

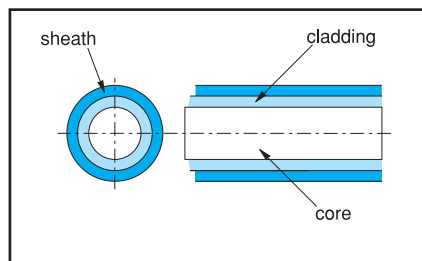
Optical fibre switches

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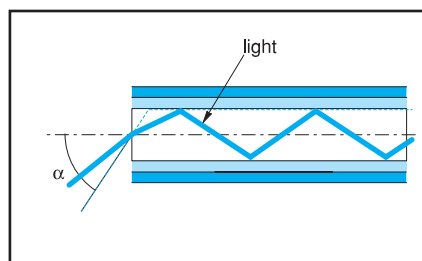
Structure of an optical fibre and operating principle

An optical fibre consists of:

- a core, through which the light propagates,
- a cladding that ensures reflection of the light and keeps it within the core,
- a sheath that serves to protect the actual fibre itself from the outside environment.



The light travelling inside the fibre is reflected by the surface separating the core from the cladding since the refractive index of the core is greater than that of the cladding. In order that a ray might enter the fibre, it is necessary that it reach the surface of the fibre with an angle of incidence lower than the critical angle α , angle beyond which the rays enter the cladding and are scattered onto the protective covering.



M.D. optical fibres can be divided into two groups according to the material utilised for the core: plastic optical fibres and glass optical fibres.

Plastic optical fibres

Ultrathin (core $\varnothing 0.5$ mm):

- 1) CF Series, "uncuttable" fibre with standard metal connection $\varnothing 2.2$ mm.

Long distance (core $\varnothing 1$ mm) Standard:

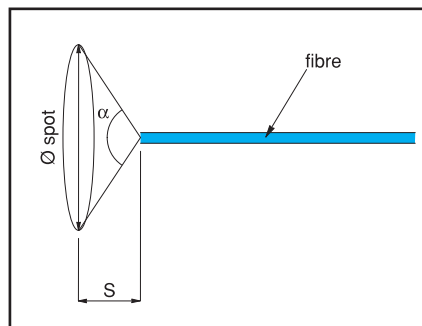
- 1) Plastic fibre Sectional: fibre by the metre (AF-1S) $\varnothing 2.2$ mm + AF Accessories.
- 2) CF Series, fibre "cuttable" $\varnothing 2.2$ mm.
- 3) Standard: OF Series, "uncuttable" fibre, with special connection for MSF amplifier.

Glass fibre

High Temperature (core $\varnothing 1$ mm multicore) covered with stainless steel sheath, standard metal connection $\varnothing 2.2$ mm.

Acceptance angle

The acceptance angle is the angle inside which a light ray is accepted by the fibre; it is also the angle with which the light is discharged from the fibre. Such angle therefore gives us the size of the spot generated by a fibre photocell.



$$\varnothing_{\text{spot}} = 2 \times S \times \tan \alpha \left(\frac{\alpha}{2} \right) = 1.3 \times S$$

For M.D. plastic fibres the opening angle is 60° ; whilst for glass fibres it is 70° .

Attenuation

Attenuation is the reduction in signal power that will depend on the length of the fibre. Such parameter must be considered if using AF-1S fibre by the metre or if fibres are required whose length is greater than the standard size.

The operating distances quoted in the catalogue have been measured using a fibre of length 2m (2m fibre emission + 2m fibre reception).

As a rule, when using fibres in projector/receiver mode there is a reduction in range of about 2-3% for every additional metre of fibre on the receiver or emitter.

When using fibres with diffuse reflection there is a reduction in range of about 5-6% for every additional metre of fibre (emitter + receiver)

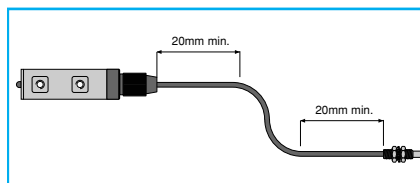
Cuttable Fibres

M.D. plastic fibres with 1 mm dia. core can be cut to size using the AF/C 5-hole cutter (supplied). It is imperative that cutting be carried out in the correct manner in order to obtain optimum performance from the fibre:

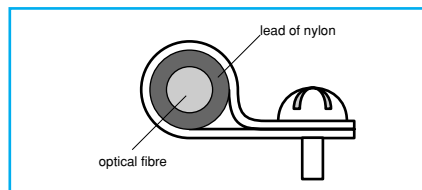
- insert the fibre into one of the holes of the cutter that have not been used, as far as the desired length and lower the blade with a smooth progressive movement,
- do not use a hole more than once since this would increase the chances of obtaining an irregular cut that could cause a reduction in sensitivity.

Installation

- do not subject the fibres to a tractive force exceeding 3 kg.
- keep the radius of curvature as wide as possible (see paragraph - Radius of curvature)
- do not bend near the amplifier or termination



- secure the fibres using nylon fairleads or cable clamps in order to avoid exercising pressure that could deform the fibre



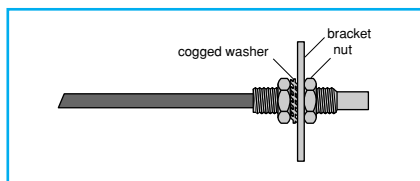
- fixing the threaded termination of the optical fibre: tighten the ring nut whilst respecting the following maximum torque wrench settings:

M7: 4.5 Nm

M6: 1.2 Nm

M4: 0.8 Nm

M3: 0.8 Nm



- fixing the smooth terminations of the optical fibre using a dowel: respecting the following maximum torque wrench settings:

$\varnothing = 3$ mm: 0.25 Nm

$\varnothing > 3$ mm: 0.5 Nm

- Inserting the fibre in the amplifier:

CF and CV Series: loosen the ring nuts on the fibre carriers, insert the two optical fibres in their special seats, push right down in order to overcome the resistance of the internal O-Ring, tighten the ring nuts securely.

OF Series: insert the special termination in the fibre-carrier seat of the MSF amplifier and tighten the ring nut securely.

Minimum radius of curvature of the fibre

When fitting a fibre it is important that the minimum radius of curvature be respected in order to avoid performance loss or even breakage.

- plastic fibre with core dia. 0.5mm: $R_{\text{min}} = 5$ mm

- plastic fibre with core dia. 1mm: $R_{\text{min}} = 10$ mm

- glass fibre with core dia. 1mm: $R_{\text{min}} = 30$ mm

Bending of mouldable terminations (with sleeve)

In the case of mouldable terminations, bend them with as wide a radius of curvature as possible and in any event no lower than the values indicated below.

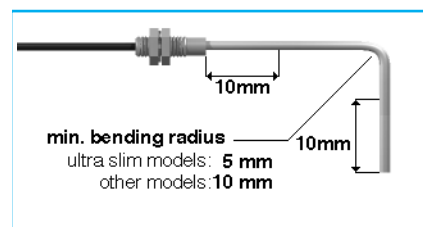
- plastic fibre with core $\varnothing 0.5$ mm:

$R_{\text{min}} = 5$ mm

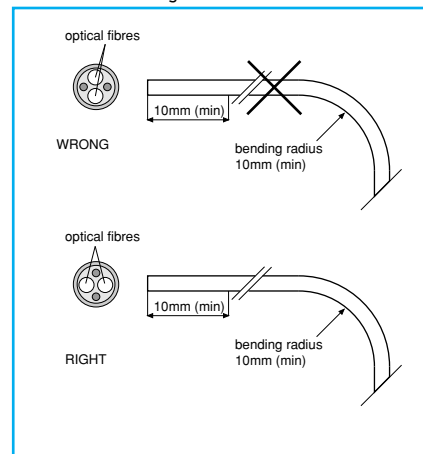
- plastic or glass fibre with core $\varnothing 1$ mm:

$R_{\text{min}} = 10$ mm

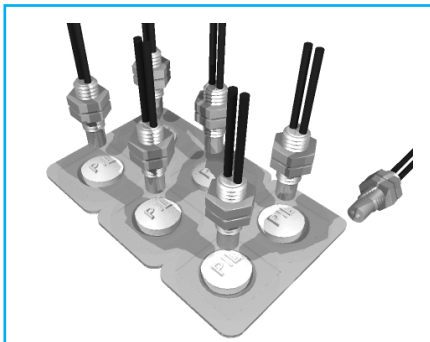
Bending of the termination should be carried out at a minimum distance of 10mm from the sensitive end.



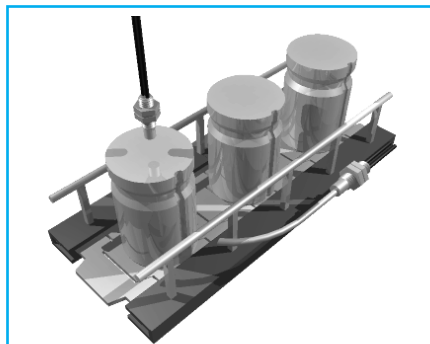
In the case of fibres with diffuse reflection, bend the termination whilst respecting the direction indicated in the figure.



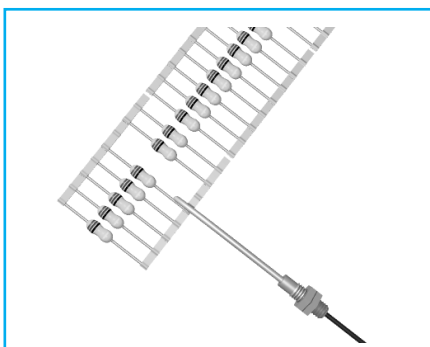
Applications



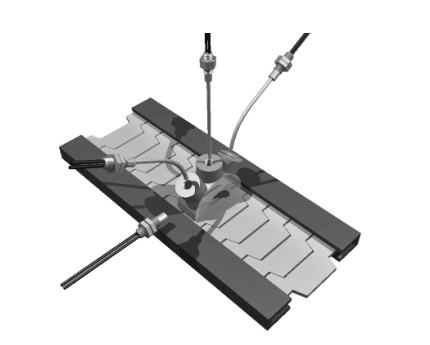
To control relining on blister and detect blisters.



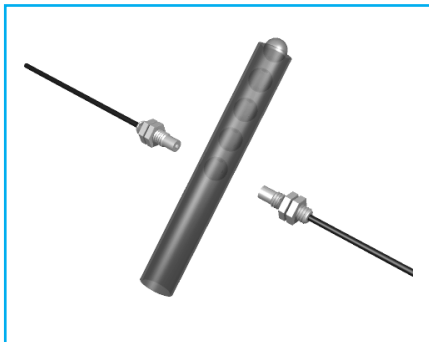
Detection of marks, even on metal parts.



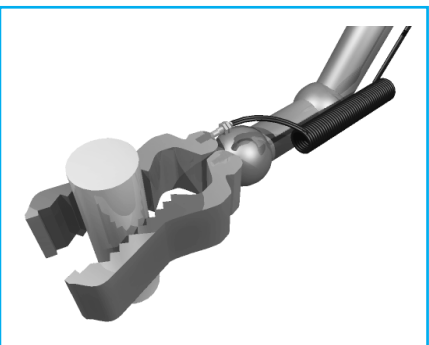
Counting resistors on a band.



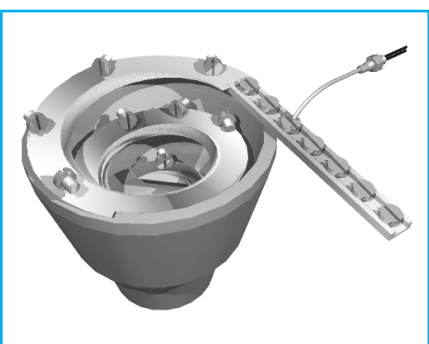
Detection of holes further to automatic processing



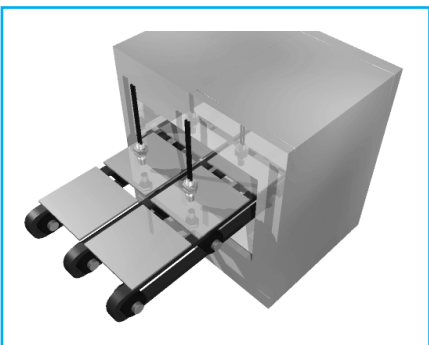
Counting small parts passing through semitransparent pipe.



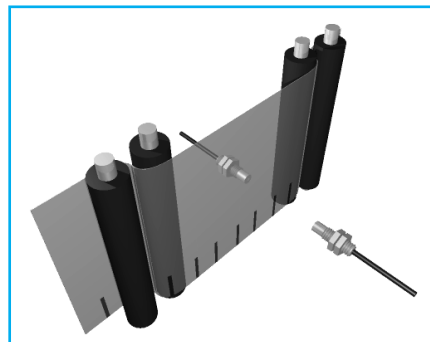
Controlling the presence of parts on handling tongs.



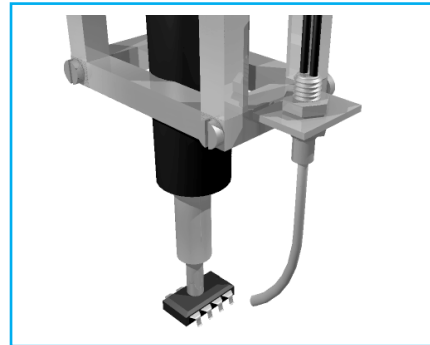
Counting thiny objects coming out from feeders.



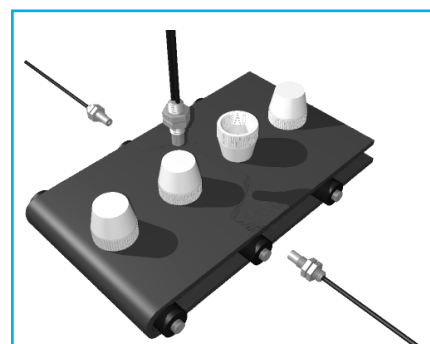
To detect presence of tiles coming out from ovens.



To detect marks on transparent films.



Controlling the pick-up of pieces on automations.

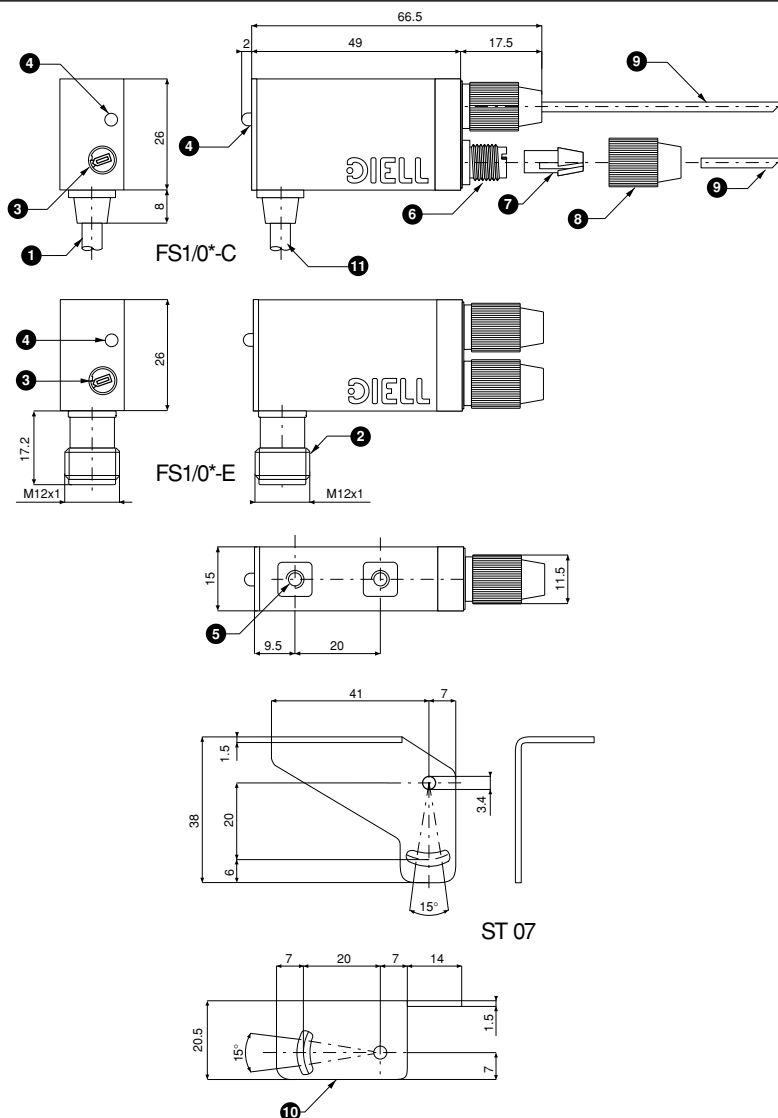


Control of capf positioning.

SERIE
FS1

**Miniature amplifier units
for optical fibres - DC**

- ◆ Extremely reduced dimensions amplifier units (only 49x26x15mm)
- ◆ Right angle cable exit or M12 plug cable exit for reducing the overall dimensions at minimum
- ◆ Trimmer for sensivity adjustment
- ◆ Advantageous price/performance ratio
- ◆ NPN or PNP outputs with selectable NO/NC
- ◆ Red light beam with visible spot
- ◆ Wide range of optical fibres (plastics and glass)
- ◆ LED status indicator
- ◆ IP65 protection degree
- ◆ Complete protection against electrical damage
- ◆ Fixing with M4 screws (2xM4, 20mm step)


DIMENSIONAL DRAWING

Key

- | | |
|---------------------------------------|--|
| 1 Right angle cable exit | 7 Fibre clamping |
| 2 M12 standard plug cable exit | 8 Locking ring nut |
| 3 Sensivity adjustment trimmer | 9 Optical fibre |
| 4 Red LED status indicator | 10 Nickel-plated iron mounting bracket ST 07 (included) |
| 5 Holes for M4 mounting screws | 11 Cable 4x0,34mm ² , Ø4,7mm, PVC, 2m |
| 6 Fibre lock slot with sealing O-ring | Connectors CD serie |
| | Accessories ST serie |

ORDERING SYSTEM

serie	F S 1	/	O N	-	C	diffuse - through beam
amplifier unit for optical fibres	FS1					cable exit
output state					C	right angle cable exit
NO/NC output selectable			0		E	M12 plug cable exit
					N	output type
					P	NPN output
						PNP output

SPECIFICATIONS

Model	FS1/0*-*
Nominal sensing distance (Sn)	see optical fibres table
Emission	red (660nm)
Operating voltage	10-30Vdc
Ripple	≤10%
No-load supply current	30mA
Load current	100mA
Voltage drop	1,2Vmax.
Output type	NPN or PNP NO/NC selectable
Switching frequency	1KHz
Time delay before availability	200ms
Supply electrical protections	polarity reversal, transient
Output electrical protections	short circuit (autoreset)
Sensitivity adjustment	1 turn trimmer
Temperature range	-25°...+70°C (without freeze)
Interference to external light	3000 lux (incandescent lamp), 10000 lux (sunlight)
Protection degree (DIN 40 050)	IEC IP65
LED indicators	Red (output NO energized)
Housing material	polyamide
Weight (approx.)	90g single unit (20g mount bracket)

OPTICAL FIBRES TABLE

	model ⁽¹⁾	type	sensing distance	Ø fibre (core)	free-cut	fibre length ⁽²⁾	head shape (mm)
Ultra-stim	CF/CA2-**	diffuse reflection	15 mm	0,5mm	no	0,5-1 m	M4
	CF/CA4-**	diffuse reflection	15 mm	0,5mm	no	0,5-1 m	M4 with sleeve
	CF/RA4-**	through-beam	30 mm	0,5mm	no	0,5-1 m	M4 with sleeve
	CF/RA7-**	through-beam	30 mm	0,5mm	no	0,5-1 m	M3
Long Distances	CF/CB1-**	diffuse reflection	50 mm	1mm	yes	1-2 m	M6
	CF/CB3-**	diffuse reflection	50 mm	1mm	yes	1-2 m	M6 with sleeve
	CF/RB4-**	through-beam	120 mm	1mm	yes	1-2 m	M4 with sleeve
	CF/RB6-**	through-beam	120 mm	1mm	yes	1-2 m	M4
	CF/RB9-**	through-beam	1200 mm	1mm	yes	1-2 m	Ø6 with lens
	CF/RBA-**	through-beam	1200 mm	1mm	yes	1-2 m	M7 with lens
Spiral tube	CF/CC1-20	diffuse reflection	15 mm	1mm	no	2 m	M6
	CF/RC6-20	through-beam	100 mm	1mm	no	2 m	M4
	CF/RC9-20	through-beam	1000 mm	1mm	no	2 m	Ø6 with lens
	CF/RCA-20	through-beam	1000 mm	1mm	no	2 m	M7 with lens
Glass (H.I.)	CV/CB1-**	diffuse reflection	50 mm	1mm	no	1-2 m	M4
	CV/CB3-**	diffuse reflection	50 mm	1mm	no	1-2 m	M4 with sleeve
	CV/RB4-**	through-beam	90 mm	1mm	no	1-2 m	M4 with sleeve
	CV/RB6-**	through-beam	90 mm	1mm	no	1-2 m	M4

(1) The last two bits of the code show the fiber length (in dm) - (2) Standard length. Special lengths are available on request. See CF-CV-AF series

WIRING DIAGRAMS

NPN output	PNP output
Maximum admissible capacity C=0,2µF, for maximum output voltage and current. Indications NO and NC are referred to the diffuse reflection optical fibres (on target absence). For retro-reflective and through-beam models the indication NO to be replaced by NC and NC becomes NO.	

CONNECTORS

M12 (E type)