



OMRON

Environment-resistant Series

Oil-resistant Components

Let Us Help You

Eliminate Production Line Stoppages

No Cutting Oil Ingress by Any Path

Unexpected Component Failures:

Approx. **30%** Are Caused by
Cutting Oil.

OMRON's Oil-resistant Components
Resist Oil for 4 Years

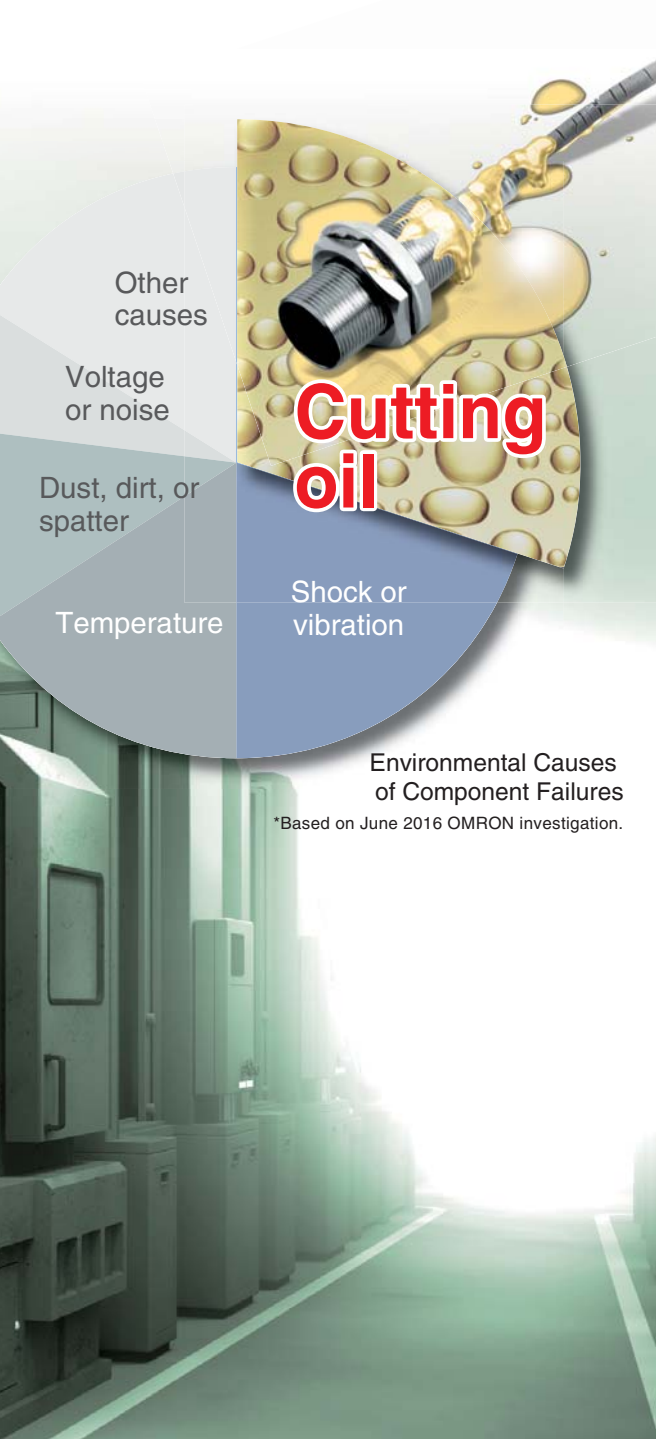
*Refer to page 12 for details on oil resistance performance.

Five products,
more than
140 models
are available.

Let OMRON help you **greatly reduce
unexpected production
line stoppages** by using the Components
that shut out cutting oil for four years and
thereby **increase operation rates.**



Oil-resistant
Fiber Units



OMRON's Oil-resistant Components Solve Problems at All Phases of Production

Management

Factories must be capable of stable production of scheduled quantities.

Eliminate lost opportunity resulting from unexpected production line stoppages.

POINT The opportunity to invest in new projects is increased.

Maintenance

Reducing unscheduled maintenance through stable operation is important.

Unscheduled maintenance visits and replacement frequencies are greatly reduced.

POINT Time can be used effectively for improvement activities.

Production

New facilities must start stable operation without delay.

The risk of faults in newly commissioned facilities is reduced.

POINT A smooth transition can be made to the next production facility commissioning.

Facility Design

Overseas facilities must provide stable operation.

The risk of faults in newly commissioned overseas facilities is reduced. Maintenance cost for unscheduled visits overseas is reduced.

POINT Resources can be centered on designing new facilities.

No Cutting Oil Ingress by Any Path

The Strongest Material

Cables with Fluororesin Sheaths

Fluororesin Blocks Ingress from Cables

Patent Pending

Fluororesin Cable Sheath

Fluororesin, which provides superior resistance to corrosion, is used for the outer cable sheath to suppress cable swelling and deterioration and prevent the ingress of cutting oil to the PCB section.

Fluororesin Sheath



Oil-resistant Connectors
XS5□R



Oil-resistant Proximity Sensors
E2ER/E2ERZ

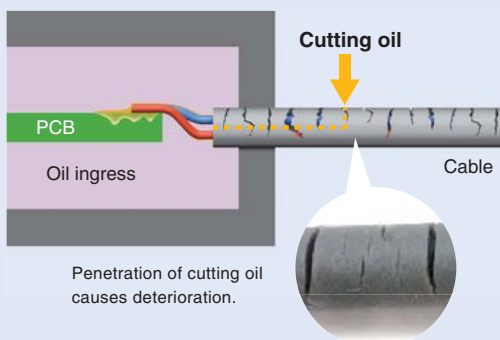


Patent pending

Soft Fluororesin Cable That Resists Deterioration Due to Cutting Oil. Used for Oil-resistant Components.

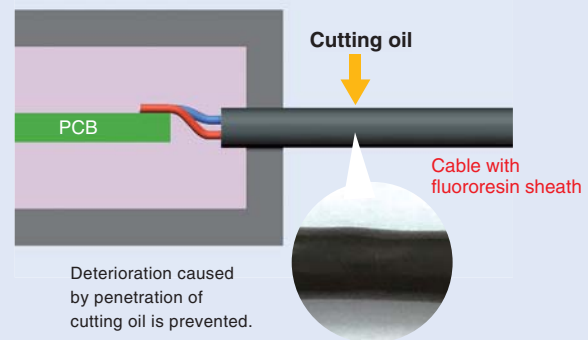
Previous Models Cable Sheath: PVC or PUR

Water-insoluble cutting oils deteriorate PVC and water-soluble cutting oils deteriorate PUR, so the correct cable must be used. Application in an oily environment that causes deterioration makes the cable harden and break, resulting in ingress of cutting oil to the conductor insulation surface. The oil follows this surface to enter the PCB and destroy the circuit.

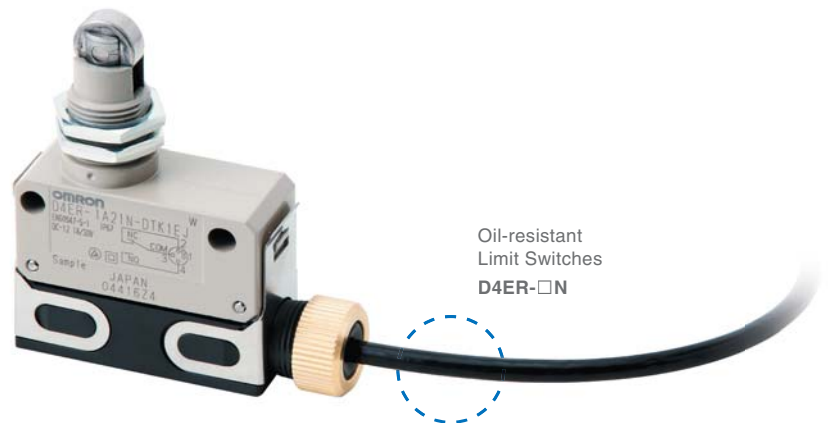
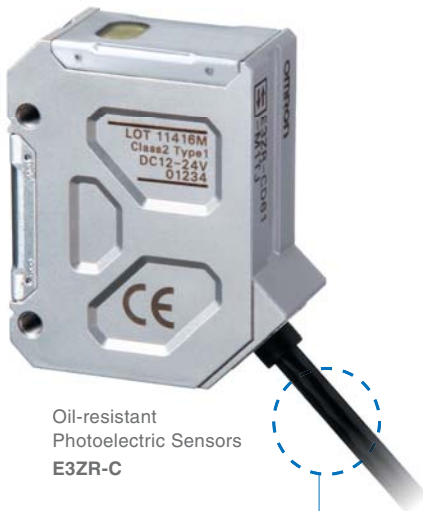


NEW Cable Sheath: Fluororesin

Fluororesin, which is less likely to be deteriorated by either water-insoluble or water-soluble cutting oils, is used for the cable sheath. This prevents penetration of cutting oils into the cable.



The results of a thorough analysis of the ingress paths of cutting oil show that the deterioration of cable sheaths is a large factor. The cable sheaths of OMRON's Oil-resistant Components are made from fluororesin materials to provide maximum protection against the deterioration with a unique new concept. The result is an oil resistance impregnable to even highly aggressive cutting oils.



Previous Models Cable Sheath (Fiber Covering): Polyethylene

Using these cables for extended periods of time in oily environments causes the cable sheath (fiber covering) to harden and crack, resulting in the ingress of cutting oil into the fiber core. This reduces the light level.

Cutting Oil
Ingress into
Fiber Core



Fiber covering
(polyethylene)

Cutting oil



Fiber core

NEW Cable Sheath (Fiber Covering): Fluororesin

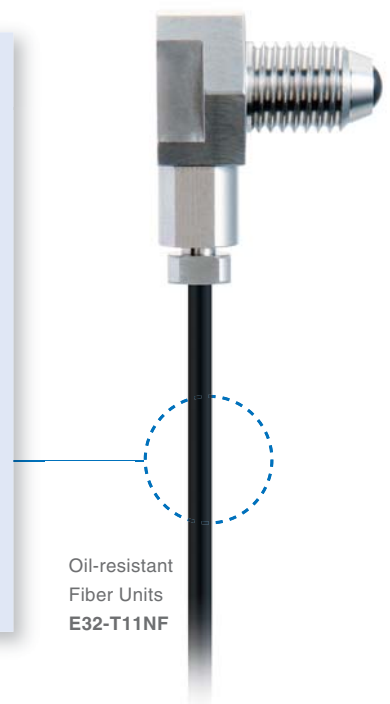
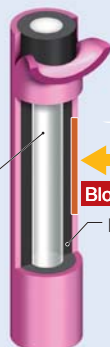
The fluororesin that covers the entire surface of the cable sheath (fiber covering) prevents the penetration of cutting oil.

Cutting oil
Blocked.



No Ingress of
Cutting Oil into
Fiber Core

Fiber covering
(fluororesin)



No Cutting Oil Ingress by Any Path

The Strongest Material

New Rubber Material Combining HNBR and Fluororubber

OMRON-developed Rubber Blocks Ingress through Joints and Moving Sections

Patented

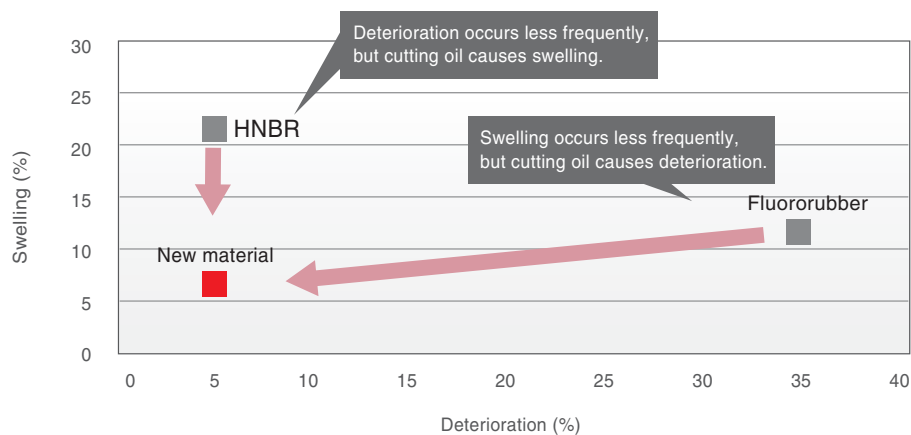
New Rubber Material Combining HNBR and Fluororubber



Hydrogenated nitrile butadiene rubber (HNBR), which provides superior resistance to oil, was blended with fluororubber in a unique OMRON compound to develop a new rubber that provides superior resistance to both swelling and deterioration due to cutting oil.

It is used in seals for joints and moving sections that prevent ingress to prevent deterioration and destruction of the seal due to cutting oil, resulting in increased oil resistance performance.

This new material combines the benefits of HNBR and fluororubber

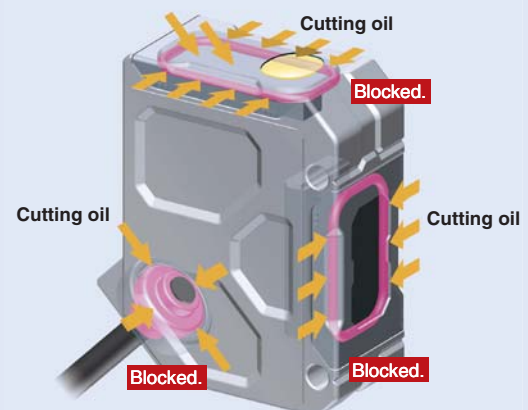


Photoelectric Sensors

Oil-resistant
Photoelectric Sensors
E3ZR-C



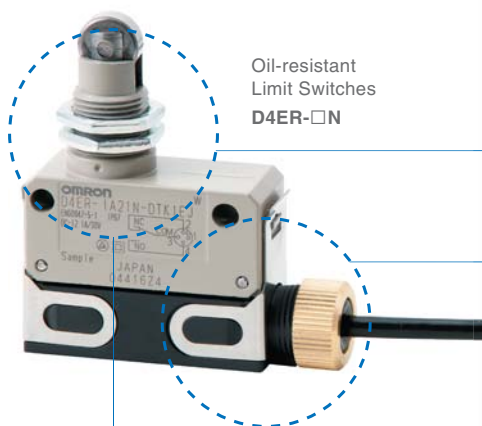
Important Sealing Areas in Joints



*The Strongest Material: Based on June 2016 OMRON investigation.

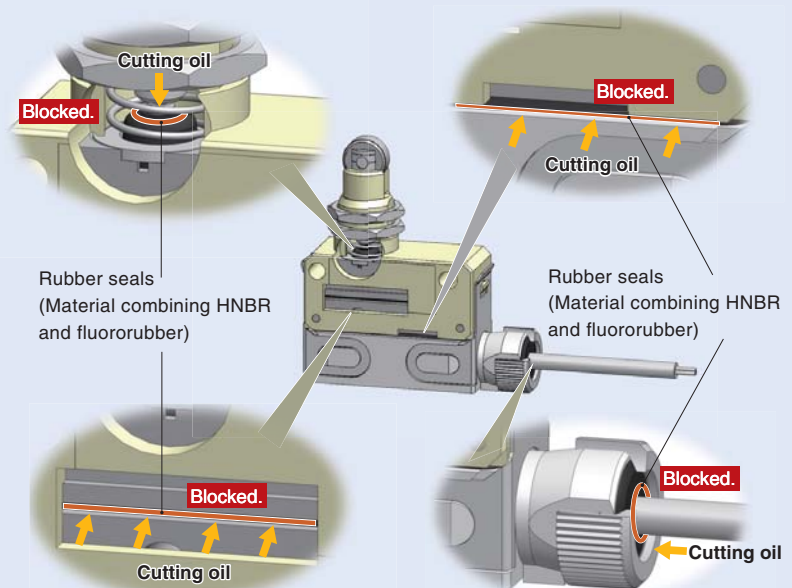
In addition to deterioration of cable sheaths, deterioration of the rubber used at joints and moving sections is also a major cause of ingress of cutting oil. In order to prevent rubber deterioration, OMRON's Oil-resistant Components use a new fluorinated rubber at joints and moving sections. Combined with fluororesin cables, this double use of the strongest materials forms an impregnable wall of oil resistance.

Limit Switches



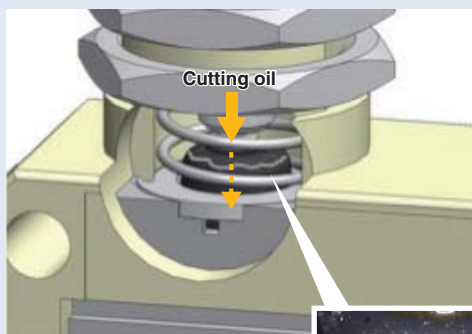
Oil-resistant
Limit Switches
D4ER-□N

Important Sealing Areas in Moving Sections



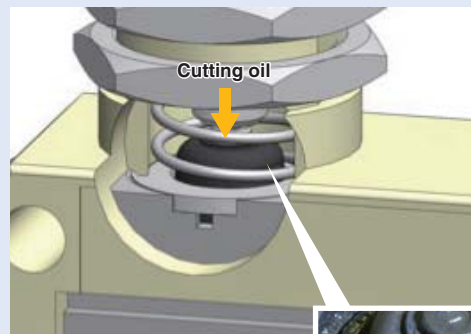
Previous Models Rubber Seal: NBR

Long-term use in an oily environment leads to the hardening and splitting of the rubber seals that block the ingress of cutting oil from moving sections. Cutting oil gets inside and destroys the built-in switches.



NEW Rubber Seal: Material Combining HNBR and Fluororubber

The moving sections are shielded with a new rubber material that has superior resistance to swelling and deterioration caused by cutting oil. This blocks the ingress of cutting oil.



No Cutting Oil Ingress by Any Path

Advanced Sealing Method

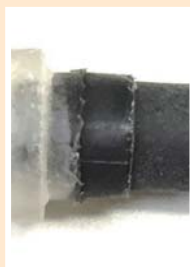
Ingress through Cable Joints
Is Blocked with a
State-of-the-art Sealing Method

Patent Pending

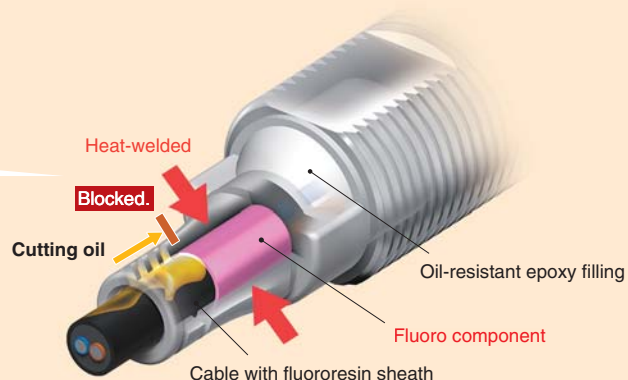
Heat-Sealing Method

Heat-
welding
Sealing

A fluororesin cable is heat-welded with a fluoro component which has a high bondability and a melting point close to that of the cable. This blocks the ingress of cutting oil from the joined surfaces.



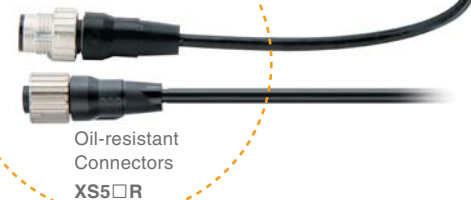
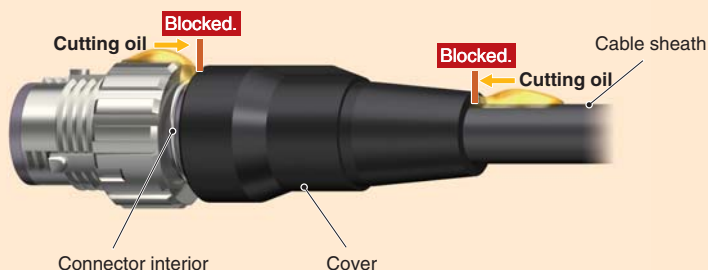
Heat-welded Joint



Forming and Sealing Method + Surface Bonding Technique

Forming/
Sealing+
Surface
Bonding

OMRON's unique over-molding method that combines forming and sealing methods with surface bonding techniques blocks the ingress of cutting oil through the joined surfaces into the connector.



In addition to cable sheaths, joints, and moving sections, cutting oil enters most easily in gaps between different materials. OMRON's Oil-resistant Components completely block the ingress of cutting oil with a state-of-the-art sealing method that does not allow the creation of gaps.

Completely Sealed with Laser Welding

Patent Pending

Method for Complete Sealing without Adhesive

Laser Welding

The gaps at joints between metal parts are sealed by fusing the metal parts together with the laser beam. At other joints, O-rings of the new material are used and the circumference is fastened with laser welding to prevent ingress of cutting oil without any adhesive which can cause swelling and deterioration.

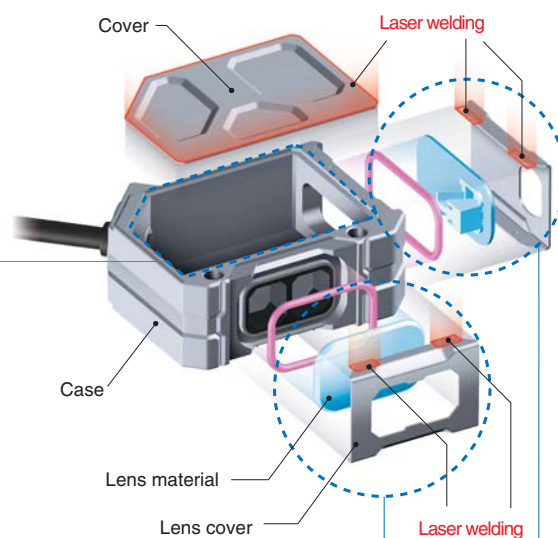


This picture is for illustrative purposes only.

The laser beam is controlled with high precision. This method of fusing metal at a precise location with a small laser beam spot enables application to sensors and other small electronic devices.



Oil-resistant Photoelectric Sensors E3ZR-C



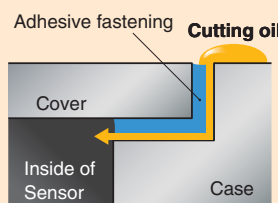
Joints between Metal Parts

Gaps are sealed by fusing the metal case and cover with a laser beam.

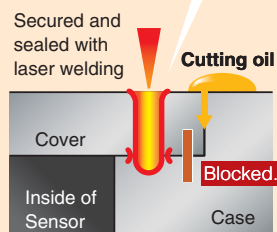


Illustration of Laser Welding

Previous Models



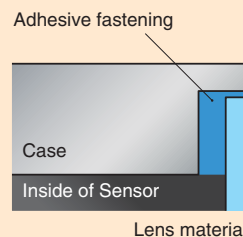
NEW



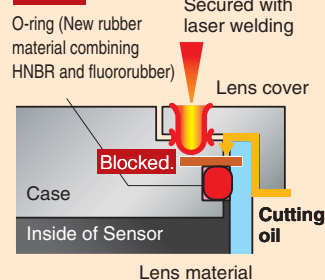
Joints between Metal and Non-metal Parts

Securing the metal case and lens cover with laser welding makes the compressed O-ring seal the gap.

Previous Models



NEW



No Cutting Oil Ingress by Any Path

Unique Structure

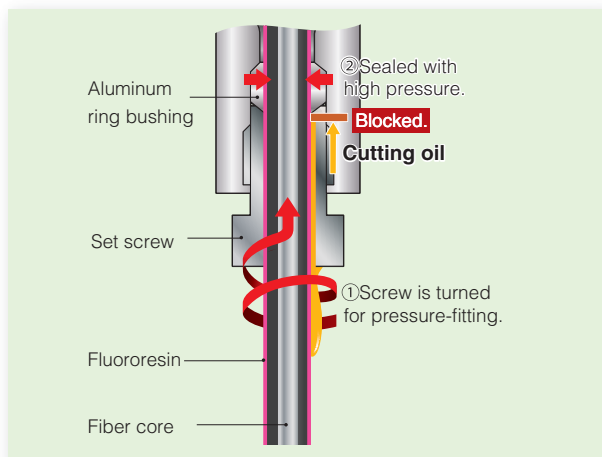
OMRON's Unique Structure without Gaps Blocks Oil Ingress

Mechanical Seal Structure

Mechanical Seal

Fiber Units

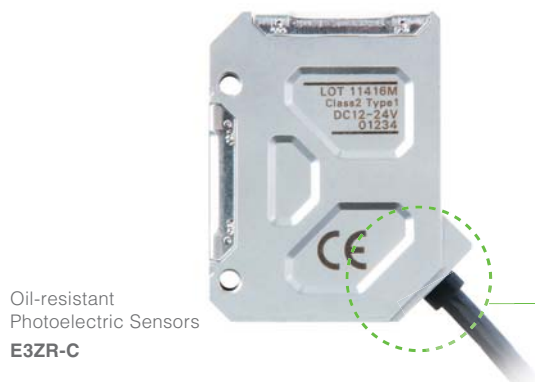
An aluminum ring bushing is compressed and deformed by a set screw to seal the structure by pressing against the fluororesin part of the fiber core. This prevents the ingress of cutting oil from the joined surfaces.



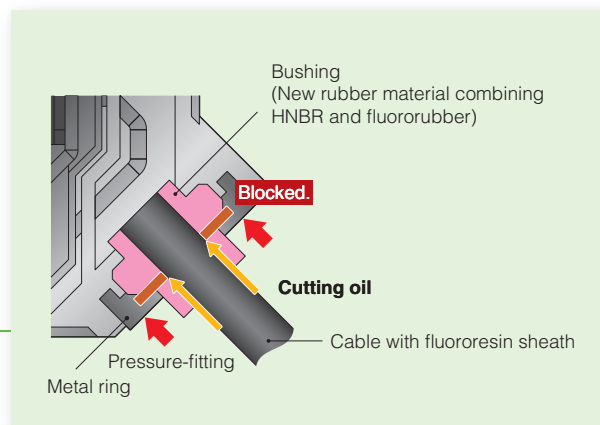
Oil-resistant Fiber Units
E32-T11NF

Photoelectric Sensors

A bushing made from the new material is compressed and deformed by pressing a metal ring against it to tighten and seal the fluororesin cable. This prevents the ingress of cutting oil through the cable lead section.



Oil-resistant
Photoelectric Sensors
E3ZR-C



In addition to cable sheaths, joints, and moving sections, cutting oil enters most easily in gaps between different materials. OMRON's Oil-resistant Components completely block the ingress of cutting oil with a unique structure that does not allow the creation of gaps.

Smartclick Patented Smartclick Structure + O-ring



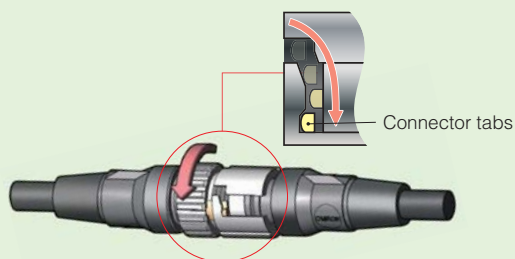
With traditional screw-tightened structures, differences in tightening torque made achieving oil resistance difficult. The Smartclick structure, however, locks in a single operation. The built-in O-ring at the lock position is dependably compressed to block the ingress of cutting oil. This structure eliminates the needs to manage screw tightening torque and prevents screw loosening due to vibration, which were issues in environments requiring oil resistance.

Smartclick is a registered trademark of OMRON Corporation.

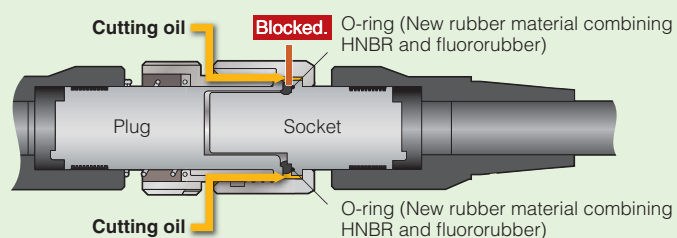


Oil-resistant Connectors XS5□R

Unique Smartclick Structure



O-ring Seal



Verification of Four-year^{*1} Oil Resistance

^{*1} Applicable oil types: specified in JIS K 2241:2000

OMRON's Unique **Evaluation Technology**

Patent Pending

Accelerated Evaluation
Tests with Failure Mode

Verification of 4-Year Oil Resistance Based on IP67G^{*2} and OMRON's Oil-resistant Component Evaluation Standards

OMRON's Environment-resistant Series Oil-resistant Components have been evaluated according to IP67G of JIS C 0920^{*2} as well as according to the strict evaluation standards for OMRON's oil-resistant components.

Test Conditions

Oil-drop Test



(Illustration)

Test Conditions

Oil Immersion



(Illustration)

Oil Resistance: **4 years**

3 years

2 years

1 year

| IP67G ^{*2} | |
|------------------------|----------------------------------|
| Oil type | N3 (water-insoluble cutting oil) |
| Evaluation time | 48 hours |
| Evaluation temperature | Room temperature |
| Dilution concentration | — |
| Criteria | Appearance and performance |

OMRON's Oil-resistant Component Evaluation Standards

| | |
|------------------------|---|
| Oil type | A1 (water-soluble cutting oil) |
| Evaluation time | 2,000 hours of machining ^{*3} 800 hours of conveyance ^{*4} |
| Evaluation temperature | 55°C |
| Dilution concentration | Undiluted |
| Criteria | Appearance, performance, and no labeling text loss |

^{*2} The IP67G is the degree of protection which is defined according to the JIS (Japanese Industrial Standards).

The IP67 indicates the same level of protection as defined by the IEC, and the G indicates that a device has resistance to oil.

^{*3} This is the evaluation time for products for machining processes where the amount of splashing cutting oil is large. Target products: Oil-resistant Proximity Sensor E2ER/E2ERZ, Oil-resistant Limit Switch D4ER-□N, Oil-resistant Connector XS5□R, Oil-resistant Fiber Unit E32-T11NF

^{*4} This is the evaluation time for products for conveyance processes where the amount of splashing cutting oil is small. Target products: Oil-resistant Photoelectric Sensor E3ZR-C

Patent Pending

OMRON's Unique Accelerated Evaluation Tests with Failure Mode

To verify a four-year oil resistance, the most aggressive of the water-soluble cutting oils (A1) was used without dilution. (Normally, it is diluted 20 to 30 times with water.)

In addition, an environmental temperature^{*5} of 55°C, a temperature that is eight times as severe as room temperature, was used in a unique OMRON evaluation method that enables the verification of four-year oil resistance in a short period of time by analyzing failure caused by cutting oils and deriving the time until occurrence of the failure in the field and time until reproduction in accelerated testing linked with the failure state. (Because conveyance processes have less splashing of cutting oil than manufacturing processes, conveyance processes were evaluated for approximately 1/3 the time.)

Also, the criterion, no labeling text loss, was added so that laser-marked lot numbers can be accurately confirmed over the life of the product for reliable usage for four years.



| | |
|------------------------|--------------------------------|
| Test oil | A1 (water-soluble cutting oil) |
| Evaluation time | 2,000 hours |
| Evaluation temperature | 55°C |
| Dilution concentration | Undiluted |

Note: The photograph shows
an E2ER Proximity Sensor.

^{*5} Deterioration proceeds twice as quickly for every 10°C increase in the ambient operating temperature (Arrhenius law). Therefore, a 30°C increase over room temperature (25°C) to an evaluation temperature of 55°C would make the evaluation eight times stricter.

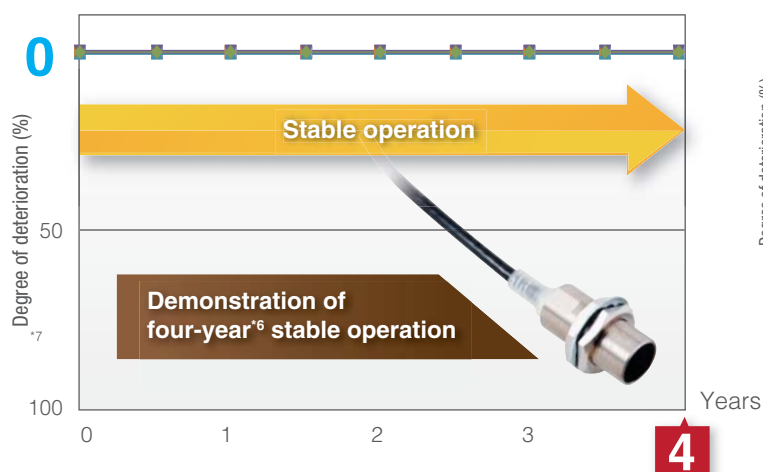
Four-year*⁶ Stable Operation Verified in Oil Resistance Testing with Representative Cutting Oils

Based on OMRON's oil-resistant component evaluation standards, we performed oil resistance testing with eight representative cutting oils that are used in manufacturing sites (see Table 1). In the results, the four-year*⁶ stable operation of the "Oil-resistant Components" was demonstrated, and the evaluation of oil resistance for four years was proven.

*6. Years in actual usage environment in OMRON's unique accelerated evaluation tests.

We offer the **reassurance of no failure for four years** on all these products.

Representative example: Oil-resistant Proximity Sensors E2ER/E2ERZ

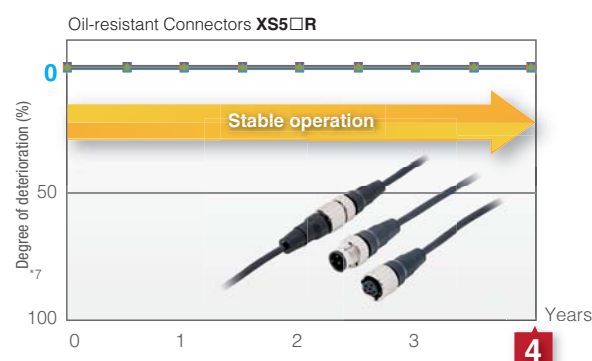
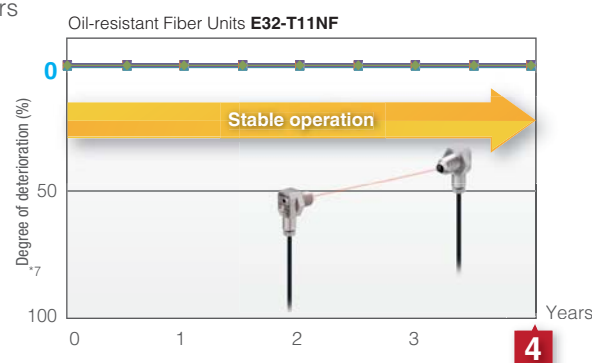
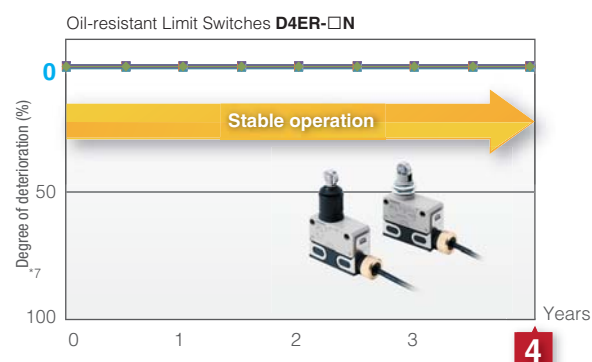


*7. The 0% degree of deterioration: a condition that meets OMRON's oil-resistant component evaluation standards

(Table 1)

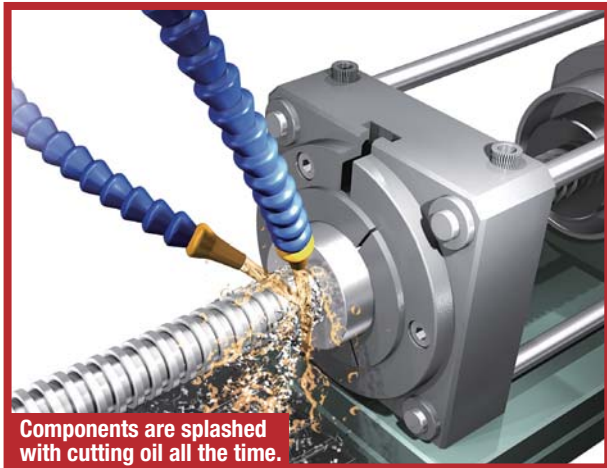
| Sample number | Test oil type | Oil | JIS classification | Kinetic viscosity (mm ² /s, 40°C) | pH ^{*8} |
|---------------|-----------------------------|---|--------------------|--|------------------|
| 1 | Water-soluble cutting oil | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A1 | — | 10.2 |
| 2 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A1 | — | 9.3 |
| 3 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A1 | — | 9.6 |
| 4 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A2 | — | 10.2 |
| 5 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A2 | — | 9.8 |
| 6 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | A3 | — | 10.1 |
| 7 | Water-insoluble cutting oil | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | N3 | 10 | — |
| 8 | | Yushiron Cut Abas KZ440 (manufactured by YUSHIRO CHEMICAL INDUSTRY CO., LTD.) | N4 | 19 | — |

*8. pH values recommended by the cutting oil manufacturer are listed.



Select a product that suits your application

Product Lineup



| Product name / model | Applicable processes | | Sensing distance |
|---|----------------------|--------------------|---|
| | Machining process | Conveyance process | |
| Oil-resistant Limit Switches D4ER-□N  | Yes | Yes | 0 mm |
| Oil-resistant Proximity Sensors E2ER/E2ERZ  | Yes | Yes | <div> <div></div> 2 mm (M8) <div></div> 3 mm (M12) <div></div> 7 mm (M18) <div></div> 10 mm (M30) *E2ER </div> |
| Oil-resistant Fiber Units E32-T11NF  | Yes | Yes | <div> <div></div> 4 m </div> |
| Oil-resistant Photoelectric Sensors E3ZR-C On sale soon  | — | Yes | <div> <div></div> 0.5 m (Diffuse-reflective Models) <div></div> 2.5 m (Retro-reflective Models) <div></div> 30 m (Through-beam Models) </div> |
| Oil-resistant Connectors XS5□R  | Yes | Yes | — |

Oil-resistant Proximity Sensors E2ER/E2ERZ

Proximity Sensors That Withstand Cutting Oil to Reduce Failures Caused by Ingress of Cutting Oil

- Fluororesin cable that withstands cutting oil.
- A sealing method that eliminates gaps at cable joints and the resin filling work together to block ingress of cutting oil.
- IP67G * degree of protection (JIS C 0920 Annex 1).

* The IP67G is the degree of protection which is defined according to the JIS (Japanese Industrial Standards). The IP67 indicates the same level of protection as defined by the IEC, and the G indicates that a device has resistance to oil.

CE



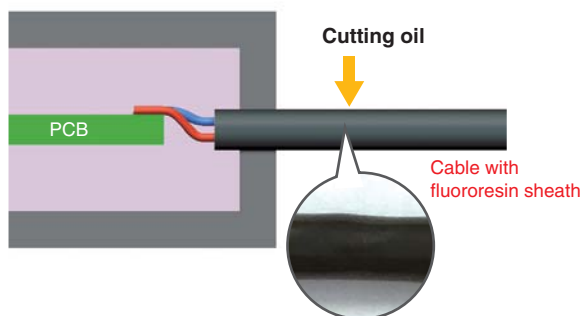
For the most recent information on models that have been certified for safety standards, refer to your OMRON website.

Features

Fluororesin Cable Sheath

Fluororesin, which is less likely to be deteriorated by either water-insoluble or water-soluble cutting oils, is used for the cable sheath. This prevents penetration of cutting oils into the cable.

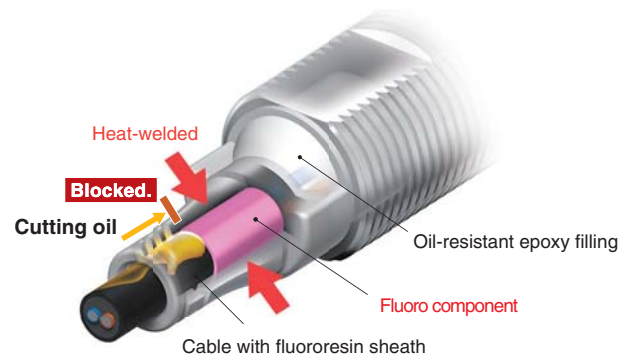
Fluororesin Sheath



Heat-Sealing Method

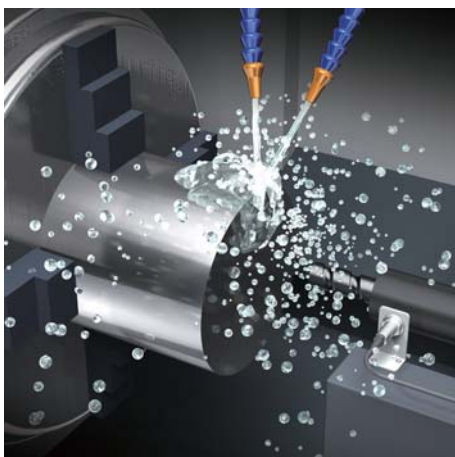
A fluororesin cable is heat-welded with a fluoro component which has a high bondability and a melting point close to that of the cable. This blocks the ingress of cutting oil from the joined surfaces.

Heat-welding Sealing



Applications

Detection of Cylinders



Detection of Cutting Workpieces



Oil-resistant Limit Switch

D4ER-□N

Even Better Oil Resistance Than D4E-N Switches

- Material combining HNBR and fluororubber used for superior resistance to oil.
Prevents ingress of cutting oil from moving sections.
- Fluororesin cable that withstands cutting oils is provided as standard.
- Models available with Smartclick connectors for easy connection.
- Minute load model with gold cladding is optimal for electronic control.
- Approved by EN (TÜV).
- Same mounting pitch as D4E-N Switches.
- IP67G degree of protection (JIS C 0920 Annex 1). *



For the most recent information on models that have been certified for safety standards, refer to your OMRON website.

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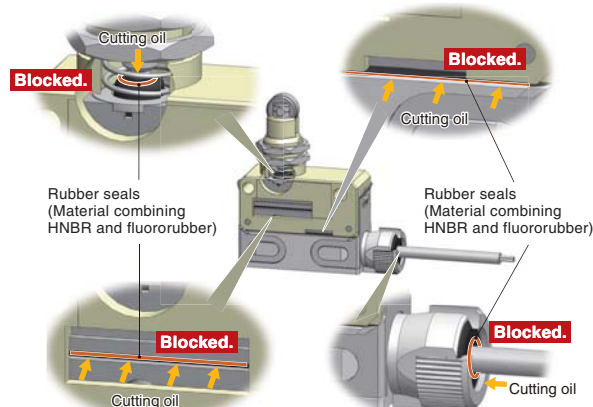
Features

Material Combining HNBR and Fluororubber for Superior Resistance to Oil

Moving sections are protected from ingress of cutting oil.

Important Sealing Sections for Moving Parts

New Rubber Material



Fluororesin Cable Provided as Standard to Withstand Cutting Oils

Fluororesin Sheath

In addition to prewired models, models are also available with prewired Smartclick connectors for easy connection.

Cable type

Pre-wired Connector type



Applications

Table Overrun Detection

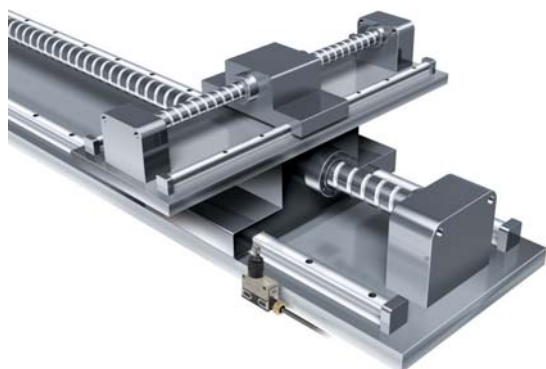


Table Position Detection



Oil-resistant Fiber Unit E32-T11NF

Fiber Units for Reliable, Stable Operation in Cutting Oil Environments

- Fluororesin cable and glass lens that withstand cutting oil.
- Mechanical seal structure that eliminates gaps works together with resin filling to block ingress of cutting oil.
- Maintains high-power output for stable workpiece detection even when covered in cutting oil.
- IP68G * degree of protection (JIS C 0920 Annex 1).

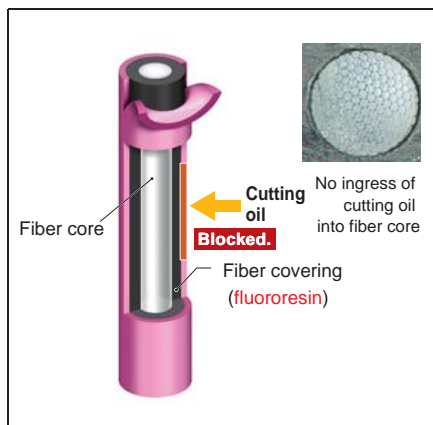
* The IP68G is the degree of protection which is defined according to the JIS (Japanese Industrial Standards).
The IP68 indicates the same level of protection as defined by the IEC, and the G indicates that a device has resistance to oil.



Features

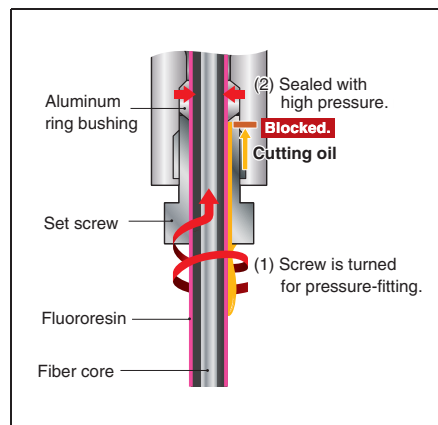
Fluororesin Cable Sheath

The fluororesin that covers the entire surface of the cable sheath (fiber covering) prevents the penetration of cutting oil.

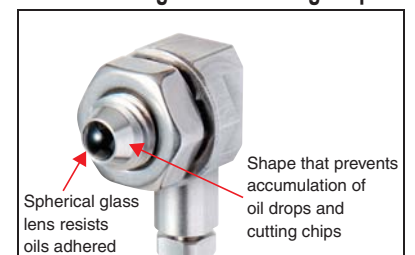


Mechanical Seal Structure

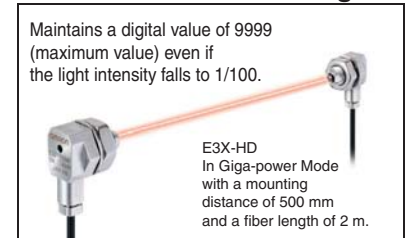
An aluminum ring bushing is compressed and deformed by a set screw to seal the structure by pressing against the fluororesin part of the fiber core. This prevents the ingress of cutting oil from the joined surfaces.



Structure Around Sensing Surface Also Resists Cutting Oil and Cutting Chips

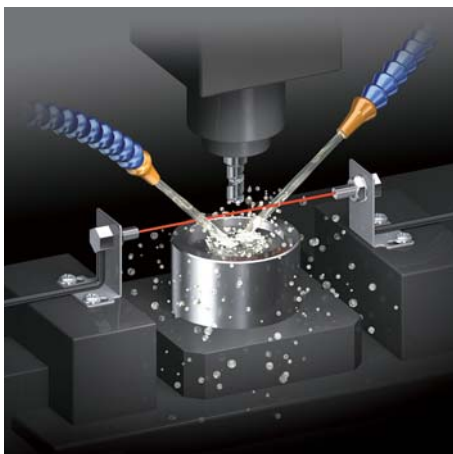


High-power Output Even When Covered in Cutting Oil

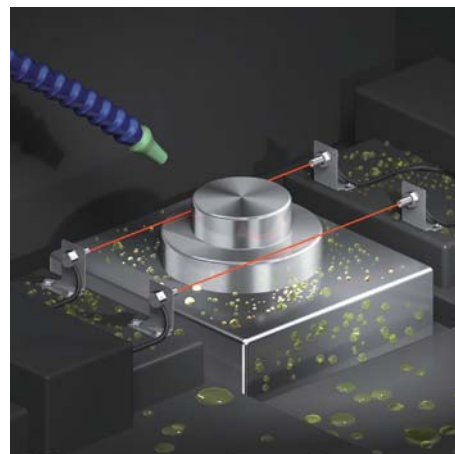


Applications

Detection of Drill Breakage



Detection of Cutting Workpieces



Oil-resistant Connectors

XS5□R

Smartclick Oil-resistant Connectors with Improved Oil Resistance

- Fluororesin cable that withstands cutting oil.
- Structured to provide greater oil resistance.
- A newly developed lock mechanism that is compatible with round M12 connectors.
- Simply insert the Connectors, then turn them approx. 1/8 of a turn to complete the connection and block the ingress of cutting oil.
- A positive click indicates locking.
- IP67G degree of protection (JIS C 0920 Annex 1). *



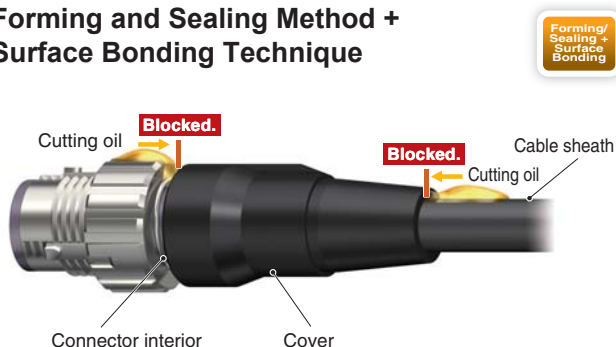
* The IP67G is the degree of protection which is defined according to the JIS (Japanese Industrial Standards). The IP67 indicates the same level of protection as defined by the IEC, and the G indicates that a device has resistance to oil.

Features

Fluororesin Cable and Structure to Increase Oil Resistance

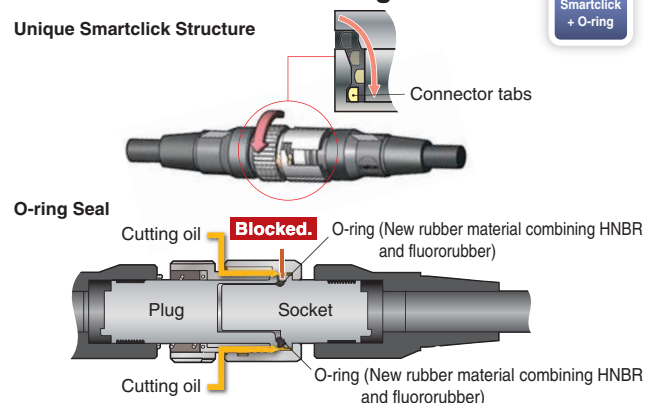
Fluororesin, which suppresses deterioration by either water-insoluble or water-soluble cutting oils, is used for the cable sheath. Ingress from the joined surfaces is prevented by unique OMRON technology that combines forming and sealing methods with surface bonding techniques. Ingress between Connectors is prevented by the unique Smartclick mechanism.

Forming and Sealing Method + Surface Bonding Technique



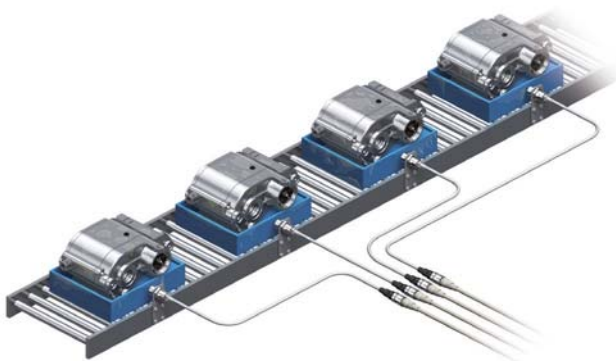
Smartclick Structure + O-ring

Unique Smartclick Structure



Application

Replacement of Sensors and Wiring

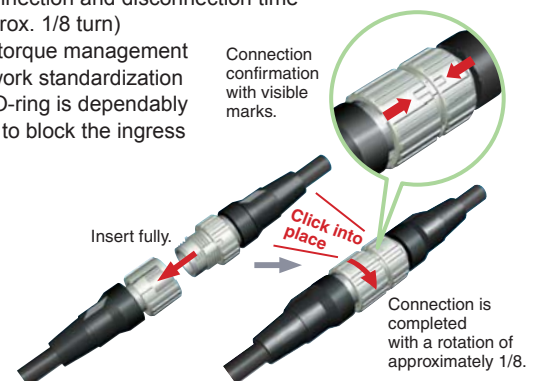


Benefits of Using Connectors:

- Less wiring work in comparison with connecting discrete wires to terminal blocks
- No wiring mistakes

Additional Benefits of Using Smartclick Connectors:

- Reduced connection and disconnection time (1 click, approx. 1/8 turn)
- No need for torque management to facilitate work standardization
- The built-in O-ring is dependably compressed to block the ingress of cutting oil.



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