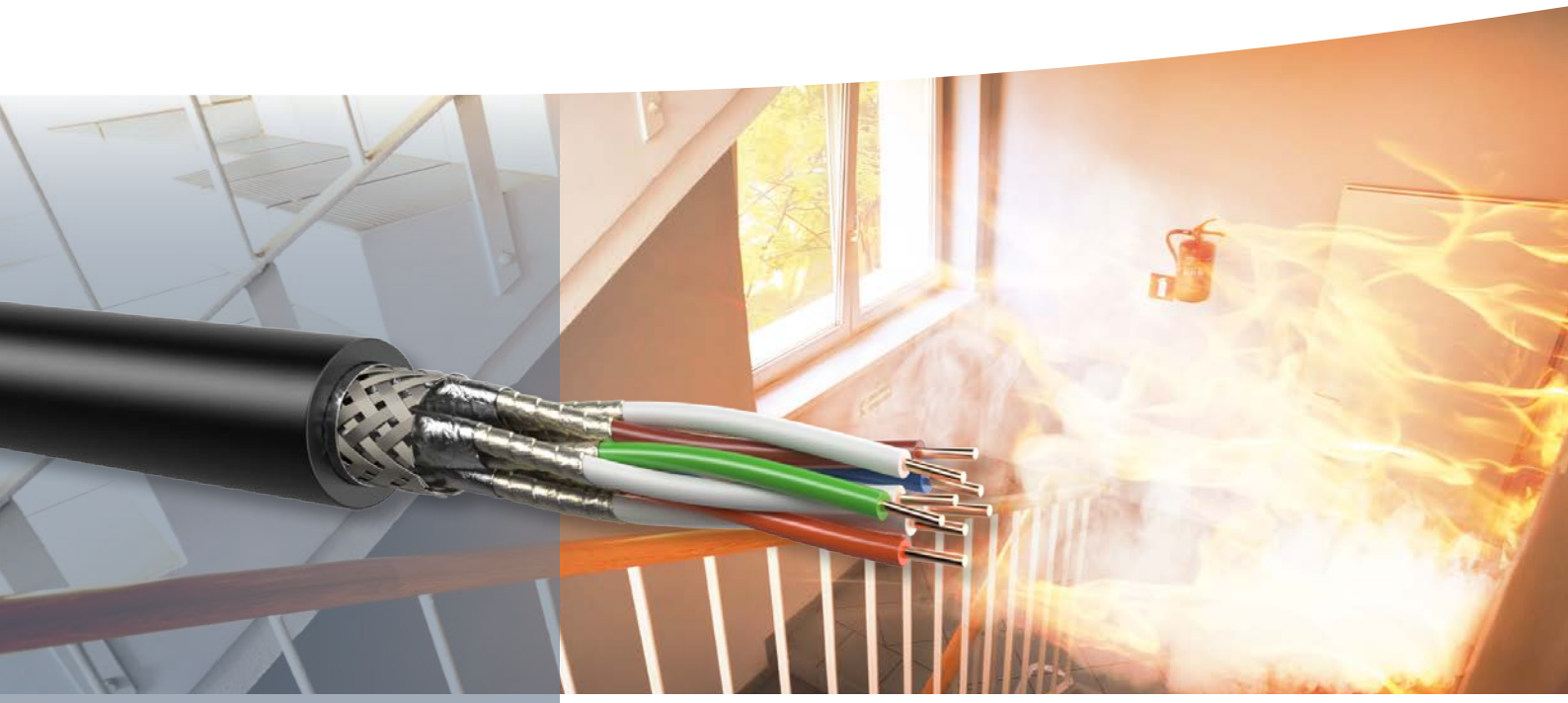
LEONI *productreport*

Data cable with resistance to fire 09/2017



Data cables with optimal reaction to fire and resistance to fire in case of fire

Fires are a Worldwide Problem

Around one-third of all fires occur within buildings. Often, only a few minutes are available to leave a burning building in safety before smoke emissions make finding one's bearings so difficult that escape routes can no longer be identified. It's therefore not surprising that gas and smoke poisoning are the leading causes of death. In addition to this, fire in a building causes considerable damage. This consists firstly of destroyed equipment and secondly of consequential damages such as downtimes or environmental damages.

Saving lives, impeding fires and minimising consequential damages are the priorities when fire breaks out in a building. Electrical and optical cables can and must also do their part in fire prevention, especially because cable density in modern buildings has increased in recent years. With fire prevention by cables there are two main safety goals. On the one hand it is about preventing or minimising the start of fires and flame propagation, as well as avoiding or inhibiting the development of smoke and creation of poisonous gases. This is a matter of reaction to fire. On the other hand, during a fire, critical energy and communication connections need to be maintained, in other words their functionality must be preserved within a specific length of time. This is a matter of fire resistance.

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What fire prevention requirements are there in buildings?

In accordance with the EU Construction Products Regulation 305/2011 structures must be designed so that in the event of a fire

a) the bearing capacity of the structure remains intact for a specific length of time;
b) the development and spread of fire and smoke within the building are limited;
c) the spread of fire to nearby structures is limited;
d) the residents of the structure can leave uninjured or be rescued by other measures;
e) the safety of rescue workers is taken into account.

Safety-related systems must maintain functionality in case of fire for an adequate length of time. This affects for example:

- Fire-fighting systems and water pump systems for provision of extinguishing water
- Smoke removal and heat extraction systems
- Emergency and safety lighting systems
- Personnel or rescue elevators with fire control systems
- Bed elevators in hospitals
- Control and supply of emergency systems
- Fire alarm, alarm and information systems for evacuation

How is the reaction to fire of cables defined?

The European standards EN 50575, EN 50399 and EN 13501-6 specify the reaction to fire requirements, the test procedures for behaviour in case of fire, and the classification of the test results. The safety goals are fulfilled by the testing and fulfilment of the following criteria:

- Flame propagation (H/FS): Classes A_{ca} (non inflammable) to F_{ca} (inflammable)
- Total thermal release (THR)
- Heat release rate (HRR)
- Fire growth rate (FIGRA)
- Smoke emission: s1 to s3
- Acid formation: a1 to a3
- Development of flaming droplets: d0 to d2

The Euro classes for reaction to fire are based on the fire risk or safety requirements of buildings. If there is a very high fire risk or safety requirement in a building (such as for example in hospitals, childcare facilities and in all escape routes) then the use of Class $B2_{ca}$ cables is recommended. In buildings with a high fire risk or safety requirement (such as hotels, schools, assembly locations) on the other hand, Class C_{ca} cables offer adequate protection (see Table 2).

Table 1: Reaction to fire requirements, Euro classes

Standard	Classification	A_{ca}	$B1_{ca}$	$B2_{ca}$	C_{ca}	D_{ca}	E_{ca}	F_{ca}
		EN ISO 1716	FIPEC Scen 2	FIPEC Scen 1	FIPEC Scen 1	FIPEC Scen 1	–	–
EN 60332	H (mm)	–	≤ 425	≤ 425	≤ 425	≤ 425	≤ 425	–
EN 50399	FS (m)	–	≤ 1.75	≤ 1.5	≤ 2.0	–	–	–
EN 50399	THR (MJ)	–	≤ 10	≤ 15	≤ 30	≤ 70	–	–
EN 50399	HRR (kW)	–	≤ 20	≤ 30	≤ 60	≤ 400	–	–
EN 50399	FIGRA (W/s)	–	≤ 120	≤ 150	≤ 300	≤ 1300	–	–
	additional classification							
EN 61034	Smoke production	–	s1a, s1b, s1, s2, s3	s1a, s1b, s1, s2, s3	s1a, s1b, s1, s2, s3	s1a, s1b, s1, s2, s3	–	–
EN 60754-2	Acid formation	–	a1, a2, a3	a1, a2, a3	a1, a2, a3	a1, a2, a3	–	–
EN 50399	Flaming droplets	–	d0, d1, d2	d0, d1, d2	d0, d1, d2	d0, d1, d2	–	–

Table 2: The ZEVI recommendation on the Euro class of low fire-hazard cables to be used depends on the safety requirement in buildings

Euro classes Flame propagation Heat development	Smoke development / smoke density	**Additional classes** Flaming droplets	Acid formation / Corrosivity	**Safety requirement in the building**
A_{ca}	–	–	–	very high
$B1_{ca}$	–	–	–	very high
$B2_{ca}$	s1	d1	a1	very high
C_{ca}	s1	d1	a1	high
D_{ca}	s2	d2	a1	moderate
E_{ca}	–	–	–	low
F_{ca}	–	–	–	none

How is the fire resistance or resistance to fire of cables defined?

For energy cables fire resistance or resistance to fire is defined as the preservation of insulation during a defined time period. Insulation integrity ensures that the energy cable maintains voltage and power distribution even during a fire.

As well as the maintenance of insulation integrity (puncture resistance), for data cables the transmission properties in accordance with EN 50289-4-16 must also be ensured. The resistance to fire of data cables in accordance with EN 50289-4-16 (see Table 3) is specified or classified based on permitted changes in the attenuation, return loss and NEXT at the stated maximum frequency. However the standard writers emphasise that this is not able to cover all fire scenarios, and additional agreements are required between the customer and manufacturer if system requirements demand other limit values for these characteristics.

For the evaluation or classification of the resistance to fire, EN 50289-4-16 provides for two different fire facilities:

a) in accordance with EN 50200: PH cable classification or
b) in accordance with EN 50577: P cable classification in reference cable routing systems. This standard has only recently been released. There are not yet any plausible and secured test results available.

During exposure to fire, the parameters listed in Table 3 must be monitored and recorded at regular intervals. The resistance to fire at high frequencies is maintained if the transmission properties at the maximum frequency listed in Table 3 remains within the specified limit values. According to this, a data cable with PH 120 classification is a data cable that fulfilled the requirements for at least 120 minutes during a fire test in accordance with EN 50200.

Table 3: Requirements for the insulation and resistance to fire of data cables (excerpt from EN 50289-4-16)

Maximum frequency	**High frequency characteristics**	**Requirements for resistance to fire**
< 100 KHz	Puncture resistance Capacity	No short circuit, DC 100 V AC 70 V Max. Difference < 30 %
> 100 KHz < 100 MHz	Puncture resistance Capacity NEXT	No short circuit, DC 100 V AC 70 V Max. Difference < 12.5 % > 26-15 Log10 (f/10) dB, 1 to 10 MHz
> 100 MHz < 1000 MHz	Puncture resistance Attenuation return loss NEXT	No short circuit, DC 100 V AC 70 V Max. Difference < 12.5 % > 8 dB > 26-15 Log10 (f/10) dB, 1 to 10 MHz

Table 4: Classes for the resistance to fire in accordance with EN 50200 and EN 50277

Classes of resistance to fire EN 50200	**Classes of resistance to fire EN 50577**	**Resistance to fire maintained up to**
PH15	**P15**	15 minutes or more
PH30	**P30**	30 minutes or more
PH60	**P60**	60 minutes or more
PH90	**P90**	90 minutes or more
PH120	**P120**	120 minutes or more

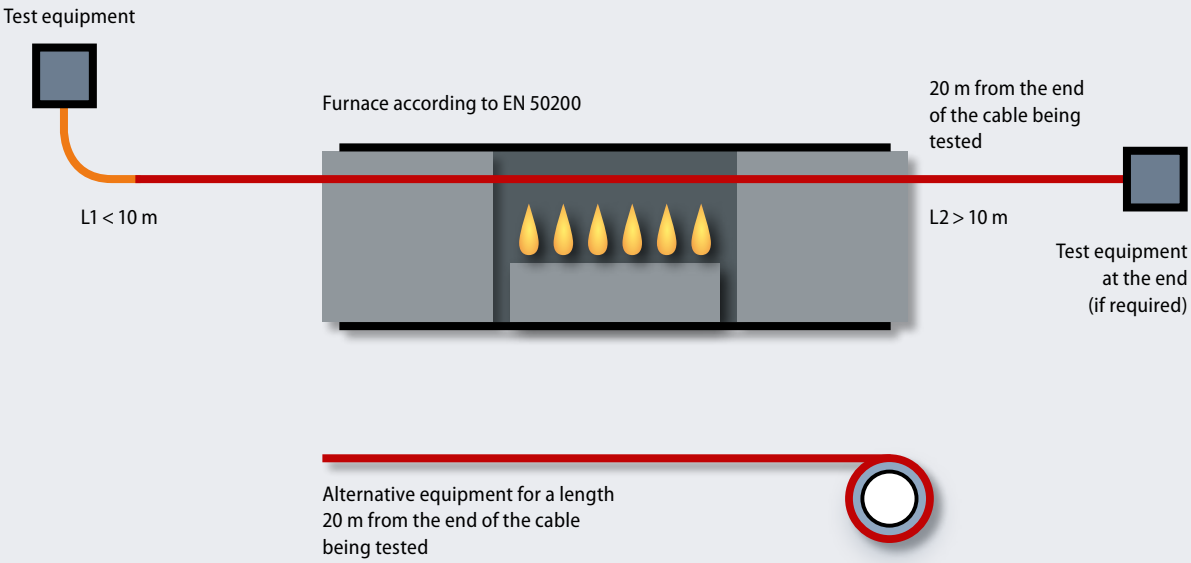

Fig. 1: Test equipment in accordance with EN 50200

Data cables with optimal reaction to fire and resistance to fire in case of fire

LEONI MegaLine® data cable without resistance to fire

As standard, LEONI MegaLine® data cables that fall under the EU Construction Products Regulation 305/2011 are tested and declared as class D_{ca} s2, d2, a1.

As well as this, for buildings with high and very high fire risk, or high and very high safety requirements, there are improved low fire-hazard cables available:
LEONI MegaLine® class C_{ca} s1, d1, a1
LEONI MegaLine® class $B2_{ca}$ s1a, d1, a1

For more information see the folder "Fire Protection Cable in Accordance with the EU Construction Products Regulation"

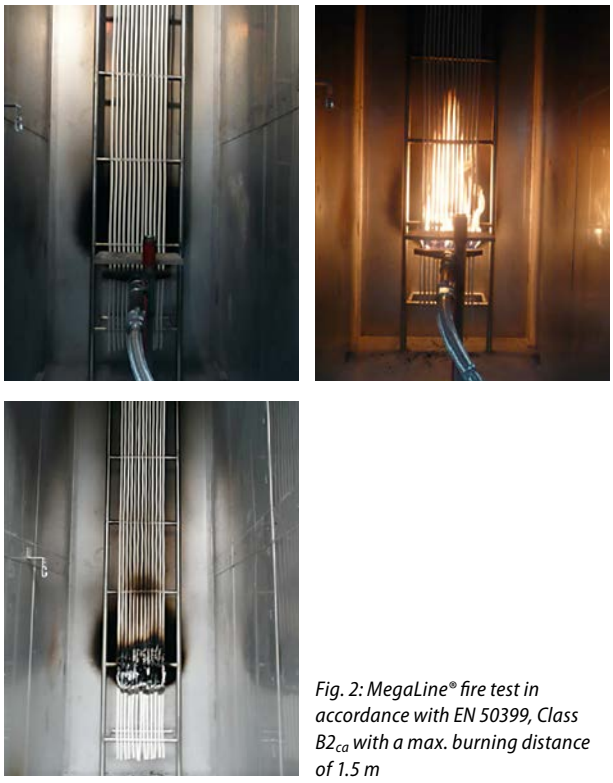

Fig. 2: MegaLine® fire test in accordance with EN 50399, Class $B2_{ca}$ with a max. burning distance of 1.5 m

LEONI MegaLine® Circuit Integrity data cable with resistance to fire

Efficient IT infrastructure is the backbone of modern industrial and service companies. There are high demands placed on the functional reliability of communication equipment. Downtimes can lead to significant economic damages, and in the case of fire even endanger lives. The use of new flame-retardant and reduced smoke gas emission data cables with resistance to fire in the case of fire can minimise or even prevent risk potential in critical IT facilities within buildings.

The data cable range with resistance to fire, which was originally developed for ships or offshore facilities and is certified by DNVGL, is now being expanded for use in buildings and construction. With MegaLine® Circuit Integrity, LEONI offers a high-quality, fire-proof safety cable, which in the case of a fire more than complies with the permitted deviations in regular operation according to EN 50289-4-16 for up to 120 minutes, or up to 180 minutes.

For example the MegaLine® F6-90 S/F CI is a 4-pair fire-proof data cable, which generally (before fire exposure) is a Category 7 (600 MHz) cable in accordance with IEC 61156-5 and EN 50288-4-1. After fire exposure (in accordance with EN 50200) of 120 minutes, the attenuation, return loss and NEXT are within the limit values permitted by EN 50289-4-16. This results in a PH120 classification, which makes it possible to maintain emergency data operation for 120 minutes.

Fig. 3: MegaLine® F6-90 S/F CI with resistance to fire of Category 7 in accordance with EN 50289-4-16 for 120 minutes (PH120 classification). Alternative sheath colour, e.g. orange, on request

Fig. 4: Fire testing of the MegaLine® F6-90 S/F CI cables with resistance to fire, in accordance with EN 50289-4-16

Länge (m), Grnz. 100.0	[Paar 36]	89.9
Laufzeit (ns), Grnz. 555	[Paar 12]	442
Abweichung (ns), Grnz. 50	[Paar 12]	1
Widerstand (Ohm)	[Paar 45]	11.4
Einfüg.-Dämpf. Reserve (dB)	[Paar 78]	3.2
Frequenz (MHz)	[Paar 78]	500.0
Grenzwert (dB)	[Paar 78]	49.3

	Min. Abstand		Min. Wert	
PASS	MAIN	SR	MAIN	SR
Schlechtest Paar	12-78	12-78	36-45	36-45
NEXT (dB)	8.7	9.4	20.1	23.1
Freq. (MHz)	3.0	2.9	490.0	493.0
Grenzwert (dB)	65.0	65.0	26.3	26.3
Schlechtest Paar	12	12	36	36
PS NEXT (dB)	8.2	9.3	22.5	25.5
Freq. (MHz)	3.3	3.3	490.0	493.0
Grenzwert (dB)	62.0	62.0	23.5	23.4

PASS	MAIN	SR	MAIN	SR
Schlechtest Paar	36-78	36-78	36-78	36-78
ACR-F (dB)	4.0	4.6	4.1	4.9
Freq. (MHz)	467.0	417.0	497.0	491.0
Grenzwert (dB)	9.9	10.9	9.3	9.4
Schlechtest Paar	78	36	78	36
PS ACR-F (dB)	5.8	6.6	5.8	6.7
Freq. (MHz)	467.0	486.0	500.0	500.0
Grenzwert (dB)	6.9	6.5	6.3	6.3

N.A.	MAIN	SR	MAIN	SR
Schlechtest Paar	12-78	12-78	36-45	36-78
ACR-N (dB)	9.6	10.3	29.0	30.7
Freq. (MHz)	3.0	2.9	490.0	486.0
Grenzwert (dB)	61.4	61.4	-22.4	-22.1
Schlechtest Paar	12	12	36	36
PS ACR-N (dB)	9.2	10.2	30.0	32.9
Freq. (MHz)	3.3	3.4	490.0	493.0
Grenzwert (dB)	58.2	57.9	-25.3	-25.5

PASS	MAIN	SR	MAIN	SR
Schlechtest Paar	12	12	78	78
RL (dB)	11.4	12.0	14.7	15.5
Freq. (MHz)	105.5	105.5	282.0	274.0
Grenzwert (dB)	11.8	11.8	7.5	7.6

Erfüllte Network Standards:

10BASE-T	100BASE-TX	100BASE-T4
1000BASE-T	10GBASE-T	ATM-25
ATM-51	ATM-155	100VG-AnyLan
TR-4	TR-16 Active	TR-16 Passive

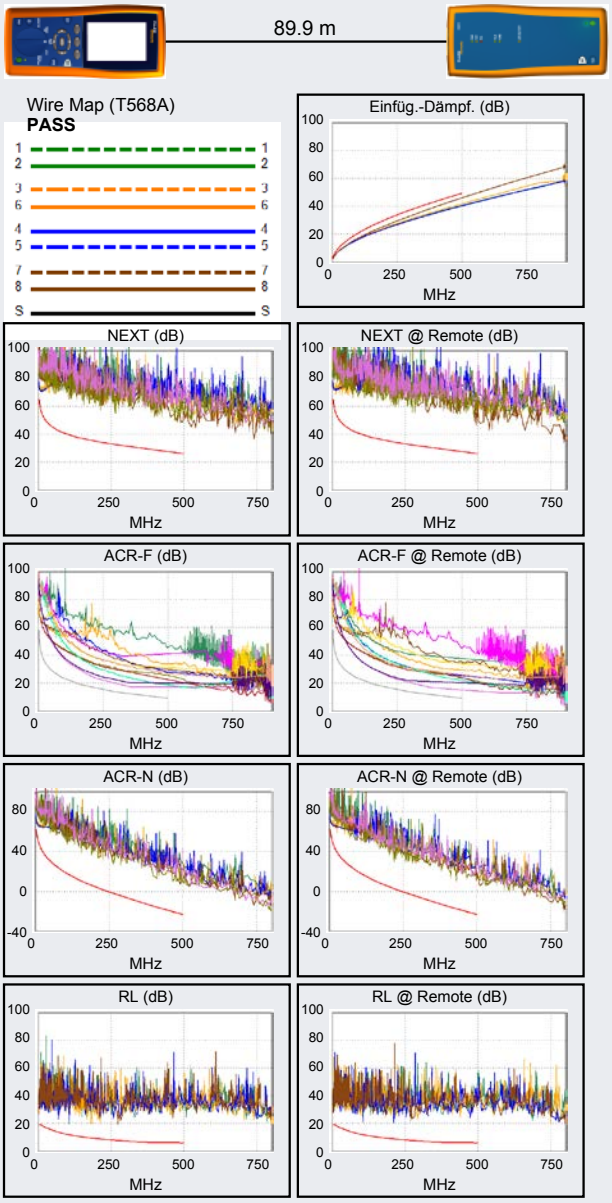

Fig. 5: Excerpt from the test report no. 20150889 by MPA Dresden.
Transmission properties after fire exposure for 120 minutes

As well as this, the data cable passes the requirements for transmission distance in accordance with Class E_A (ISO/IEC 11801 and EN 50173). After fire exposure of 120 minutes the required transmission of up to 500 MHz received a PASS. As well as this, there was no dielectric breakdown during the 120 minutes.

Data cables with resistance to fire may not yet be designated with CE due to the lack of a European standard harmonisation.

However it is worth mentioning that LEONI data cables with resistance to fire generally have a reaction to fire in accordance with Class $B2_{ca}$ s1a, d0, a1.

From the end of 2017 matching connectors will also be available for all listed cable solutions.

Summary

LEONI MegaLine® data cables feature resistance to fire for at least 120 minutes (PH120) and also optimal reaction to fire (Class $B2_{ca}$ s1a d1 a1).

This allows LEONI to make an important contribution to fire prevention by maintaining emergency operation in case of a fire!

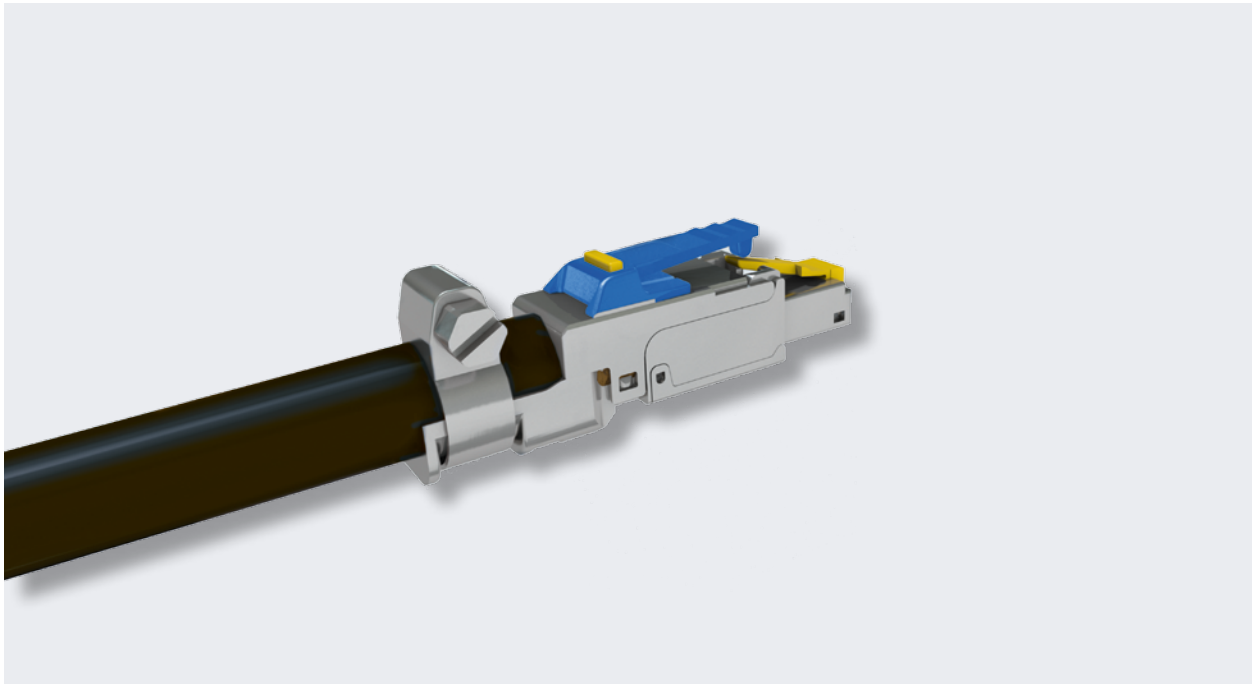

Fig. 6: The cable sheath is available in black or orange depending on customer demands or domestic requirements.