Part 9:
How the water detector works

Water detector: optical sensor E9/125

General

- **The water detector (optical sensor E9/125 ITU-T G.652)** detects and pinpoints the source of water or chemicals leaks in closed cable joint boxes or water collecting tanks.
- An optical fibre is selected and inserted into optical sensor E9/125 for monitoring purposes. This may be done subsequent to the initial installation without any interruption of on-going processes.
- The optical sensor works on the basis that single mode optical fibres acc. to ITU-T G.652 are bending-sensitive.
- As soon as the target medium is detected, the optical sensor causes bending in the monitoring fibre, with a measurable increase of attenuation.
- Regular control checks of the route should be carried out at least once a month, to detect any deviation in relation to the reference measurements taken when the route was inspected for acceptance.
- This enables early detection of any increase of attenuation (e.g. alert given by the activated sensor) or other optical events.
- If the sensor has been activated, the cause of the problem can be dealt with and attenuation returns to normal.
- Networks with optical fibres acc. to ITU-T G.657 can be monitored after splicing a fibre loop with fibres acc. to ITU-T G.652 (length $\geq$ 0,3 m)

Monitoring

The optical fibre water detector can be used for monitoring as shown below:

Analyte: water mixtures pH 2-14

- From a relative humidity of > 70 %
- For water leaks pH 2-14
- Suitable for use in buildings (data-processing areas), at the welding points of insulated casing pipes, in tunnels, pits, hazardous areas
- Measuring signal trigger "pressed sponge"

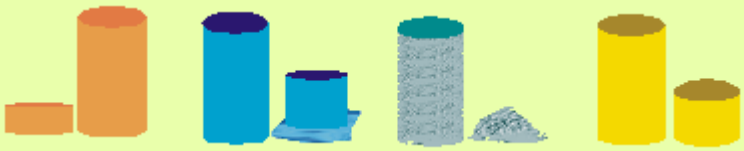
Analyte: > 10% acid or water mixtures

- In buildings, collecting tanks etc.
- The transmission paths used for monitoring are compatible with standard telecommunications installations (LAN and WLAN)
- Monitoring distances from several metres up to 80 km
- No electrical connections (no amplifiers)
- Suitable for EX and security areas in buildings
- Suitable for use in corrosive surroundings or electromagnetic areas

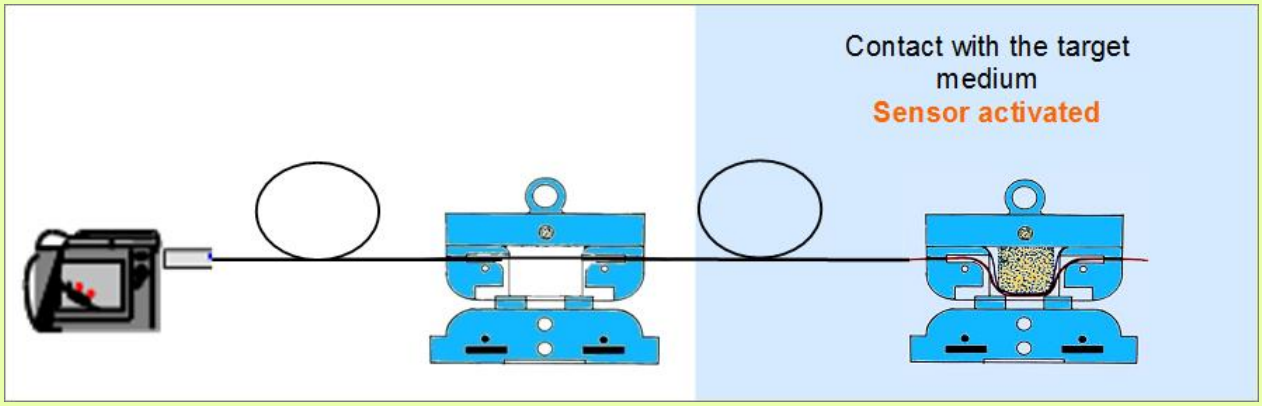
How the optical fibre sensor works

- The materials used in the sensor react to the target media to be detected. When the materials in the sensor (the measuring-signal trigger) come into contact with the target medium, their shape or properties change. For example, they may:

  expand disintegrate become brittle shrink

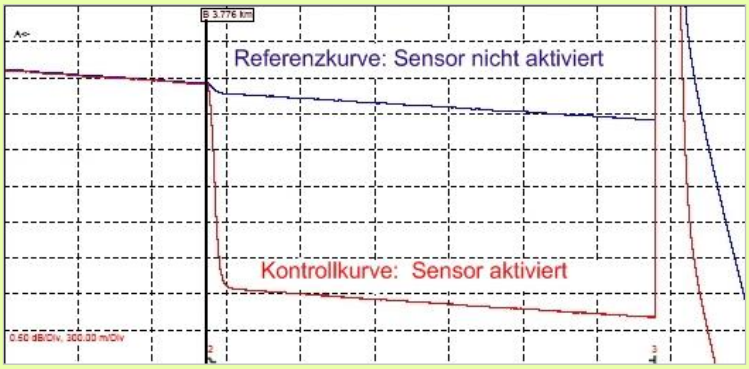


- Property changes in the signal transmitter then cause bending in the sensor (the single mode fibre E9/125 acc. to ITU-T G.652). This shows up in the control measurements carried out with the measuring instrument (OTDR) as a localised measurement of attenuation increase.
- A comparison of the control measurement with the reference measurement taken at acceptance indicates the degree of increase of attenuation.



Example:

OTDR trace showing increase of attenuation caused by activation of the optical water sensor



- An activated water sensor must be replaced and the fault corrected, to avoid fibre breakage. Depending on the type of water detector this can be done within 90 days or, in the case of waterdetector 44.3 WS-R and 44.4 WS-O shortly after activation.
- Optical sensors can be renewed without special tools and without any disturbance of network operation.

Why is single mode technology used in sensor technology?

Our monitoring systems make use of the bending sensitivity of single mode fibres.

Single-mode-fibre transmission

- Light-conductive area of fibres approx.10.5 µm at 1550 nm
- Power density 720 mW / mm² (laser class 3a)
- Output approx. 50 mW

The high power density and low attenuation of single mode fibres make transmission over long distances possible without amplification.

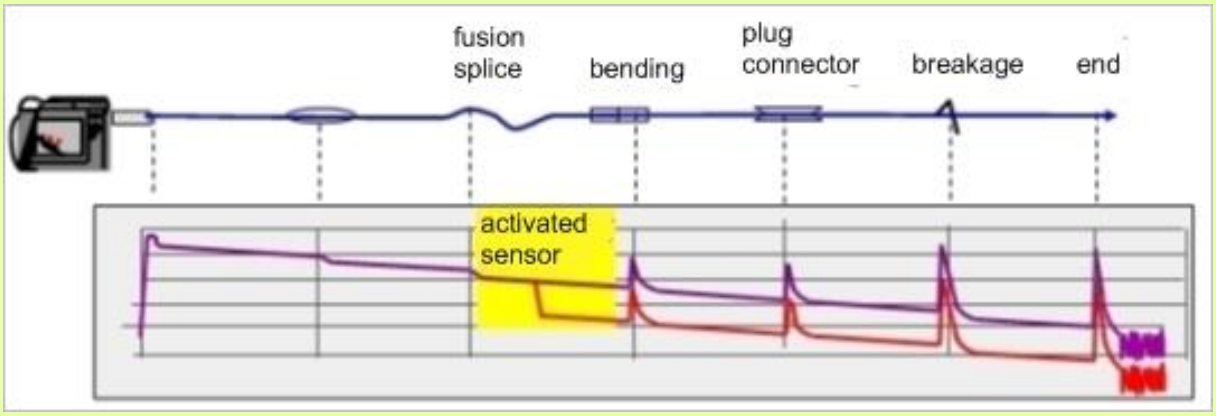
Detecting increases of attenuation

The OTDR uses "backscatter" technology to provide information about the properties of the optical fibre connection.

In other words:

- The laser transmitter of the OTDR sends out a light pulse to the optical fibre route.
- All the optical events along the route (splices, bends, plug connections etc) and the fibres themselves scatter part of the light pulse back to the OTDR.
- The OTDR receiver measures the backscattered pulse power.

- The route and the optical events on it (plug connectors, splices, bends, fibre ends) are shown on the OTDR display as a trace.



The diagram above shows a sensor inserted into the route without splicing.
The activated sensor appears on the trace as a non-reflecting event ("big fusion splice").

Monitoring options (examples)

Article No.	Fibre bending Ø in activated state/ Area of application	Features	Fault correction within	Monitoring options
44.1 WS-BO 	20 mm Bending-sensitive fibres e.g. G.652.A/B	With pulling eye. For clipping or screwing in. For standard splice cases.	90 days	Dark fibre test (not active)
44.1 WS-B 	20 mm Bending-sensitive fibres G.652.A/B	For glueing in. For all types of splice case.	90 days	
44.1 WS-B/K1 	20 mm Bending-insensitive fibres e.g G.657.A1/A2 G.657.B2/B3	For glueing in. For all kinds of splice case. Incl. 1 m fibre ring G.652.D for intermediate splicing.	90 days	
44.2 WS-G 	20 mm Bending-sensitive fibres G.652.D, G.657.A G.652.D	For glueing in. For all types of splice case. Causes greater attenuation than Art. No. 44.1 WS-BO / B	90 days	Dark fibre test (inactive) Active fibre test (active)

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