# High-Efficiency Plastic Optical Fiber

September 10, 2012

S.Sasho

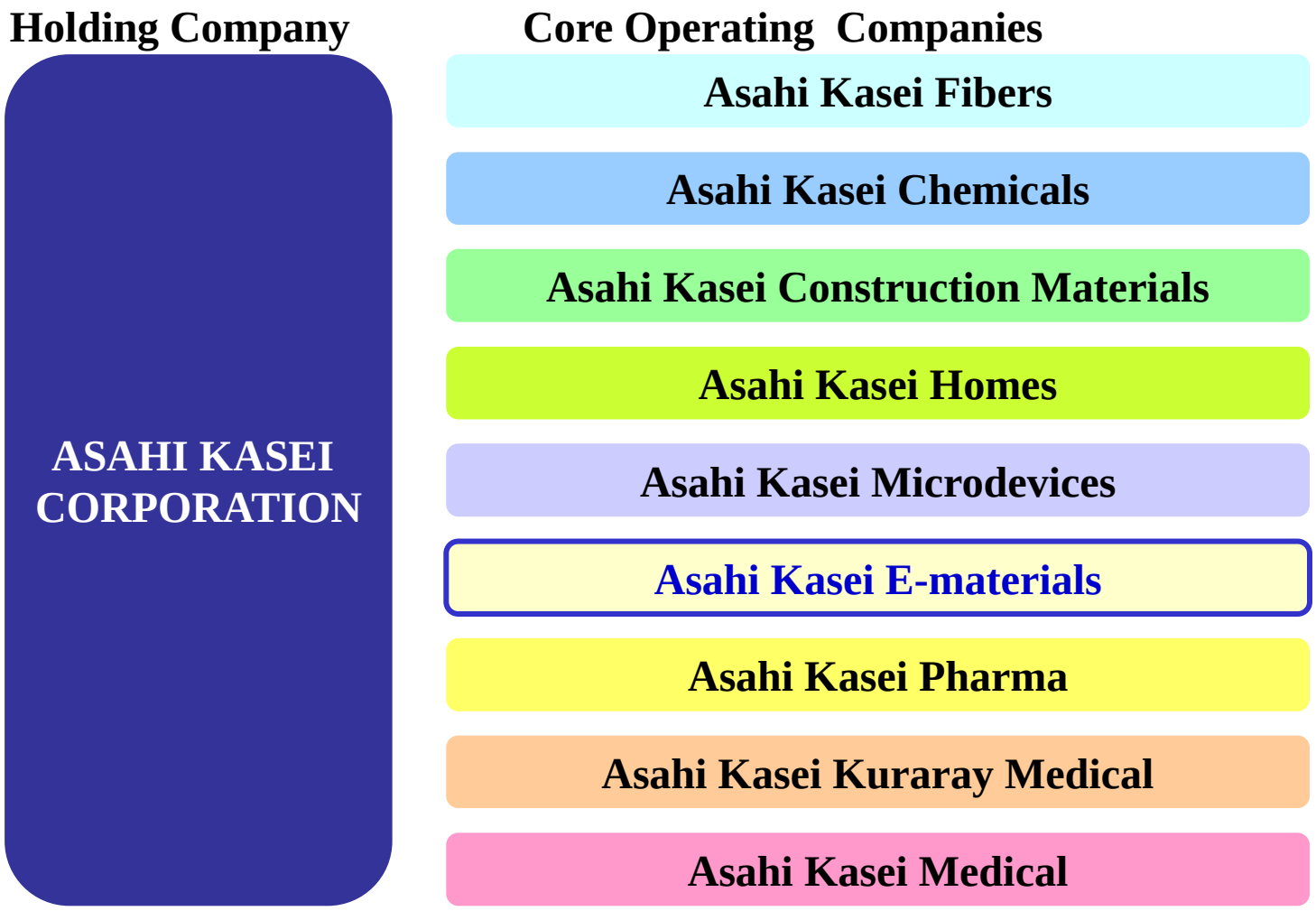
Asahi Kasei E-materials Corp.

Plastic Optical Fibers Dept.

AsahiKASEI

1, Introduction to Asahi Kasei E-materials
2, What's POF
3, Single-core POF
4, Multi-core POF
5, POF under Development
6, Application

The Asahi Kasei Group is structured with Asahi Kasei Corp. as a holding company and nine core operating companies focused on specific fields of operation.



AsahiKASEI

# Overview of Asahi Kasei E-materials

## Corporate Philosophy

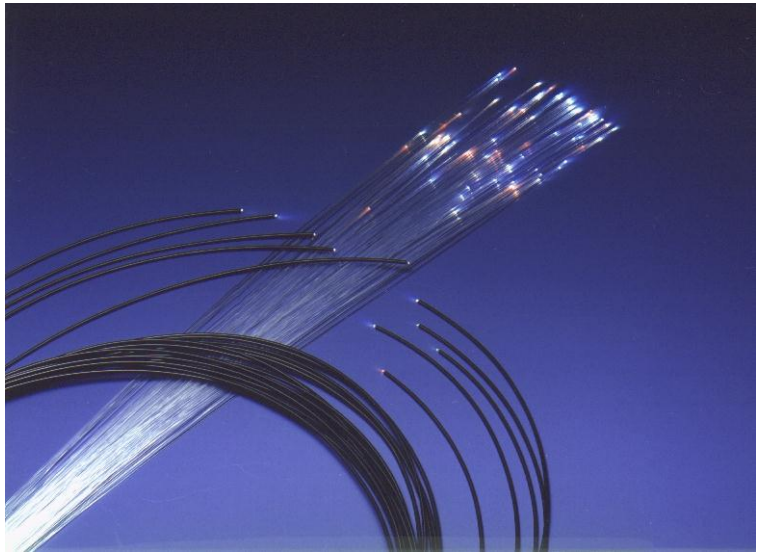
Contributing to sustainable growth and prosperity, using chemical technology for green electronic materials, enhancing the environmental performance of electronic products

- A new core operating company of the Asahi Kasei Group, integrating businesses in electrochemicals-related* product fields. April 1, 2009, start-up.
- Fields of business : Energy materials and electronic materials.
- The company will strive for greater creation of customer value in both products and service, with concentrated allocation of resources and nimble, responsive management.
- The "E" represents the company's main business fields – "energy materials" and "electronic materials" – and "ecology" as a key focus in products and operations.

*Electronic materials based on chemical technology used in applications such as semiconductor packaging, displays, and batteries.

AsahiKASEI

# What's POF



High-efficiency plastic optical fibers are a product of the world-leading polymer and spinning technologies of Asahi Kasei E-materials.

With their highly transparent PMMA (Poly-methylmethacrylate) core and fluoropolymer clad, the plastic optical fibers are becoming the material of choice for the emerging era of optics, in data transmission systems, sensors, light guides, and decorative illumination.

AsahiKASEI

# a) Features & Application

## Features

* Highest optical transmission levels in plastic optical fibers.
* Excellent visible-spectrum transmission.
* Excellent rupture strength, elongation, and durability.
* Large transmission capacity due to large fiber diameter and numerical aperture.
* Easy of cutting, layout, bonding, polishing, other processing.
* Minimum attenuation in visible spectrum, for efficient optical systems with low-cost LED's and photodiodes.

## Typical Applications

* Data Transmission

Factory automation, audio systems, automotive controls, car navigation, LANs, home network.

* Sensors

Defect and fault detectors; position, color, and gloss sensors.

* Light Guides

Point illumination for industrial inspections and measurements, medical examination and therapy, electrical appliances and automotive devices, hazardous or underwater environments, and artworks and jewelry.

* Decor

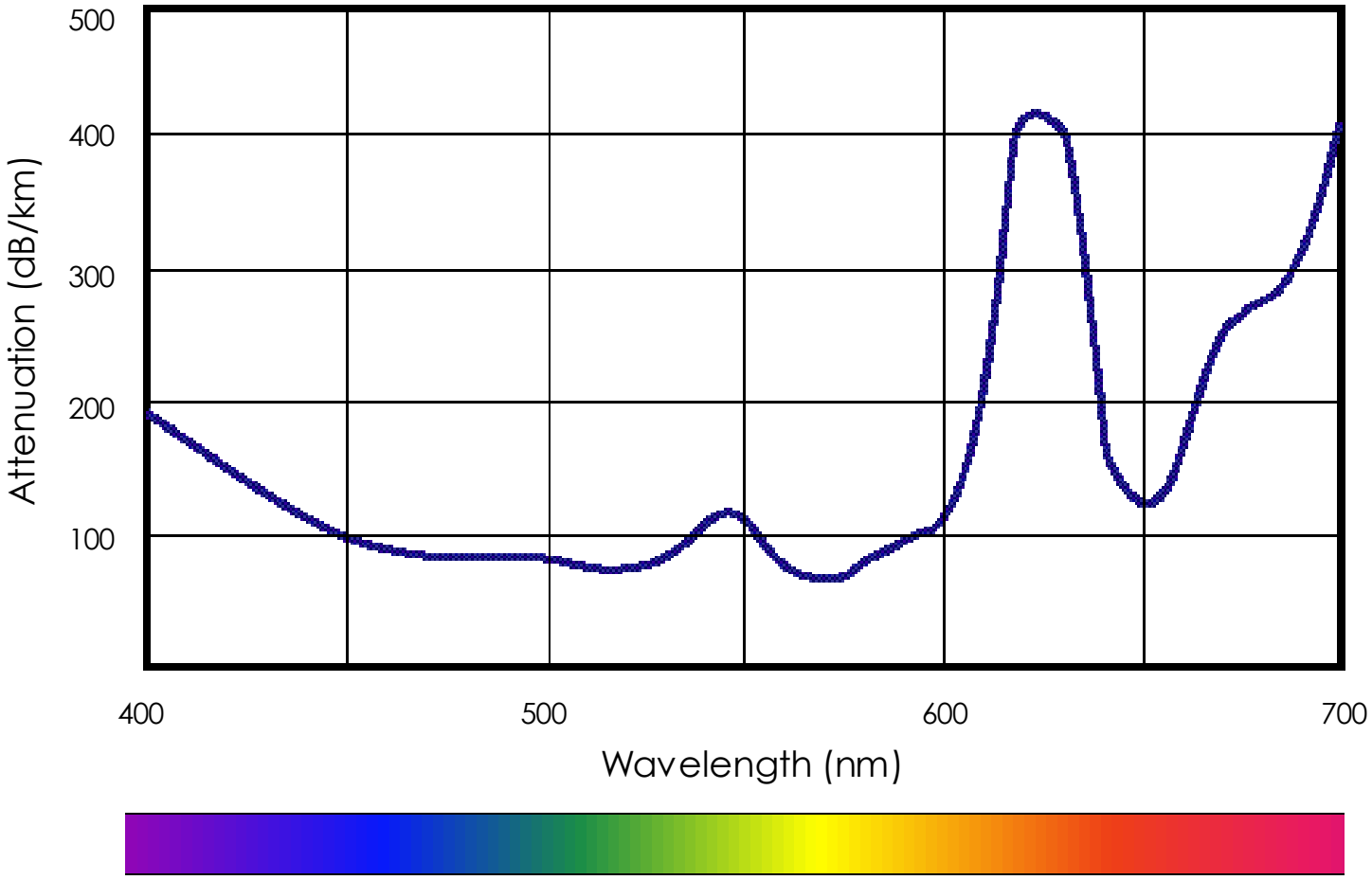
Signs, decorative illumination, underwater luminescent decoration.

* Others

The range of creative possibilities is limited only by the imagination.

AsahiKASEI

# b) Spectral Attenuation



AsahiKASEI

# c) Product Lineup

The following grades are available for a very wide range of applications:

* T-grade

Highest transmission performance in the lineup. Has been particularly well received in signal transmission applications.

* S-grade

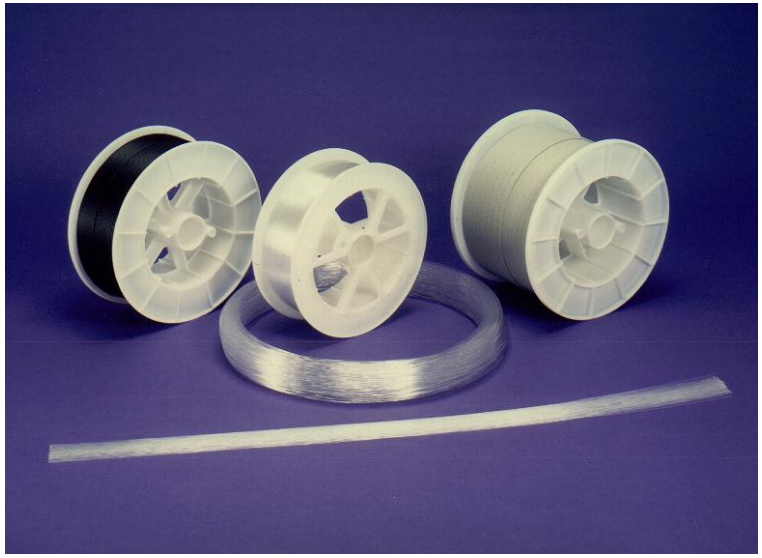
Limited attenuation increase with bending for improved ease of use. Suited for automotive and factory automation applications.

* D-grade

General-purpose grade. Widely employed in sensors and light guides, as well as in illumination and decor.

* Multi-core POF

A completely new type of optical fiber --with a large number of "cores" emplaced in a sea of "clad"-- developed by Asahi Kasei E-materials.
The remarkable new POF which practically eliminates attenuation due to bending.



AsahiKASEI

# Bare Single-core POF

| Grade Name | Fiber Dia.(mm) | NA | Minimum Bending Radius (mm) | Standard Winding Length (m) |
|---|---|---|---|---|
| DB-175 | 0.175 | 0.5 | 8 | 10,000 |
| DB-400 | 0.4 | 0.5 | 8 | 10,000 |
| DB-500 | 0.5 | 0.5 | 10 | 6,000 |
| DB-750 | 0.75 | 0.5 | 10 | 3,000 |
| DB-1000 | 1.0 | 0.5 | 20 | 1,500/5,250 |
| DB-1500 | 1.5 | 0.5 | 30 | 750 |
| DB-2000 | 2.0 | 0.5 | 40 | 250/2,000 |
| TB-500 | 0.5 | 0.5 | 10 | 6,000 |
| TB-750 | 0.75 | 0.5 | 10 | 3,000 |
| TB-1000 | 1.0 | 0.5 | 20 | 1500/5,250 |

AsahiKASEI

# Single-core POF cables

| Grade Name | Fiber Dia. (mm) | Jacket Dia. (mm) | Jacket Material | NA | Minimum Bending Radius (mm) | Remarks |
|---|---|---|---|---|---|---|
| DC-265-10 | 0.265 | 1.0 | PE | 0.5 | 5 | |
| DC-500 | 0.5 | 1.0 | PE | 0.5 | 20 | |
| DC-500W-10 | 0.5*2 | 1.0*2 | PE | 0.5 | 20 | |
| DC-750-10 | 0.75 | 1.0 | PE | 0.5 | 25 | |
| DC-1000 | 1.0 | 2.2 | PE | 0.5 | 30 | |
| DC-1500-22 | 1.5 | 2.2 | PE | 0.5 | 35 | |
| SC-500-22 | 0.5 | 2.2 | PE | 0.6 | 20 | |
| SC-1000 | 1.0 | 2.2 | PE | 0.6 | 20 | |
| SHCN-1000-15(02) | 1.0 | 1.5 | PA | 0.6 | 25 | 105℃ |
| SHCN-500-10(E) | 0.5 | 1.0 | PA | 0.6 | 20 | 105℃ |
| SHCN-1000(E) | 1.0 | 2.2 | PA | 0.6 | 20 | 105℃ |

AsahiKASEI

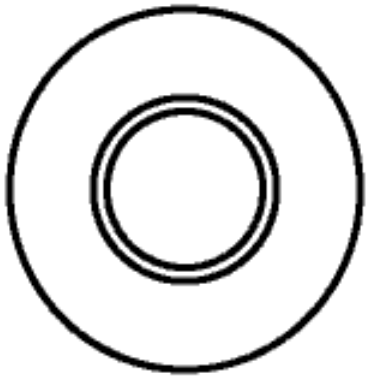
# Single-core POF cables

| Grade Name | Fiber Dia. (mm) | Jacket Dia. (mm) | Jacket Material | NA | Minimum Bending Radius (mm) | Remarks |
|---|---|---|---|---|---|---|
| TC-500 | 0.5 | 1.0 | PE | 0.5 | 20 | |
| TC-1000 | 1.0 | 2.2 | PE | 0.5 | 30 | |
| TC-1000W | 1.0*2 | 2.2*2 | PE | 0.5 | 30 | |
| TCU-1000 | 1.0 | 2.2 | PE | 0.5 | 30 | UL VW-1 |
| TCU-1000W | 1.0*2 | 2.2*2 | PE | 0.5 | 30 | UL VW-1 |
| TCV-1000 | 1.0 | 2.2 | PVC | 0.5 | 30 | UL VW-1 |
| TCV-1000W | 1.0*2 | 2.2*2 | PVC | 0.5 | 30 | UL VW-1 |
| TCU-1000(L) | 1.0 | 2.2 | PE | 0.5 | 30 | LSZH jacket |
| TbCU-1000W(W) | 1.0*2 | 2.2*2 | PE | 0.5 | 30 | White Jacket |
| TCN-1000-15-23N(24G) | 1.0 | 1.5/2.2 | PA/PA | 0.5 | 30 | MOST Green |
| TCN-1000-15-23N(24O) | 1.0 | 1.5/2.2 | PA/PA | 0.5 | 30 | MOST Orange |

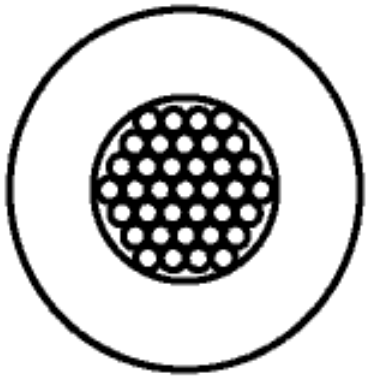
AsahiKASEI

# Multi-core POF

Multi-core POF --with a large number of "cores" emplaced in a sea of "clad"-- is a completely new type of optical fiber developed by Asahi Kasei E-materials. Until now, the versatility of optical fibers has been limited by the increased attenuation which accompanied bending. Multi-core POF, with its unique multi-core structure, has eliminated this problem for all practical purposes. Even the tightest kink in the cord will not cause attenuation to rise significantly.



Single-core POF



Multi-core POF

# 1) Multi-core POF -Features-

## a) Insensitivity to bending

The problem of attenuation due to bending, which occurs with single-core optical fibers, has been practically eliminated, making Multi-core POF ideal for LANs and computer peripheral connections, audio cables, and other applications where cords are bent.

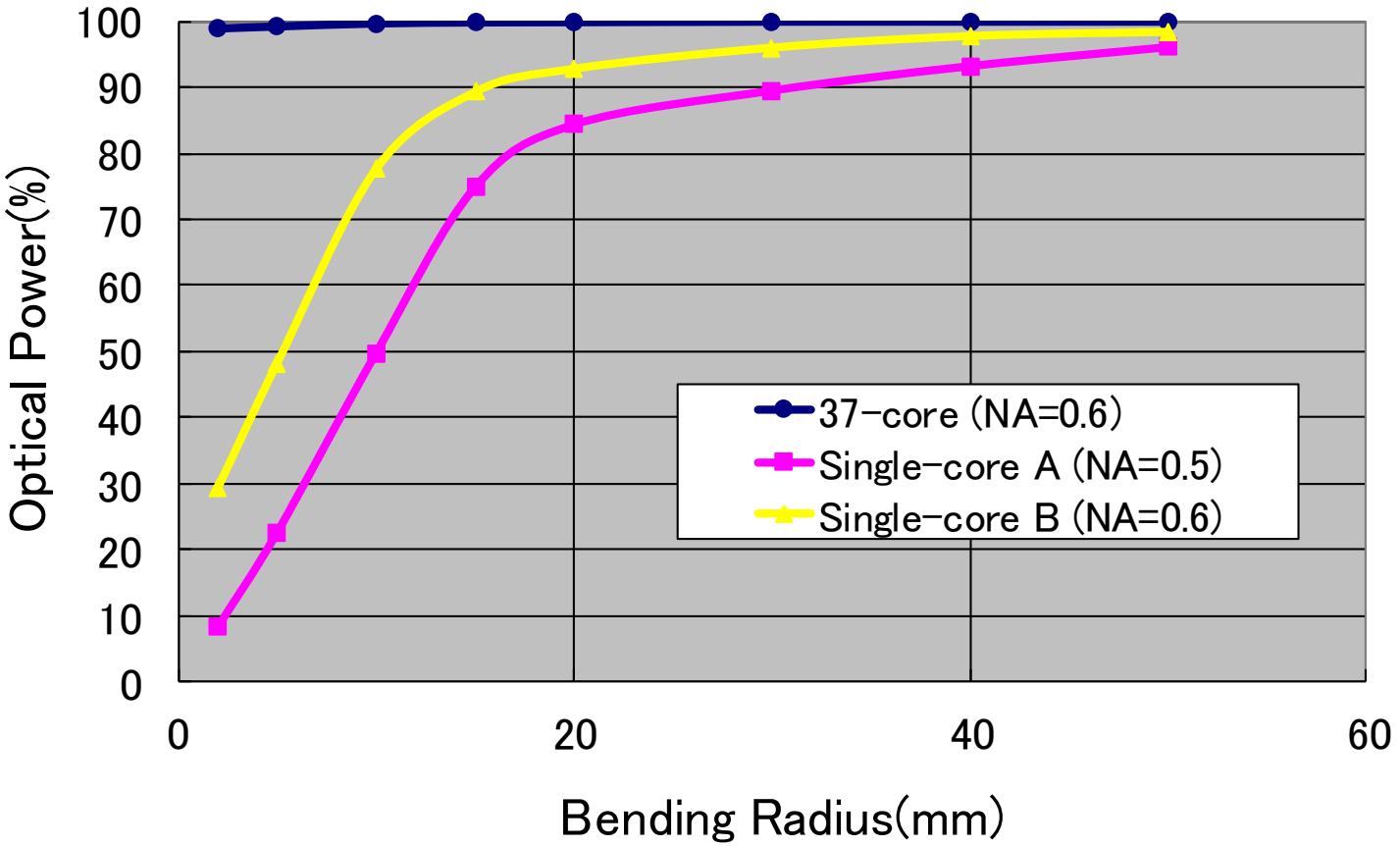
## b) High-speed transmission

Even with a low NA for high-speed transmission, there is no need to worry about increased attenuation due to bending, as with single-core optical fibers. 400 MHz/50 m transmission in a plastic optical fiber is made possible with Multi-core POF.

## c) Easy handling

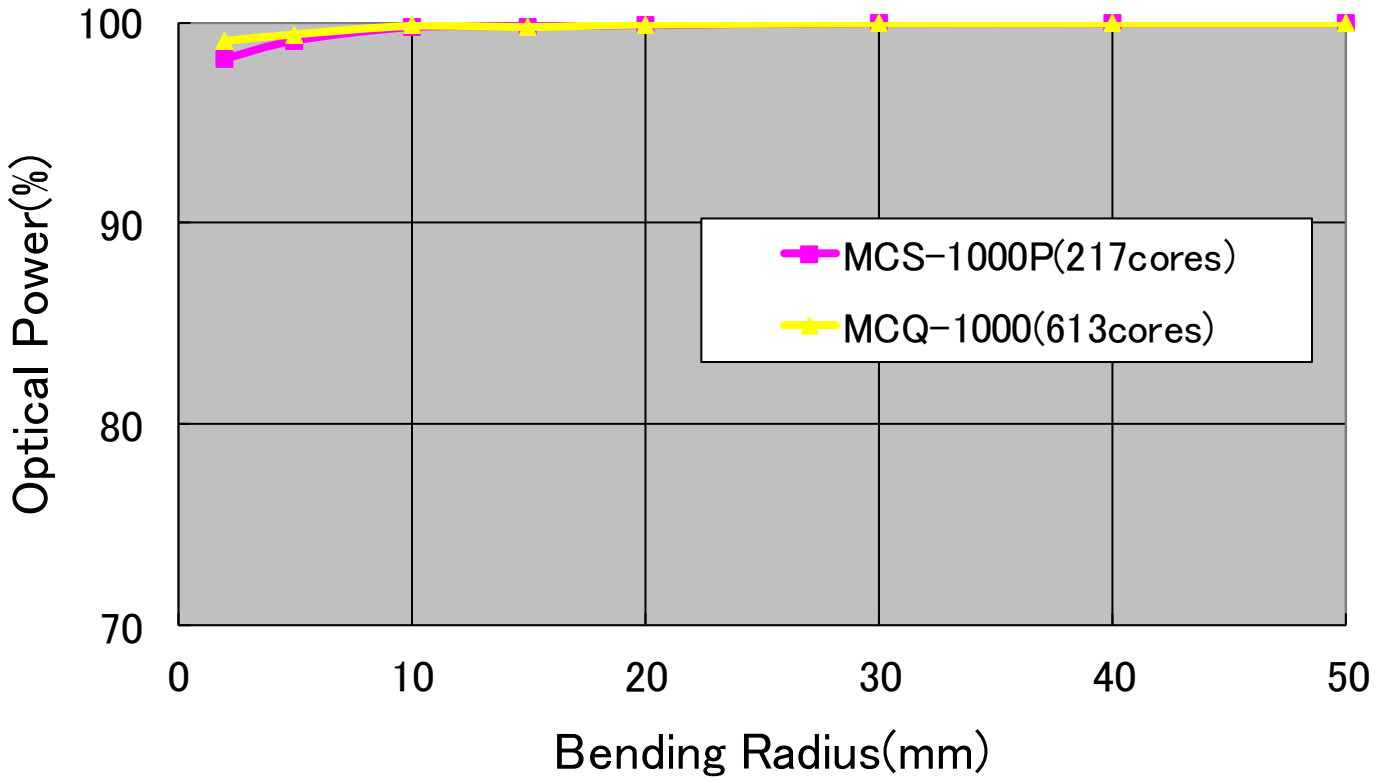
Possible to use parts designed for ordinary plastic optical fibers with no modification in combination with Multi-core POF.

# d) Multi-core POF –bending Loss-



AsahiKASEI

# e) Multi-core POF –bending Loss-



# f) Multi-core POF –Versatility-

Multi-core POF is made of the same materials as ordinary single-core plastic optical fibers, and the fiber diameter is 1 mm, making it possible to use parts designed for ordinary plastic optical fibers with no modification in combination with Multi-core POF. Multi-core POF is currently being employed in sensors, audio and communications.

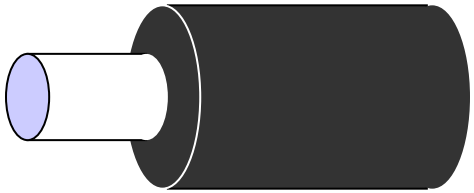
**Various types of connector**

F05, F07, PN, OMJ,

SMI, AVAGO Style

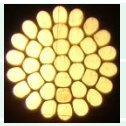
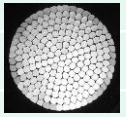
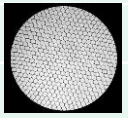
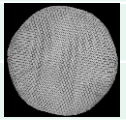
MOST Style, etc.

Applicability!!



AsahiKASEI

# Multi-core POF

| Grade Name | Core Number | Fiber Dia. (mm) | Jacket Dia. (mm) | Jacket Material | NA | Min. Bending Radius (mm) | Remarks |
|---|---|---|---|---|---|---|---|
| SMCK-500P-10 | 19 | 0.5 | 1.0 | PE | 0.6 | 1 |  |
| SMCK-1000P | 19 | 1.0 | 2.2 | PE | 0.6 | 2 | |
| HMCKU-1000PW | 19 | 1.0*2 | 2.2*2 | PE | 0.5 | 6 | Low attenuation |
| PMC-1000 | 37 | 1.0 | 2.2 | PE | 0.2 | 5 | Wide band width |
| PMC-1000W | 37 | 1.0*2 | 2.2*2 | PE | 0.2 | 5 | Wide band width |
| MCS-500P-10 | 217 | 0.5 | 1.0 | PE | 0.5 | 1 | |
| MCS-1000P | 217 | 1.0 | 2.2 | PE | 0.5 | 2 |  |
| MCS-1000P-13 | 217 | 1.0 | 1.3 | PE | 0.5 | 2 | |
| SHMCSN-1000P(E) | 217 | 1.0 | 2.2 | PA | 0.6 | 2 | 105℃ |
| SHMCSN-1000P-18-22PF(EB)* | 217 | 1.0 | 1.8/2.2 | PA/FP | 0.6 | 2 | 105℃, Resistance to oil |
| MCQ-1000 | 613 | 1.0 | 2.2 | PE | 0.5 | 1 |  |
| MCQ-1500-22 | 613 | 1.5 | 2.2 | PE | 0.5 | 3 | |
| MCJ-500-10 | 1300 | 0.5 | 1.0 | PE | 0.5 | 1 |  |
| MCJ-1000 | 1300 | 1.0 | 2.2 | PE | 0.5 | 1 | |

AsahiKASEI

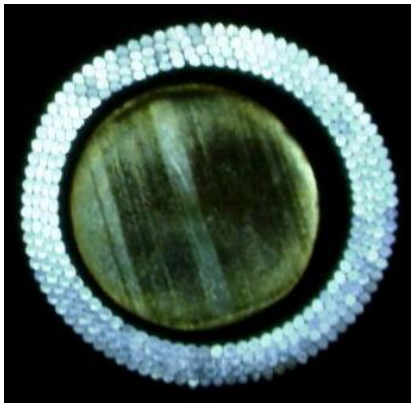
# Multi-core POF - Image Guide -

| Grade Name | Core Number | Fiber Dia. (mm) | Jacket Dia. (mm) | Jacket Material | NA |
|---|---|---|---|---|---|
| MBI-450S | 7400 | 0.45 | - | - | 0.5 |
| MBI-500S | 7400 | 0.5 | - | - | 0.5 |
| MBI-750 | 7400 | 0.75 | - | - | 0.5 |
| MBI-1000 | 7400 | 1.0 | - | - | 0.5 |
| MBI-1500 | 7400 | 1.5 | - | - | 0.5 |
| MBI-2000 | 7400 | 2.0 | - | - | 0.5 |
| MBL-1500 | 13000 | 1.5 | - | - | 0.5 |
| MBL-2000 | 13000 | 2.0 | - | - | 0.5 |
| MCI-500S | 7400 | 0.5 | 1.0 | PE | 0.5 |
| MCI-750-10 | 7400 | 0.75 | 1.0 | PE | 0.5 |
| MCI-1000-1.25 | 7400 | 1.0 | 1.25 | PE | 0.5 |
| MCI-1500-1.75 | 7400 | 1.5 | 1.75 | PE | 0.5 |
| MCI-2000-24 | 7400 | 2.0 | 2.4 | PE | 0.5 |
| MCL-1500-1.75 | 13000 | 1.5 | 1.75 | PE | 0.5 |
| MCL-2000-24 | 13000 | 2.0 | 2.4 | PE | 0.5 |

AsahiKASEI

# Hollow Multi-core POF - Under Development-

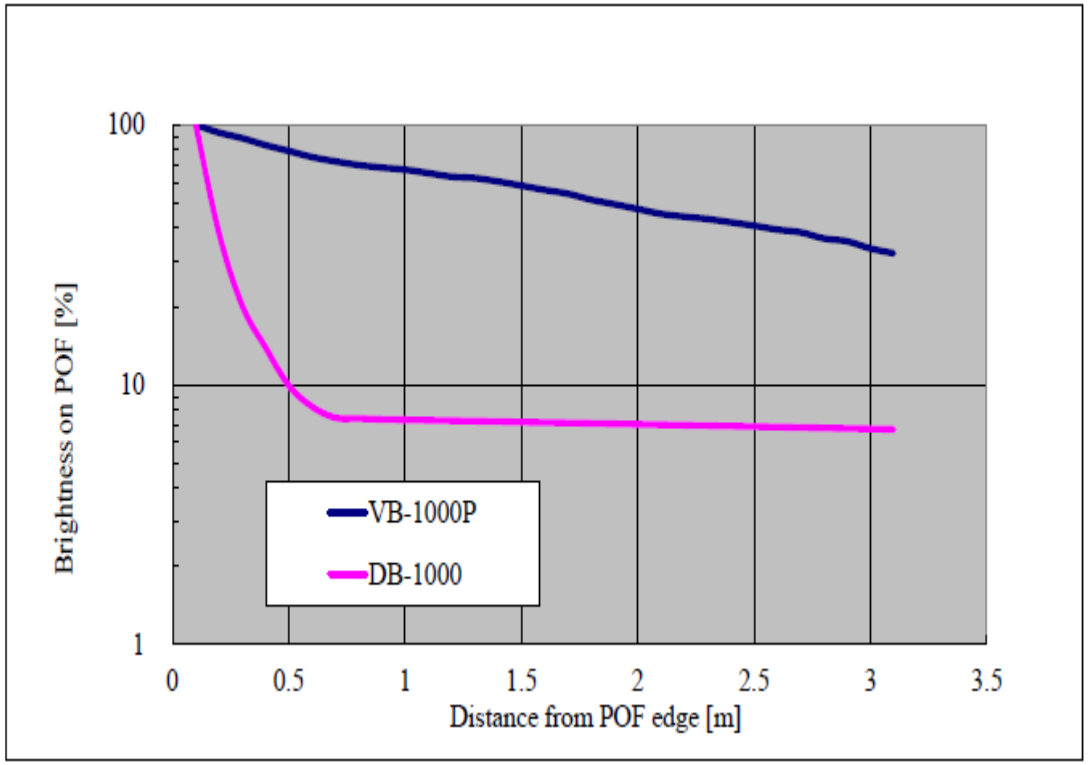
| Type | Concentric | | | | | Eccentric |
|---|---|---|---|---|---|---|
| Inner Dia.(mm) | 0.48 | 0.85 | 1.1 | 1.4 | 1.9 | 0.65 |
| Outer Dia.(mm) | 0.68 | 1.05 | 1.35 | 1.7 | 2.4 | 0.9 |
| Core Number | 320 | | | | | 325 |



AsahiKASEI

# Side Emission POF - Under Development-

| Grade Name | Fiber Dia. (mm) |
|---|---|
| VB-300P | 0.3 |
| VB-500P | 0.5 |
| VB-750P | 0.75 |
| VB-1000P | 1.0 |
| VB-1500P | 1.5 |
| VB-2000P | 2.0 |

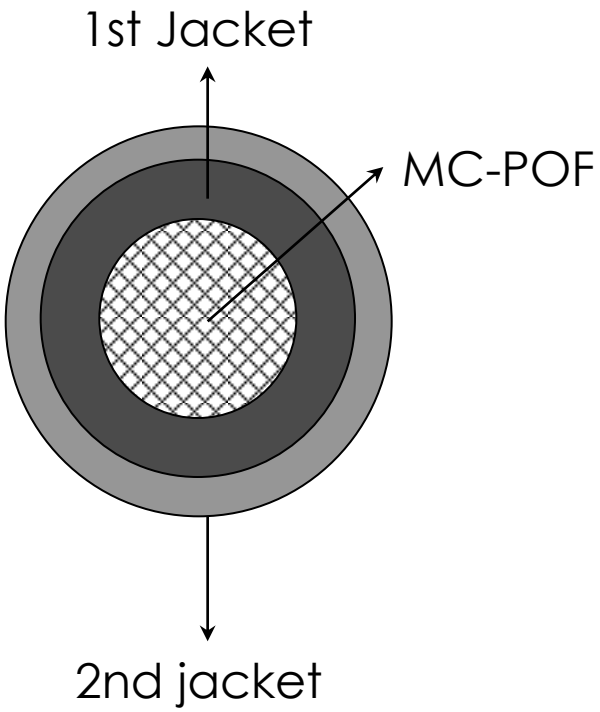


AsahiKASEI

# Introduction : SHMCSN-1000P-18-22FP(EB)

## Feature : 105℃, Resistance to oil

| | |
|---|---|
| Core | PMMA |
| Clad | Fluorinated polymer |
| Fiber Dia. | 1000 ± 60μm |
| Core Number | 217 |
| NA | 0.6 |
| 1st Jacket | PA12 |
| 1st Jacket Dia. | 1800 ± 70μm |
| 1st Jacket color | Black |
| 2nd jacket | PFA |
| 2nd Jacket Dia. | 2200 ± 70μm |
| 2nd Jacket color | Black |



AsahiKASEI

# Application : Medical Endoscope

**A thin endoscope made of a thin POF image guide and thin hollow multi-core POF light guide.**

| | Image Guide | Light Guide |
|---|---|---|
| Core | PMMA | |
| Clad | Fluorinated Polymer | |
| Core # | 7400 | 320 |
| Inside Dia. | - | 0.48mm |
| Outside Dia. | 0.45mm | 0.68mm |