S3200-COCF2011<br>CF-2501H,<br>S3200-COCF2511 |
| S3200-CAT2700            | S3200-CAT2702 | 810 nm      | DF-1700, TODX294 (OMRON)<br>DF-1800<br>DF-2700<br>DF-2800 | CF-2001H,<br>S3200-COCF2011<br>CF-2501H,<br>S3200-COCF2511 |

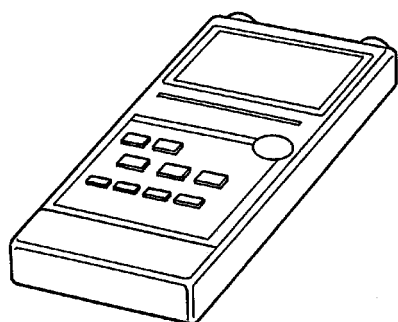


The following table lists the component parts of the Optical Power Tester Sets and Head Unit Sets.

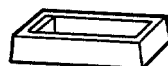
| Component            | Optical Power Tester Set |                          | Head Unit Set            |                          |
|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                      | S3200-CAT2000            | S3200-CAT2700            | S3200-CAT2002            | S3200-CAT2702            |
| Main Unit            | Model 205                | Model 205                | ---                      | ---                      |
| Connector Adapter    | 180-HTL                  | 180-HTL                  | 180-HTL                  | 180-HTL                  |
| Light Source         | 310-085CF (yellow label) | 310-081CF (orange label) | 310-085CF (yellow label) | 310-081CF (orange label) |
| AC Adapter           | DP-1005                  | DP-1005                  | ---                      | ---                      |
| Instruction Booklets | Higishi 1939 (English)   | Higishi 1939 (English)   | Higishi 1939 (English)   | Higishi 1939 (English)   |

The following diagrams show the Power Tester Main Unit, the Connector Adapter (transmitter and receiver), and the Light Source.

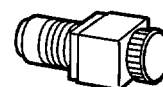
Power Tester Main Unit



Connector Adapter



Light Source



### Master Fiber Set

The S3200-CAT2001H Master Fiber Set contains standard optical fibers that are used in conjunction with the Optical Power Tester Sets when measuring optical characteristics. Components of the S3200-CAT2001H Master Fiber Set are listed in the following table.

| Component                         | Model Number | Quantity |
|-----------------------------------|--------------|----------|
| 2001-MM-1 Master Fiber (see note) | DCV-HC-20/07 | 1 m × 2  |
| Inline Adapter                    | IAT-2000     | 1        |
| Case                              | ---          | 1        |

**Note** These optical fibers are sorted for use as master fibers.

### 3-4-3 Optical Power Testing Methods

The light transmitted through a cable with optical connectors or inline adapters should satisfy the ratings given later in this section. The ratings use the value  $af$ , which can be calculated from the length of the optical fiber ( $L$ ), as shown in the following table.

| Total Fiber Length ( $L$ )             | $af$                           |
|--|--------------------------------|
| $0.1 \text{ km} < L \leq 1 \text{ km}$ | $(7-4 \times \log L) \times L$ |
| $L \leq 0.1 \text{ km}$                | 1.1                            |

**Testing Optical Fibers with Two Crimp Connectors**

The amount of light transmitted through an optical fiber with crimp connectors at both ends should satisfy the ratings given in the following table. The maximum transmission distance for this configuration is 800 m.

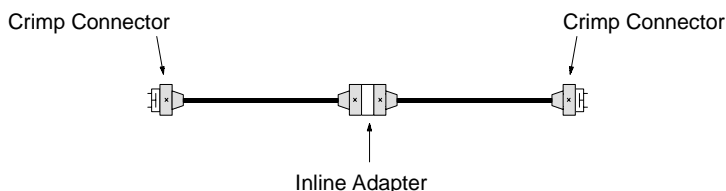


| Light Path   | Rating                       |
|--|------------------------------|
| OPT LED (see note 1) A Master Fiber A Light Meter (measuring $P_0$ dBm)  | ---                          |
| OPT LED A Test Fiber (see note 2) A Light Meter (measuring $P_1$ dBm)  | $P_0 - P_1 \leq af + 1.5$ dB |
| OPT LED A Test Fiber A Inline Adapter (see note 3) A Master Fiber A Light Meter (measuring $P_2$ dBm) (see note 4) | $P_0 - P_2 \leq af + 3.5$ dB |

- Note**
1. The term OPT LED refers to an Optical Power Tester LED light source.
  2. The term Test Fiber refers to an optical fiber with crimp connectors (S3200-COCF2011 and/or S3200-COCF2511) on both ends.
  3. An S3200-COIAT2000 Inline Adapter.
  4. It is not necessary to measure  $P_2$  when an Inline Adapter is not used.

**Testing Optical Fibers Linked by an Inline Adapter**

The amount of light transmitted through two optical fibers attached by an Inline Adapter should satisfy the ratings given in the following table. Each optical fiber has a crimp connector on just one end and this end is attached to the Inline Adapter. The maximum transmission distance for this configuration is 200 m.



| Light Path   | Rating                       |
|--|------------------------------|
| OPT LED (see note 1) A Master Fiber A Light Meter (measuring $P_0$ dBm)  | ---                          |
| OPT LED A Test Fiber (see note 2) A Inline Adapter (see note 3) A Test Fiber A Light Meter (measuring $P_1$ dBm) | $P_0 - P_1 \leq af + 7.1$ dB |

- Note**
1. The term OPT LED refers to an Optical Power Tester LED light source.
  2. The term Test Fiber refers to an optical fiber with a crimp connector (S3200-COCF2011 or S3200-COCF2511) on the end connected to the Inline Adapter.
  3. An S3200-COIAT2000 Inline Adapter.

## SECTION 4

# H-PCF Cord and Cable Installation

This section describes how to install H-PCF Optical Fiber Cords and Cables in buildings and around equipment at building sites.

|       |  |    |
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## 4-1 Introduction

Although Optical Fiber Cable is similar in appearance to ordinary coaxial cable or power supply wiring, it is more fragile and must be handled with proper care. The following table shows the basic mechanical limitations of Optical Fiber Cords and Cables.

| Item                | Tensile Load   | Bend Radius   | Lateral Pressure | Twist         |
|---------------------|--|---|------------------|---------------|
| Optical Fiber Cord  | 10 kg max. when laying cord<br>0 kg when installed       | 60 mm max. when laying cord<br>30 mm max. when installed    | 30 kg/10 cm max. | 180%/2 m max. |
| Optical Fiber Cable | 50 kg max. when laying cable<br>5 kg max. when installed | 200 mm max. when laying cable<br>100 mm max. when installed | 50 kg/10 cm max. | 90%/2 m max.  |

This manual does not provide information regarding oil and chemical resistance of cords and cables or specifications for special applications in which the cord or cable is subjected to bending motions. Consult your OMRON dealer for details on these specifications.

**Caution** An Optical Fiber Cable or Cord's transmission characteristics will deteriorate if it is stretched beyond 0.2%. Be sure to pull the Optical Fiber Cable or Cord by the tension member and observe the tensile load limits listed in the specifications. Do not allow the cable or cord to be stretched by a falling load, or bent or twisted to an extreme angle.

## 4-2 Installation Conditions

The following table provides information for installing Optical Fiber Cord or Cable in a variety of conditions.

| Installation       | Optical Fiber Cord   | Optical Fiber Cable  |
|--------------------|--|--|
| Hanging Rack       | Provide adequate protection.   | Protect the cable when there are external forces that might damage the cable.    |
| Trough             | Use a cover, etc., to provide adequate protection.   | Protect the cable when there are external forces that might damage the cable.    |
| Electrical Conduit | Use steel electrical conduit, PVC pipe, or plastic duct.   | Use steel electrical conduit, PVC pipe, or plastic duct.                         |
| Outdoor Conduit    | A connector-less cord can be laid in an outdoor conduit if locations subject to flooding or high temperature are avoided. (see note 1) | Be sure to avoid locations subject to flooding or high temperature. (see note 1) |
| Elevated Wiring    | Not recommended.   | Be sure to prevent excessive tensile vibrations.                                 |
| Buried Wiring      | Not recommended.   | Not recommended. (see note 2)  |

**Note**

1. The outer sheath of cords and cables is PVC. Consult your OMRON dealer if the installation site has oils or chemicals that can damage PVC. Also consult your dealer if the cable will be subject to movement.
2. It is possible to bury a cable if special construction is used. Consult your OMRON dealer for details.

## 4-3 Basic Installation Methods

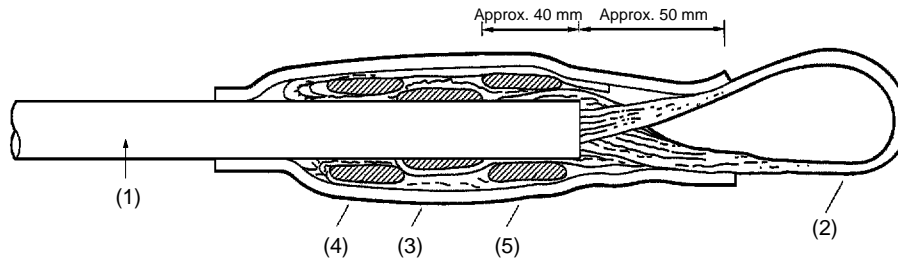
### 4-3-1 Preparing a Cord for Pulling

Optical Fiber Cords must not be pulled by their optical fibers, but by the cord's reinforcement material. This section describes three methods for preparing a

loop at the end of an Optical Fiber Cord. These methods will not make the end of the cord watertight. If the cord is being pulled through water, be sure to treat the end of the cord so it is watertight.

### Example 1

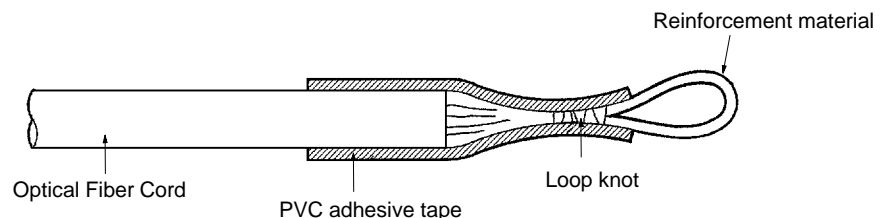
The following diagram and list describe the basic procedure for preparing an Optical Fiber Cord for pulling.



- 1, 2, 3...**
1. First remove about 300 mm of the outer PVC sheath from the end of the Optical Fiber Cord (1).
  2. Wrap about 1 mm of adhesive PVC tape (3) about 40 mm from the end of the PVC sheath.
  3. Create a loop by folding back the internal reinforcement material (2) about 50 mm from the end of the PVC sheath and secure it to the cord by wrapping PVC tape around it (4).
  4. Wrap another layer of tape around the reinforcement material close to the end of the PVC sheath (5).
  5. Finally, wrap the end of the cord from the exposed PVC sheath to close the the loop made from the reinforcement material. This last layer of PVC tape will protect the end of the cord but won't make it watertight.
  6. When laying the cord, connect a lead wire to the loop of reinforcement material and pull the cord.

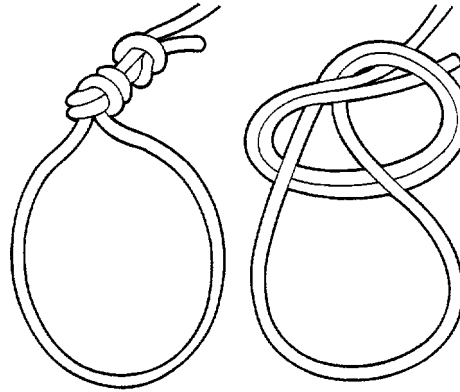
### Example 2

In order to increase the tensile force that can be applied when laying the cord, a loop knot can be tied in the reinforcement material. The end of the cord should then be covered from the PVC sheath past the loop knot. This treatment will not make the end of the cord watertight.



The loop knot shown in the following diagram, known as a guide knot, is a good knot to use to tie the reinforcement material. It is the simplest knot used by moun-

tain climbers when the rope is tied around the body and can be mastered quickly by beginners.



### Example 3

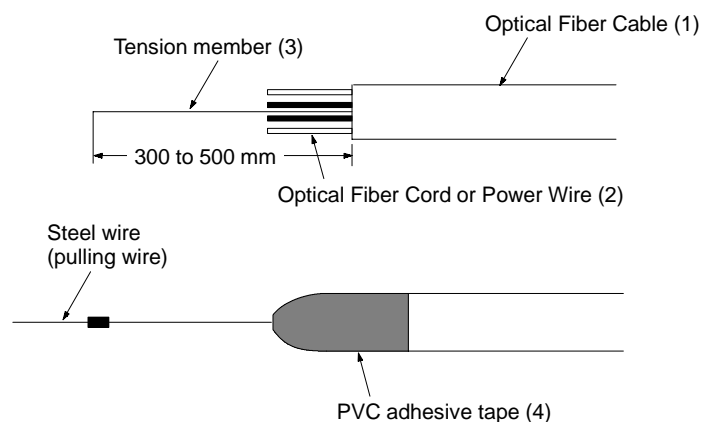
If the cord is being pulled through a relatively large conduit, a cord can be folded back onto itself and taped to make a loop. If this method is used, the end of the cord which was folded will be damaged and cannot be used to transmit light. Cut off the end of the cord after it has been installed.

## 4-3-2 Preparing a Cable for Pulling

Optical Fiber Cables must not be pulled by their optical fibers or power wires, but by the cable's tension member. The methods described here will not make the end of the cable watertight. If the cord is being pulled through water, be sure to treat the end of the cable so it is watertight.

### Cable Without a Connector

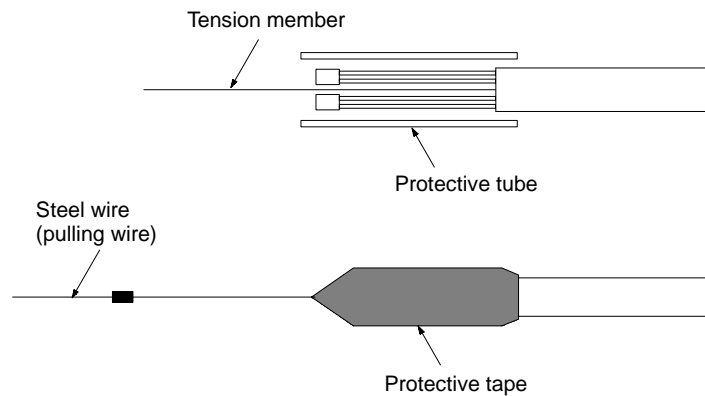
Follow the procedure below to prepare an Optical Fiber Cable without a connector attached.



- 1, 2, 3...**
1. First remove 300 to 500 mm of the outer PVC sheath from the end of the Optical Fiber Cable (1).
  2. Cut the Optical Fiber Cords, power wires, and spacing cords so that the tension member (3) protrudes.
  3. Cover the Optical Fiber Cords and power wires with a protective tube or cover and wrap the end of the cable with PVC tape.
  4. Tie the exposed tension member to the steel pulling wire.

**Cable With a Connector**

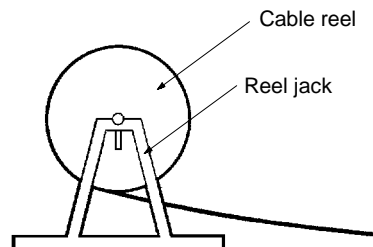
Follow the procedure below to prepare an Optical Fiber Cable with a connector attached.



- 1, 2, 3...**
1. First remove any parts of the connector's plastic housing that can be removed.
  2. Cover the Optical Fiber Cords and power wires with a protective tube or cover and wrap the end of the cable with PVC tape.
  3. Tie the exposed tension member to the steel pulling wire.

**4-3-3 Cord or Cable Installation**

This section describes three methods for pulling cable through conduit. When pulling the cord or cable from the reel, raise it off of the ground with a reel jack so that it can turn easily. Pull the cable off of the reel while spinning the reel so that only moderate force is placed on the cable itself.



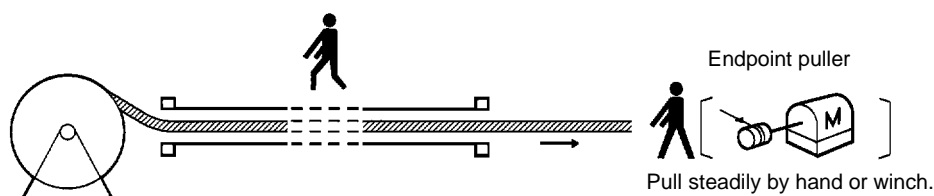
When removing cable from the reel, apply less than  $\frac{2}{3}$  of the maximum tensile load for the cable and unreel the cable at less than 10 m/min.

**One-way Pulling**

With this method, the cord or cable is pulled or laid in one direction. Pull the cable from the higher to the lower end of the route if one end is higher than the other and pull from the end closest to the turn if there is a turn or bend in the route.

Station people along the route to monitor the installation or pull the cable to avoid excessive force (pulling tension, compression, bending, or twisting) on the cable. Insert a tension meter to monitor pulling tension if the tension is suspected to be too great.

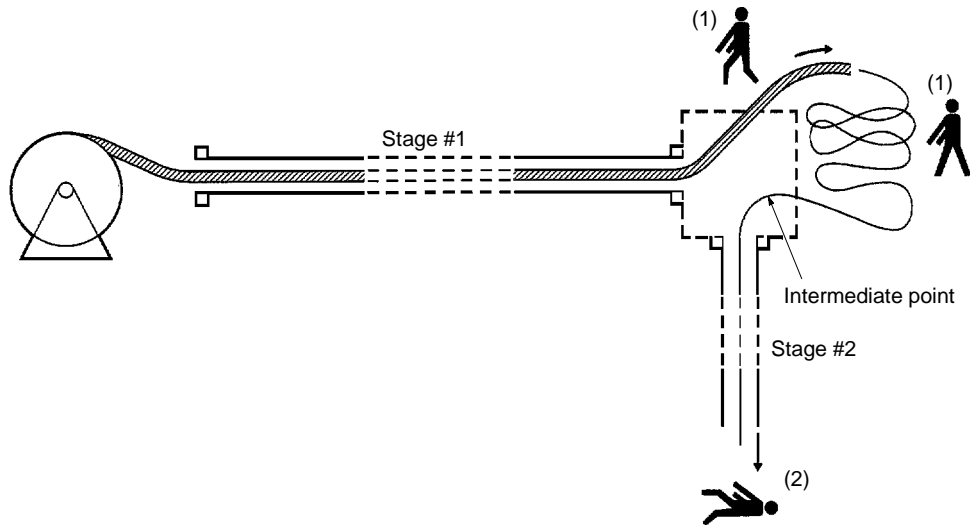
Midpoint puller  
(Station a puller along the pulling route if the tension is too high.)



**Multiple-stage Pulling**

With this method the cable is installed in one direction, but the cable is pulled through the route in stages. The remainder of the cable is temporarily piled in figure-eight layers at the end of each successive stage. A single stage might be selected because it is a practical pulling distance or because it ends at a turn in the route.

In the following example, a cable is laid in two stages which are separated by a 90° turn.



**1, 2, 3...**

1. Pull or lay all of the required cable through stage #1 and pile the remaining cable in figure-eight layers at the turn in the installation route.
2. Pull or lay the second stage of the installation route from the turn, taking care not to tangle or twist the cable.
3. Repeat steps 1 and 2 for installation routes with 3 or more stages.

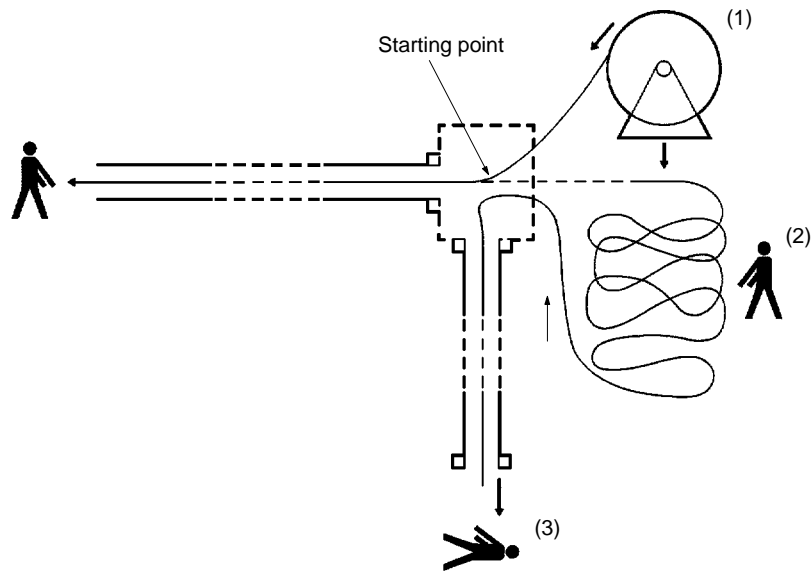
**Two-way Pulling**

If it is impossible to install the cable in one direction because of restricted access or sharp turns along the route, pull the cable in two directions from an intermediate point on the route.

Install the cable in one direction, remove the remaining cable from the reel and pile it in figure-eight layers, and install that part of the cable in the opposite direction.



Be sure to follow the precautions described above under the heading “one-way pulling” and eliminate any bends or twists in the cable after installation.

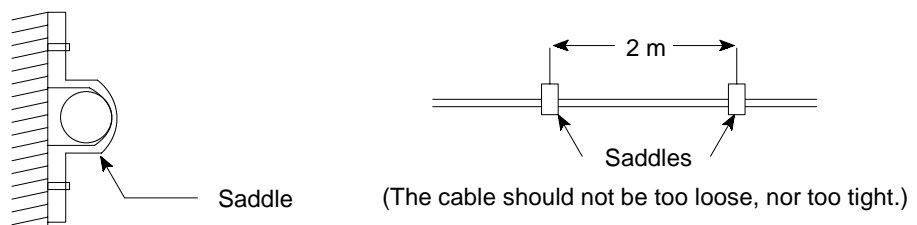


- 1, 2, 3...**
1. Pull or lay the cable from the starting point in the first direction (1).
  2. Remove the remaining cable from the reel and pile it in figure-eight layers near the starting point (2).
  3. Install the remaining cable in the second part of the installation route, taking care not to tangle or twist the cable (3).

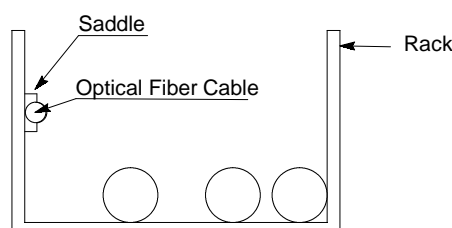
## 4-4 Installation Precautions

### 4-4-1 Rack or Trough Installation

Install the cord or cable on the rack (or in the trough) being careful not to apply too much tension, bending, or twisting, and allowing a little slack (about 10 mm/m).



Do not install the cord or cable on top of or between power supply wires. The power wires might cut into the cord or cable or pinch it, increasing the pulling tension. Allow at least 10 mm between the Optical Fiber Cord or Cable and power supply wires or install the Optical Fiber Cord or Cable off to the side, as shown below.



**Note** Be sure to protect the connector on Optical Fiber Cords or Cables that have connectors attached. In particular, use a protective cap to prevent the tip of the connector from being contaminated by dirt.

## 4-4-2 Installation in Electrical Conduit

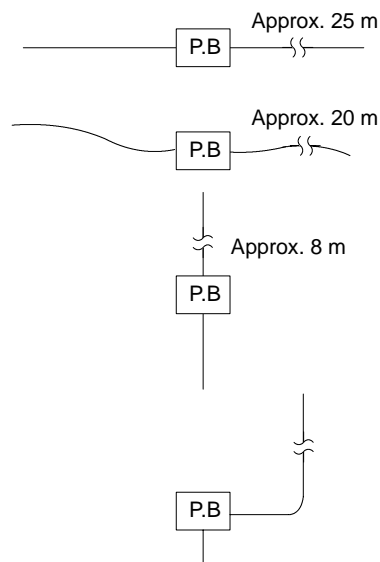
Use a steel conduit, high or low-relief PVC pipe, or flexible plastic pipe. Use a conduit with a diameter taken from the following table.

| Connector Attachment       | Outer Diameter | Inner Diameter | Electrical Conduit |           | Application                 |
|----------------------------|----------------|----------------|--------------------|-----------|-----------------------------|
|                            |                |                | Thick wall         | Thin wall |                             |
| Connector attached on site | 19 to 21 mm    | 16 mm          | 16                 | 19        | Optical Fiber Cord only     |
|                            | 25 to 27 mm    | 22 mm          | 22                 | 25        | Optical Fiber Cord or Cable |
| Connector already attached | 25 to 27 mm    | 22 mm          | 22                 | 25        | Optical Fiber Cord only     |
|                            | 32 to 33 mm    | 28 mm          | 28                 | 31        | Optical Fiber Cord or Cable |

The inside of the conduit should be smooth, without any projections or joints that might impede the cord or cable. Install just one Optical Fiber Cord or Cable in a conduit.

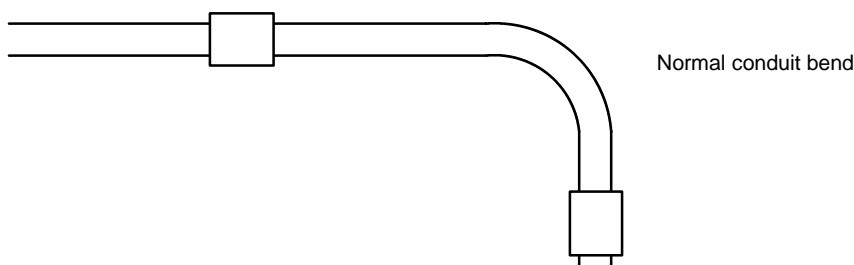
The length of the conduit should be no more than 25 meters when the conduit is straight and level. When the conduit has bends along its path, the overall length should be approximately 20 meters or less. When the route is vertical, pull boxes (about 200 × 300 × 700 mm) should be installed at intervals of approximately eight meters.

In the following diagram P.B. indicates a pull box.



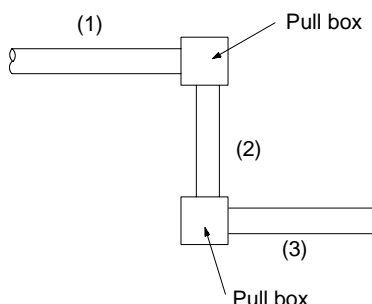
Use a pre-bent piece of pipe or bend the conduit with a pipe bending tool. The radius of the bend should be at least six times larger than the internal

diameter of the conduit. Attach a bushing and saddles at the end of the conduit so that the Optical Fiber Cable does not bend at too sharp an angle.



Turns in the installation route should be avoided if possible, but if a turn must be made, pull boxes are preferred to bends in the conduit. The pull boxes should be large enough to allow the Optical Fiber Cord or Cable to bend with a large enough radius, and the connecting conduit should be straight.

The Optical Fiber Cord or Cable can be installed by the “multiple-stage pulling” or “two-way pulling” methods described in *4-3-3 Cord or Cable Installation*. Three stages would be required for the route shown in the following diagram.



Use the pull boxes as intermediate points when installing the cable. Pull the cable through the first pull box and set aside the remainder in figure-eight layers as described in *4-3-3 Cord or Cable Installation*. Repeat this process for each pull box, being careful not to pull, bend, or twist the cable excessively.

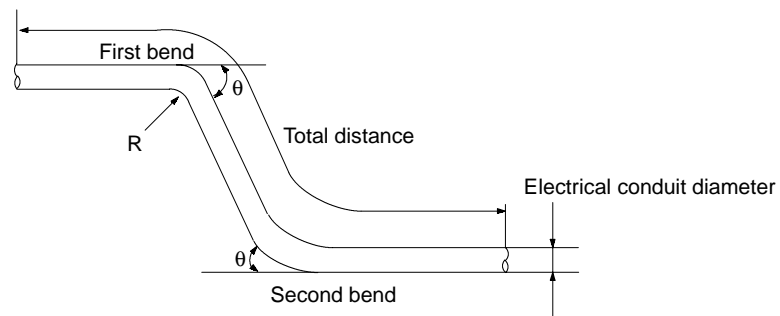
The pull box must be large enough to allow room for the minimum bend radius shown in the following table plus some room for expansion.

| Item                | Bend Radius at Installation | Bend Radius after Installation |
|---------------------|-----------------------------|--------------------------------|
| Optical Fiber Cord  | Greater than 60 mm          | Greater than 30 mm             |
| Optical Fiber Cable | Greater than 200 mm         | Greater than 100 mm            |

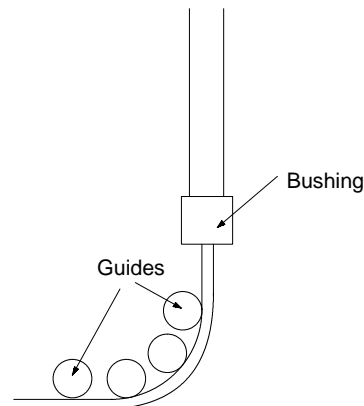
Insert bushings at the entrance and exit of the pull box and guides to prevent sharp bends in the cable. The cable should be held in place and not move freely.

If the area where the turn must be made is inaccessible (when the electrical conduit bends), two bends can be made very carefully in the conduit. The installation will be limited by the radius of the bends (R), angle of the

bends ( $\theta$ ), number of bends, diameter of the conduit, and total distance of the route.



Insert bushings at the ends of the conduit and install guides to prevent sharp bends.



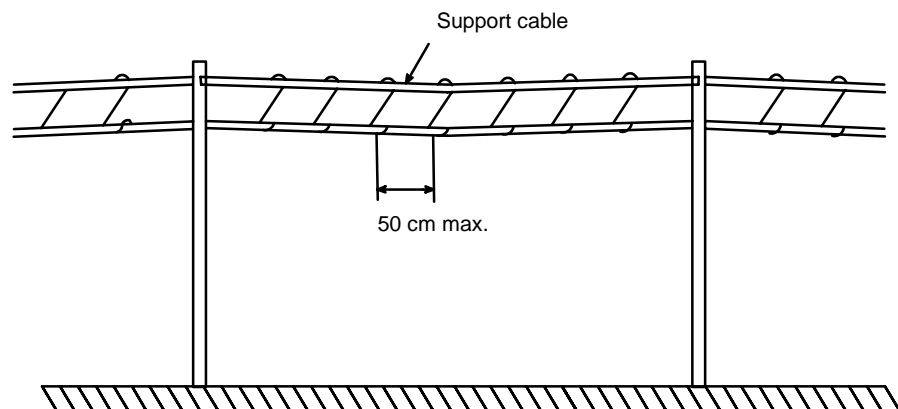
### 4-4-3 Installation in Ducts

The instructions for installation in electrical conduits also apply to installation in ducts. Flooding might occur in outdoor underground installation sites, so be sure to waterproof the end of the Optical Fiber Cord or Cable with a waterproofing compound or adhesive tape before pulling it through the duct.

### 4-4-4 Elevated Installation

Optical Fiber Cables can be hung from a support cable like ordinary low-tension power lines. It is not recommended to hang Optical Fiber Cords, especially outdoors.

Support the Optical Fiber Cable from a sufficiently thick support cable (greater than the earlier 22 mm<sup>2</sup> metal cable) using suitable hooks spaced at intervals of 50 mm max.



Gently unreel the Optical Fiber Cable at less than 10 m/min by spinning the reel, so that no pulling tension is applied to the Optical Fiber Cable itself. Be sure not to apply any force to the cable (tension, bending, compression, twisting, or impact) during installation that exceeds its maximum specifications.

The minimum bend radius for an Optical Fiber Cable during installation is 200 mm (20 times the cable diameter). Use a tool such as a pulley at bends of the cable to ensure that the bends exceed the minimum radius.

When installing straight sections, use pulleys as guides to ensure that the tension on the cable does not exceed the maximum value. Set the pulleys no more than 25 meters apart and allow the cable to sag at least 0.5 m.

Use a tension meter to monitor the tension in the cable if it is suspected to be too high, and pull the cable along the installation route by hand or other means if the tension is found to be too high.

**Note** It is good practice to leave about 2 or 3 meters of spare cable before each node connection. This margin of cable allows room for attaching the connector and some repositioning of the node.

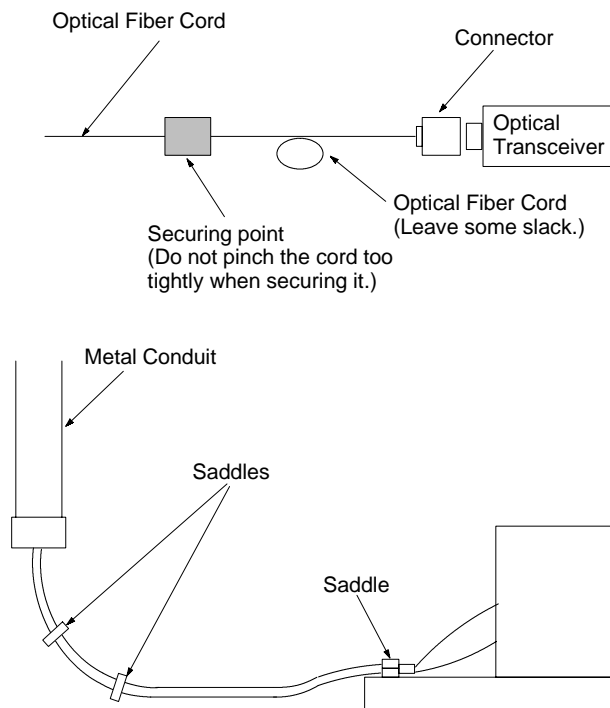
## 4-5 Securing the Cord or Cable

After laying the Optical Fiber Cord or Cable along the installation route, remove the tape or tube used to protect the end of the cable. If a ferrule is going to be attached to the end of the cable, clean the end of the ferrule surface with water and wipe it with a soft, clean, and lint-free cloth or paper towel.

### Optical Fiber Cord

When installed in a rack or trough, secure the cord gently with mounting brackets or saddles to prevent movement. Be sure not to attach the brackets or saddles too tightly, because excessive compression will damage the cord.

At the last mounting bracket, bushing, or saddle, protect the cord with a rubber ring, strip of rubber, or a few layers of PVC tape and secure it. Leave enough slack in the cord to attach and remove the connector or move the node, if necessary.

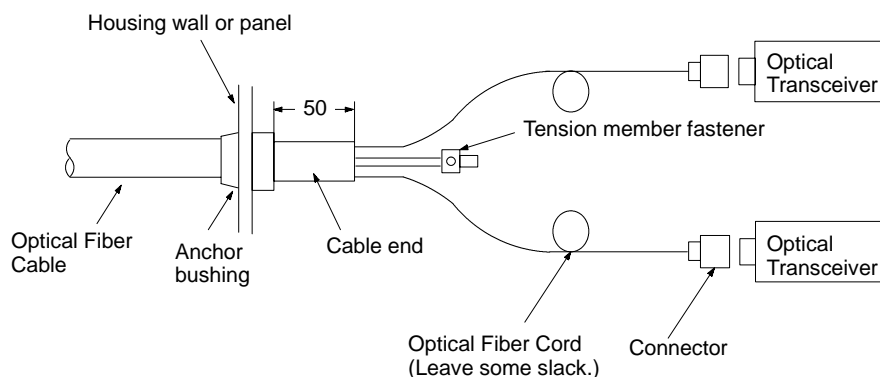


## Optical Fiber Cable

When installed in a rack or trough, secure the cable with mounting brackets or saddles to prevent movement. Be sure not to attach the brackets or saddles too tightly, because excessive compression will damage the cable.

Use a bushing with a rubber ring, saddle, etc., to secure the cable to the wall of the housing or panel where the cable ends. If the bushing or saddle is too large for the cable, wrap a strip of rubber or a few layers of PVC tape so it fits snugly. Leave 2 to 3 m of slack in the cable if connectors are being attached on site.

Take up any slack from the tension member and fasten it securely. The tension member's metal fastener must be properly grounded. Always secure the tension member.



- Note**
1. Protect the end of the cable with conduit if the exposed cable is in a location where it might be stepped on or damaged accidentally.
  2. If conduit is used, insert a bushing at the end of the conduit and use saddles or guides to prevent the cable from being bent at too severe an angle.

## 4-6 Increasing Cable Length

In general, an Optical Fiber Cord or Cable that is not long enough should be replaced with a cord or cable of sufficient length.

When a cord or cable is installed in a trough or rack, the connection point is indoors and accessible, and an increase in signal loss of 1.5 dB is acceptable, an extension cable can be connected with an inline adapter. Transmissions with two cables connected by an inline adapter are less reliable than transmissions through a single cable.

Use of an inline adapter in conduit, duct, or elevated installation should be avoided because of reliability concerns.

## 4-7 Connector Attachment

Refer to the manual included with the S3200-CAK1062 Optical Connector Assembly Tool Kit for information regarding the attachment of connectors to Optical Fiber Cords and Cables.

## Appendix A

### Standard Models

#### H-PCF Two-fiber Optical Fiber Cord

| Connectors | Tension Member | Power Wires | Color | Length  | Model number  | Applications   |
|------------|----------------|-------------|-------|---------|---------------|--|
| No         | No             | No          | Black | 10 m    | S3200-HBCB101 | SYSMAC NET Link,<br>SYSMAC LINK,<br>SYSMAC BUS/2,<br>SYSMAC BUS,<br>SYSMAC Host Link |
|            |                |             |       | 50 m    | S3200-HBCB501 |  |
|            |                |             |       | 100 m   | S3200-HBCB102 |  |
|            |                |             |       | 500 m   | S3200-HBCB502 |  |
|            |                |             |       | 1,000 m | S3200-HBCB103 |  |

#### H-PCF Two-fiber Optical Fiber Cable (Without Connectors)

| Connectors | Tension Member | Power Wires | Color  | Length  | Model Number   | Applications   |
|------------|----------------|-------------|--------|---------|----------------|--|
| No         | Yes            | Yes         | Black  | 10 m    | S3200-HCLB101  | SYSMAC NET Link  |
|            |                |             |        | 50 m    | S3200-HCLB501  |  |
|            |                |             |        | 100 m   | S3200-HCLB102  |  |
|            |                |             |        | 500 m   | S3200-HCLB502  |  |
|            |                |             |        | 1,000 m | S3200-HCLB103  |  |
|            |                |             | Orange | 10 m    | S3200-HCLO101  |  |
|            |                |             |        | 50 m    | S3200-HCLO501  |  |
|            |                |             |        | 100 m   | S3200-HCLO102  |  |
|            |                |             |        | 500 m   | S3200-HCLO502  |  |
|            |                |             |        | 1,000 m | S3200-HCLO103  |  |
|            | No             | No          | Black  | 10 m    | S3200-HCCB101  | SYSMAC NET Link,<br>SYSMAC LINK,<br>SYSMAC BUS/2,<br>SYSMAC BUS,<br>SYSMAC Host Link |
|            |                |             |        | 50 m    | S3200-HCCB501  |  |
|            |                |             |        | 100 m   | S3200-HCCB102  |  |
|            |                |             |        | 500 m   | S3200-HCCB502  |  |
|            |                |             |        | 1,000 m | S3200-HCCB103  |  |
|            |                |             | Orange | 10 m    | S3200-HCCO101  |  |
|            |                |             |        | 50 m    | S3200-HCCO501  |  |
|            |                |             |        | 100 m   | S3200-HCCO102  |  |
|            |                |             |        | 500 m   | S3200-HCCO502  |  |
|            |                |             |        | 1,000 m | S3200-HCCO103  |  |
|            | No             | No          | Black  | 10 m    | S3200-HCCB101N | SYSMAC NET Link,<br>SYSMAC LINK,<br>SYSMAC BUS/2,<br>SYSMAC BUS,<br>SYSMAC Host Link |
|            |                |             |        | 50 m    | S3200-HCCB501N |  |
|            |                |             |        | 100 m   | S3200-HCCB102N |  |
|            |                |             |        | 500 m   | S3200-HCCB502N |  |

**Note** We will continue to accept orders for conventional cable models S3200-FH-L-C22T and B500-OF \_\_\_\_.

## H-PCF Two-fiber Optical Fiber Cable (With Connectors)

| Tension Member | Power Wires | Color | Connectors                                | Length | Model Number      | Applications                                   |
|----------------|-------------|-------|---|--------|-------------------|--|
| Yes            | Yes         | Black | Both S3200-COCF2011                       | 2 m    | S3200-CN201-20-20 | SYSMAC NET Link<br>SYSMAC LINK<br>SYSMAC BUS/2 |
|                |             |       |   | 5 m    | S3200-CN501-20-20 |  |
|                |             |       |   | 10 m   | S3200-CN102-20-20 |  |
|                |             |       |   | 15 m   | S3200-CN152-20-20 |  |
|                |             |       |   | 20 m   | S3200-CN202-20-20 |  |
|                |             |       | One S3200-COCF2011,<br>one S3200-COCF2511 | 2 m    | S3200-CN201-20-25 |  |
|                |             |       |   | 5 m    | S3200-CN501-20-25 |  |
|                |             |       |   | 10 m   | S3200-CN102-20-25 |  |
|                |             |       |   | 15 m   | S3200-CN152-20-25 |  |
|                |             |       |   | 20 m   | S3200-CN202-20-25 |  |
|                |             |       | One S3200-COCF2011,<br>one S3200-COCH62M  | 2 m    | S3200-CN201-20-62 |  |
|                |             |       |   | 5 m    | S3200-CN501-20-62 |  |
|                |             |       |   | 10 m   | S3200-CN102-20-62 |  |
|                |             |       |   | 15 m   | S3200-CN152-20-62 |  |
|                |             |       |   | 20 m   | S3200-CN202-20-62 |  |
|                |             |       | Both S3200-COCF2511                       | 2 m    | S3200-CN201-25-25 |  |
|                |             |       |   | 5 m    | S3200-CN501-25-25 |  |
|                |             |       |   | 10 m   | S3200-CN102-25-25 |  |
|                |             |       |   | 15 m   | S3200-CN152-25-25 |  |
|                |             |       |   | 20 m   | S3200-CN202-25-25 |  |
|                |             |       | One S3200-COCF2511,<br>one S3200-COCH62M  | 2 m    | S3200-CN201-25-62 |  |
|                |             |       |   | 5 m    | S3200-CN501-25-62 |  |
|                |             |       |   | 10 m   | S3200-CN102-25-62 |  |
|                |             |       |   | 15 m   | S3200-CN152-25-62 |  |
|                |             |       |   | 20 m   | S3200-CN202-25-62 |  |
|                |             |       | Both S3200-COCH62M                        | 2 m    | S3200-CN201-62-62 | SYSMAC NET Link                                |
|                |             |       |   | 5 m    | S3200-CN501-62-62 |  |
|                |             |       |   | 10 m   | S3200-CN102-62-62 |  |
|                |             |       |   | 15 m   | S3200-CN152-62-62 |  |
|                |             |       |   | 20 m   | S3200-CN202-62-62 |  |

**Note** We will continue to accept orders for conventional cable models S3200-FH-L-C22T and B500-OF \_\_\_\_.



## Optical Connectors

| Model Number    | Connection     | Applicable Units/Boards   |
|-----------------|----------------|---|
| S3200-COCH62M   | Full lock      | SYSMAC NET Link:<br>S3200-LSU03-01E, C500-SNT31-V4, S3200-NSUG4-00E, S3200-NSUA1-00E, S3200-NSB11-E, FIT10-IF401  |
| S3200-COCF62M   | Relay (male)   | Used with the S3200-COCF62F.  |
| S3200-COCF62F   | Relay (female) | Used with the S3200-COCF62M.  |
| S3200-COCH82    | Half lock      | SYSMAC BUS:<br>C500-RM001-(P)EV1, C120-RM001-(P)-E, C200H-RM001-PV1,<br>C500-RT001-(P)EV1, C500-RT002-(P)EV1, C200H-RT001-P, C200H-RT002-P,<br>C500-LK010-(P)-E, C120-LK010-(P)-E, 3G2C7-LK011-(P), 3G5A2-___-PE<br>SYSMAC Host Link:<br>C500-LK103-(P), C500-LK101-(P)EV1, C200H-LK101-P, 3G2A6-LK101-(P)EV1 |
| S3200-COCF2511  | Half lock      | SYSMAC NET Link: C200H-SNT31, CV500-SNT31<br>SYSMAC LINK: C200H-SLK11, C1000H-SLK11, CV500-SLK11<br>SYSMAC BUS/2: CV500-RM211, CV500-RT211  |
| S3200-COCF2011  | Full lock      | SYSMAC NET Link: CV500-SNT31<br>SYSMAC LINK: C1000H-SLK11, CV500-SLK11<br>SYSMAC BUS/2: CV500-RM211, CV500-RT211  |
| S3200-COIAT2000 | Relay          | Inline Adapter used with the S3200-COCF2511 and S3200-COCF2011.   |

## Optical Connector Assembly Tool Set

| Model Number  | Applicable connectors   |
|---------------|---|
| S3200-CAK1062 | S3200-COCH62M, S3200-COCF62M, S3200-COCF62F, S3200-COCF2511, S3200-COCF2011, S3200-COCH82 |

**Note** The S3200-CAK1062 Optical Connector Assembly Tool Set contains an S3200-FC200 Optical Fiber Cutter.

## Optical Power Tester Sets

| Model Number  | Head Unit*    | Applicable Units/Boards   |
|---------------|---------------|---|
| S3200-CAT3200 | S3200-CAT3202 | SYSMAC NET Link:<br>S3200-LSU03-01E, C500-SNT31-V4, S3200-NSUG4-00E, S3200-NSUA1-00E, S3200-NSB11-E, FIT10-IF401  |
| S3200-CAT2000 | S3200-CAT2002 | SYSMAC NET Link: C200H-SNT31, CV500-SNT31   |
| S3200-CAT2700 | S3200-CAT2702 | SYSMAC LINK: C200H-SLK11, C1000H-SLK11, CV500-SLK11<br>SYSMAC BUS/2: CV500-RM211, CV500-RT211   |
| S3200-CAT2820 | S3200-CAT2822 | SYSMAC BUS:<br>C500-RM001-(P)EV1, C120-RM001-(P)-E, C200H-RM001-PV1,<br>C500-RT001-(P)EV1, C500-RT002-(P)EV1, C200H-RT001-P, C200H-RT002-P,<br>C500-LK010-(P)-E, C120-LK010-(P)-E, 3G2C7-LK011-(P), 3G5A2-___-PE<br>SYSMAC Host Link:<br>C500-LK103-(P), C500-LK101-(P)EV1, C200H-LK101-P, 3G2A6-LK101-(P)EV1 |

**Note** \*The Head Unit is the light source and connector adapter included in the Optical Power Tester Set. All parts of the Optical Power Tester Sets are compatible except the Head Units, which differ according to the optical module (for series of units and boards). When more than one Head Unit is required, specify one of the Optical Power Tester Sets and the other Head Units required.

## Master Fiber Sets

| Model Number   | Applicable Head Unit         |
|----------------|------------------------------|
| S3200-CAT3201  | S3200-CAT3202                |
| S3200-CAT2001H | S3200-CAT2002, S3200-CAT2702 |
| S3200-CAT2821  | S3200-CAT2822                |

**Note** The applicable Head Unit is determined by the connector adapter in the Head Unit that fits the master fiber.

# Glossary

|                                |   |
|--------------------------------|---|
| <b>dBm</b>                     | A unit for expressing power level in decibels, relative to a reference level of one milliwatt.  |
| <b>ferrule</b>                 | A short tube which is attached to the end of an optical fiber and is part of the optical fiber connector.   |
| <b>H-PCF</b>                   | Hard-clad plastic cable fiber.  |
| <b>LAN</b>                     | An acronym for local area network.  |
| <b>local area network</b>      | A network consisting of nodes or positions in a loop arrangement. Each node can be any one of a number of devices. This kind of network usually operates over a small area such as a group of offices or a factory floor.   |
| <b>Programmable Controller</b> | A small, computer-like device that can control peripheral equipment, such as an electric door or quality control devices, based on programming and peripheral input devices. Any process that can be controlled using electrical signals can be controlled by a PC. PCs can be used independently or networked together into a system to control more complex operations. |
| <b>pull box</b>                | A box which allows access to optical fiber cable in a conduit. Pull boxes are used to pull the cable through sections of conduit during installation.   |
| <b>PVC</b>                     | Polyvinyl chloride. The outer layer or sheath on the optical fiber cable.   |
| <b>tension member</b>          | A steel wire running through an optical fiber cable. It is used to give the cable longitudinal strength.  |

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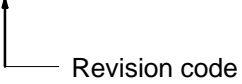
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## Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. W156-E1-3



Revision code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

| Revision code | Date          | Revised content                                   |
|---------------|---------------|---|
| 1             | November 1989 | Original production                               |
| 2             | March 1990    | New text added and some new graphics.             |
| 3             | July 1993     | Extensively rewritten with new information added. |



## OMRON ELECTRONICS LLC

1 Commerce Drive  
Schaumburg, IL 60173  
847.843.7900  
For US technical support or  
other inquiries: 800.556.6766

## OMRON CANADA, INC.

885 Milner Avenue  
Toronto, Ontario M1B 5V8  
416.286.6465

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|                         | Kingston  | 613.376.3968 |
| <b>Quebec</b>           | Montreal  | 514.636.6676 |
| <b>British Columbia</b> | Vancouver | 604.522.8855 |
| <b>Alberta</b>          | Edmonton  | 403.440.0818 |
|                         | Calgary   | 403.257.3095 |

### BRAZIL SALES OFFICE

**Sao Paulo** 55.11.5564.6488

### ARGENTINA SALES OFFICE

**Cono Sur** 54.114.787.1129

### MEXICO SALES OFFICES

|                                  |                                     |
|----------------------------------|-------------------------------------|
| <b>Florida</b> 954.227.2121      | <b>Ciudad Juarez</b> 656.623.7083   |
| <b>Mexico, D.F.</b> 555.534.1195 | <b>Monterrey, N.L.</b> 818.377.4281 |