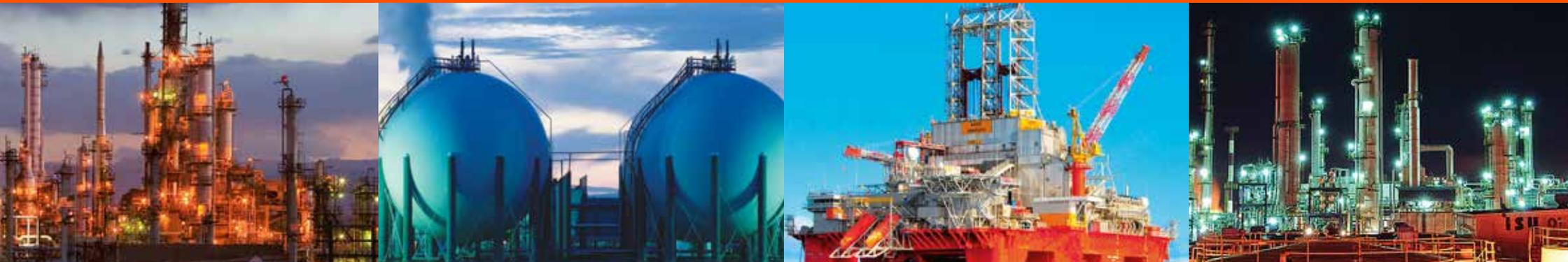


# CAMUNA CAVI

Instrumentation, control, power and data cables for the  
Oil & Gas and process industries



 **LAPP CAMUNACAVI**



## LAPP GROUP: FROM SMALL START-UP TO GLOBAL PLAYER

### Family business and global player

LAPP is both. The history of our company has been one of success and expansion ever since it was founded in 1959 by Ursula Ida and Oskar Lapp. It remains resolutely family owned to this day. We safeguard our success by staying close to our customers and markets, maintaining our innovative strength and brand quality, and being a reliable partner. We provide continuity, always guided in our thoughts and actions by our values.

### Success built on family values

At LAPP, we maintain values that promote cooperation and enable relationships with employees, suppliers and customers based on partnership and trust. Good relations and mutual respect are key elements of our company culture and a central plank of company policy. We know that our successful business development of the last decades is down in particular to our 3,770 skilled and dedicated staff around the world, as well as the reliable partnership with our customers.

With 17 production facilities, over 40 sales companies and hundreds of dedicated consultants, we are always close to the individual needs and challenges of our customers all over the globe. We are constantly developing our products and system solutions, setting standards in safety, quality and functionality. This is why we are one of the world's leading manufacturers of integrated solutions and branded products in cable and connection technology. As our success story enters its third generation, we are aware of our duty to the future.



## CAMUNA CAVI

### With 45 years experience in cable business, Camuna Cavi become part of Lapp in 2001.

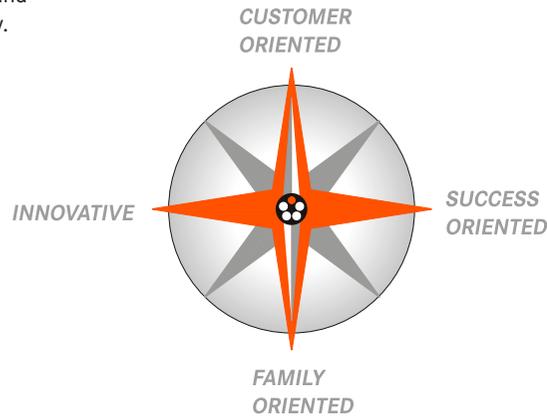
Camuna Cavi is listed on the vendor lists of the major EPCs, Operators and End-Users. The Industrial Project Business Unit supplies products in full compliance with our customer's technical specifications to meet applications whenever durability, quality and reliability are mandatory.

Most of Camuna Cavi cables are designed and manufactured according to customer's needs; they fulfill the technical specs of plants and applications. Camuna Cavi cables are devoted to measurement and control, to connect sensors and actuators and to be installed in dangerous areas such as intrinsically safe or explosion proof zones.

**TOTAL QUALITY COMMITMENT**

Camuna Cavi is committed to grow as a special and standard cable manufacturer with mutually and continually contributing in the growth of society. Camuna Cavi recognizes that successful Quality, Health, Safety, Environment and Energy management are fundamental to its business and is committed to improve it continually ensuring all legal requirements are met. We firmly believe and stick to the ethical code of practice of Lapp Group implemented under Lapp group values that are:

**LAPP GROUP'S GUIDING PRINCIPLE VALUES**



Camuna Cavi also considers that the development of its activities should be sustainable and compatible with the environment that hosts. Camuna Cavi has decided to adopt a system of integrated management for quality environment and energy management; Camuna Cavi undertakes to make available the necessary resources to ensure the respect of quality standards and environmental concerns and to operate in reference to

**UNI-EN ISO 9001:2015<sup>1</sup> and UNI EN ISO 14001:2015<sup>2</sup>, UNI EN ISO 50001:2011<sup>3</sup>.** Camuna Cavi is encouraging all necessary initiatives to ensure continual improvement by involving our employees, suppliers, contractors and society to make an Environment and Energy efficient, business system. Top Management of **Camuna Cavi** also recognizes the necessity of training and employee development in order to achieve best results on above commitments.



1



2



3





## Camuna Cavi can offer you versatile and wide range of products for the Oil&Gas and process industries applications

Our products have been designed to deliver results where reliability and durability are a key factor.

Connect with **Camuna Cavi** for custom designed cables manufactured according to your specific needs. Our team is ready to understand your operating challenges and design the right cable solution for your applications in the oil and gas and in all process industries.

Together we will develop unique cable designs that can be installed in the most rigorous environments, where EMC protection or explosion-proof products are required.

1. Oil & Gas Refinery
2. Chemical & Petrochemical
3. Offshore Exploration
4. Marine Shipbuilding & Dockyard
5. Submarine & Underwater Surveillance
6. Water Treatment
7. Power & Energy
8. Mining & Tunnel
9. Iron & Steel



FLAME/FIRE RETARDANT  
FIRE RESISTANT



OIL RESISTANT



HYDROCARBON AND CHEMICAL



SUNLIGHT RESISTANT



HALOGEN FREE



Low  
SMOKE

LOW SMOKE



DNV



EAC



BV



IMQ

4

ÖLFLEX® INSTRUM  
Instrumentation cables



6

ÖLFLEX® CONTROL  
Control cables



8

THERMOCOUPLE CABLES  
Extension and Compensating



10

ÖLFLEX® POWER  
Power and earthing cables



12

DATA & BUS  
Copper and fiber optic



14

Extreme Series Cables



16

The Construction Products Regulation "CPR"





## INSTRUMENTATION CABLES



### Design

- **Conductor:** Stranded Annealed Copper, Tinned Copper
- **Core insulation:** PE/XLPE/PVC/LSZH
- **Screen:** IS/OS Aluminum/PET + TC Drain wire, Copper Braid, Copper Tape
- **Armor:** Galvanized Steel Wire, Galvanized Steel Wire Braid, Galvanized Steel Tape
- **Chemical Barrier:** Lead sheath, AL/HDPE/PA
- **Outer sheath:** LSZH/PVC

**ÖLFLEX® INSTRUM**



#### Core identification code:

Pairs are black & white with printed numbers  
Triads are black, white, red with printed numbers  
Other colors available on demand.



#### Insulation resistance:

PVC 100 MOhm x km  
PE/XLPE 5000 MOhm x km



#### Conductor stranding:

Class 2 or Class 5 IEC 60228  
Size 0.5 - 0.75 - 1.0 - 1.5 mm<sup>2</sup>



#### Nominal Voltage U<sub>0</sub>/U:

150/250 V-300/300 V-300/500 V



#### Test voltage:

C/C 1500 V x 1 minute or C/C 1500 V x 5 minutes  
Depending on construction



#### Temperature range:

during operation: -30° to +70°C  
during installation: -5° to +50°C  
available upon request constructions from  
-60 to +125°



#### Minimum Bending Radius:

8 x Outer Diameter not armoured cables  
10 x Outer Diameter armoured cables  
15 x Outer Diameter lead or AL/HDPE/PA &  
armoured cables

### Benefits

- Sunlight resistant
- Hydrocarbon and Chemical resistant
- Oil resistant
- Halogen free
- Low smoke
- Fire behaviour

### Product features

Instrumentation Cable are single or multi-pair/triple cables designed to carry signals. They are used for connecting instruments and electrical equipment especially in plants where process control is required, where transducer-generated signals are transmitted through to panels, controllers and other devices. Twisting of the pairs reduces the amount of electromagnetic interference (EMI) from external sources or cross talk between neighboring pairs. The construction with individually shielded pairs is preferred for analog signals; the construction with total shield only is mainly used for digital signals. Instrumentation cables are designed and manufactured following well known international standards like EN-50288-7, NF M 87-202, IEC 60092-376. Special constructions available with DNV-GL approval.

### Norm references / Approvals

- **Hydrocarbon & Oil resistance:** CEI 20-34/0
- **Halogen acid gas:** IEC 60754-1 (max 20%) for PVC cables, IEC 60754-1 and 2 for LSZH cables
- **Fire behaviour:** IEC 60332-1-2 (flame retardant), IEC 60332-3-22 (Cat. A) (fire retardant), IEC 60331-21 (fire resistant), IEC 60331-23 (90 min./750°C fire resistant)
- **Smoke:** IEC 61034-1 and 2

- |                  |                            |                                 |
|------------------|----------------------------|---------------------------------|
| 1. CEI 20-34/0   | 4. IEC 60332-3-22 (Cat. A) | 7. IEC 61034-1 and 2            |
| 2. IEC 60331-21  | 5. IEC 60754-1 (max 20%)   | 8. IEC 60331-23 (90 min./750°C) |
| 3. IEC 60332-1-2 | 6. IEC 60754-1 and 2       | 9. NF M 87-202                  |

CABLES	NOMENCLATURE	CORE INSULATION	SCREEN	CHEMICAL BARRIER	ARMOUR	REFERENCE NORMS
• ÖLFLEX® INSTRUM 160 • ÖLFLEX® INSTRUM 161	▪ REXOHR 300 V, EN 50288 - 7 ▪ REXHOHR 300 V, EN 50288 - 7	PE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 5)
• ÖLFLEX® INSTRUM SWA 162 • ÖLFLEX® INSTRUM SWA 163	▪ REXOHRFR 300 V, EN 50288 - 7 ▪ REXHOHRFR 300 V, EN 50288 - 7	PE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 5)
• ÖLFLEX® INSTRUM 164 H • ÖLFLEX® INSTRUM 165 H	▪ RM9XOHM1 300 V, EN 50288 - 7 ▪ RM9XHOHM1 300 V, EN 50288 - 7	LSZH	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM 166 H • ÖLFLEX® INSTRUM 167 H	▪ RM9XOHM1FM1 300 V, EN 50288 - 7 ▪ RM9XHOHM1FM1 300 V, EN 50288 - 7	LSZH	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM 170 • ÖLFLEX® INSTRUM 171	▪ RRXOHR 300 V, EN 50288-7 ▪ RRXHOHR 300 V, EN 50288-7	PVC	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 5)
• ÖLFLEX® INSTRUM SWA 172 • ÖLFLEX® INSTRUM SWA 173	▪ RRXOHRFR 300 V, EN 50288-7 ▪ RRXHOHRFR 300 V, EN 50288-7	PVC	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 5)
• ÖLFLEX® INSTRUM 174 IS • ÖLFLEX® INSTRUM 175 IS	▪ RE4XOHR 300 V, EN 50288-7 ▪ RE4XHOHR 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 5)
• ÖLFLEX® INSTRUM SWA 176 IS • ÖLFLEX® INSTRUM SWA 177 IS	▪ RE4XOHRFR 300 V, EN 50288-7 ▪ RE4XHOHRFR 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 5)
• ÖLFLEX® INSTRUM SWA LEAD 180 • ÖLFLEX® INSTRUM SWA LEAD 181	▪ RE4XOHLRFR 300 V, EN 50288-7 ▪ RE4XHOHLRFR 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	Lead sheath	Galvanized Steel Wire	1), 3), 4), 5)
• ÖLFLEX® INSTRUM SWA AL/HDPE/PA 182 • ÖLFLEX® INSTRUM SWA AL/HDPE/PA 183	▪ RE4XOH5ER4FR 300 V, EN 50288-7 ▪ RE4XHOH5ER4FR 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS Aluminum/PET + TC Drain wire, OS Aluminum longitudinal tape (AL) + TC Drain wire	AL/HDPE/PA	Galvanized Steel Wire	1), 3), 5)
• ÖLFLEX® INSTRUM 278 H • ÖLFLEX® INSTRUM 279 H	▪ RE4XOHM1 300 V, EN 50288-7 ▪ RE4XHOHM1 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM 280 H • ÖLFLEX® INSTRUM 281 H	▪ RE4XOHM1FM1 300 V, EN 50288-7 ▪ RE4XHOHM1FM1 300 V, EN 50288-7	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM F90 378 H • ÖLFLEX® INSTRUM F90 379 H	▪ RTE4XOHM1 300 V, EN 50288-7 ▪ RTE4XHOHM1 300 V, EN 50288-7	XLPE, over MICA-tape wrapped conductor	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 8), 7), 6)
• ÖLFLEX® INSTRUM SWA F90 380 H • ÖLFLEX® INSTRUM SWA F90 381 H	▪ RTE4XOHM1FM1 300 V, EN 50288-7 ▪ RTE4XHOHM1FM1 300 V, EN 50288-7	XLPE, over MICA-tape wrapped conductor	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 8), 7), 6)
• vÖLFLEX® INSTRUM NF 670 • ÖLFLEX® INSTRUM NF 671	▪ U/RRXOHR 300/500 V, NF M 87-202 ▪ U/RXHOHR 300/500 V, NF M 87-202	PVC	▪ OS Aluminum/PET + TC Drain wire ▪ PVC pair jacket over IS Aluminum/PET + TC Drain wire. OS Aluminum/PET + TC Drain wire	-	Double Steel tape	1), 3), 4), 5), 9)
• ÖLFLEX® INSTRUM NF 672 • ÖLFLEX® INSTRUM STA NF 673	▪ U/RXOHRNR 300/500 V, NF M 87-202 ▪ U/RXHOHRNR 300/500 V NF M 87-202	PVC	▪ OS Aluminum/PET + TC Drain wire ▪ PVC pair jacket over IS Aluminum/PET + TC Drain wire. OS Aluminum/PET + TC Drain wire	-	Double Steel tape	1), 3), 4), 5), 9)
• ÖLFLEX® INSTRUM SC 701 H • ÖLFLEX® INSTRUM SC 702 H	▪ RE4XOHM1 150/250 V, IEC 60092-376 ▪ RE4XHOHM1 150/250 V, IEC 60092-376	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM SC SWB 703 H • ÖLFLEX® INSTRUM SC SWB 704 H	▪ RE4XOHAM1 150/250 V, IEC 60092-376 ▪ RE4XHOHAM1 150/250 V, IEC 60092-376	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM SC SWB F90 705 H • ÖLFLEX® INSTRUM SC SWB F90 706 H	▪ RTE4XOHAM1 150/250V IEC60092-376 ▪ RTE4XHOHAM1 150/250V IEC60092-376	"XLPE, over MICA-tape wrapped conductor"	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 2), 7), 6)
• ÖLFLEX® INSTRUM SC 707 H • ÖLFLEX® INSTRUM SC 708 H	▪ FE4XOHM1 150/250 V, IEC 60092-376 ▪ FE4XHOHM1 150/250 V, IEC 60092-376	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM SC SWB 709 H • ÖLFLEX® INSTRUM SC SWB 79 H	▪ FE4XOHAM1 150/250 V, IEC 60092-376 ▪ FE4XHOHAM1 150/250 V, IEC 60092-376	XLPE	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
• ÖLFLEX® INSTRUM SC SWB F90 711 H • ÖLFLEX® INSTRUM SC SWB F90 712 H	▪ FTE4XOHAM1 150/250V IEC 60092-376 ▪ FTE4XHOHAM1 150/250V IEC 60092-376	"XLPE, over MICA-tape wrapped conductor"	▪ OS Aluminum/PET + TC Drain wire ▪ IS/OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 2), 7), 6)



## CONTROL CABLES



### Design

- **Conductor:** Stranded Annealed Copper, Tinned Copper
- **Core insulation:** PE/XLPE/HEPR/PVC/LSZH
- **Screen:** OS Aluminum/PET + TC Drain wire, Copper Braid, Copper Tape
- **Armour:** Galvanized Steel Wire, Galvanized Steel Wire Braid, Galvanized Steel Tape
- **Chemical Barrier:** Lead sheath, AL/HDPE/PA
- **Outer sheath:** LSZH/PVC

**ÖLFLEX® CONTROL**

- |  |   |
|--|---|
| <p> <b>Core identification code:</b><br/>Black with printed numbers<br/>Other colors available on demand</p> <p> <b>Insulation resistance:</b><br/>PVC 100 MOhm x km<br/>PE/XLPE 5000 MOhm x km</p> <p> <b>Conductor stranding:</b><br/>Class 1, Class 2 or Class 5 IEC 60228<br/>Size 1.0 - 1.5 - 2.5 mm<sup>2</sup></p> <p> <b>Nominal Voltage U<sub>0</sub>/U:</b><br/>600/1000 V</p> | <p> <b>Test voltage:</b><br/>C/C 2000 V x 1 minute or C/C 3500 V x 5 minutes<br/>Depending on construction</p> <p> <b>Temperature range:</b><br/>during operation: -30° to +70°C<br/>during installation: -5° to +50°C<br/>available upon request constructions from<br/>-60 to +125°C</p> <p> <b>Minimum Bending Radius:</b><br/>8 x Outer Diameter not armoured cables<br/>10 x Outer Diameter armoured cables<br/>15 x Outer Diameter lead or AL/HDPE/PA &amp; armoured cables</p> |
|--|---|

### Benefits

- Sunlight resistant
- Hydrocarbon and Chemical resistant
- Oil resistant
- Halogen free
- Low smoke
- Fire behaviour

### Product features

A control cable is a multi-conductor cable made for operation in control circuit, like for example controlling of valves or engines.

It is generally used to carry out on/off controlling signals like for example start/stop command. The nature of the type of the signal (on/off) do not require special precaution in terms of shielding and twisting of pairs, in fact the assembling of cores have a simple multi-core structure.

Control Cables are designed and manufactured following well known international standards like EN-50288-7, NF C 32-322, IEC 60502-1, IEC 60092-353. Special constructions available with DNV-GL and UL approval.

### Norm references / Approvals

- **Hydrocarbon & Oil resistance:** CEI 20-34/0
- **Halogen acid gas:** IEC 60754-1 (max 20%) for PVC cables, IEC 60754-1 and 2 for LSZH cables
- **Fire behaviour:** IEC 60332-1-2 (flame retardant), IEC 60332-3-22 (Cat. A) (fire retardant), IEC 60331-21 (fire resistant), IEC 60331-23 (90 min./750°C fire resistant)
- **Smoke:** IEC 61034-1 and 2

CABLES	NOMENCLATURE	CORE INSULATION	SCREEN	CHEMICAL BARRIER	ARMOUR	REFERENCE NORMS
ÖLFLEX® CONTROL 133	RROHR 500 V, EN 50288-7	PVC	OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 5)
ÖLFLEX® CONTROL SWA 135	RROHRFR 500 V, EN 50288-7	PVC	OS Aluminum/PET + TC Drain wire	-	Galvanized steel wires	1), 3), 4), 5)
ÖLFLEX® CONTROL SWA LEAD 185	RE4OHRFR 500 V, EN 50288-7	XLPE	OS Aluminum/PET + TC Drain wire	Lead sheath	-	1), 3), 4), 7), 6)
ÖLFLEX® INSTRUM SWA AL/HDPE/PA 186	RE4OH5ER4FR 500 V, EN 50288-7	XLPE	"OS Aluminum longitudinal tape (AL) + TC Drain wire"	AL/HDPE/PA	Galvanized Steel Wire	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL 232 H	FG70M1 0,6/1 kV, IEC 60502-1	XLPE	-	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL 234 H	RE4OHM1 500 V, EN 50288-7	XLPE	OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL SWA 235 H	RE4OHM1FM1 500 V, EN 50288-7	XLPE	OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL F90 339 H	RTE4OHM1 500 V EN 50288-7, IEC 60331-23	XLPE, over MICA-tape wrapped conductor	OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL SWA F90 341 H	RTE4OHM1FM1 500 V EN 50288-7, IEC 60331-23	XLPE, over MICA-tape wrapped conductor	OS Aluminum/PET + TC Drain wire	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL STA NF 601	U/RE4ORNR 0,6/1 Kv, NF C.32-322	XLPE	-	-	Galvanized steel wire braid	1), 3), 4), 5), NF C.32-322
SERIES 602	RE4OR 600 V, UL 1277 tray cable (Type TC), UL44, Type TC-ER 90°C, 600 V cable, c(UL)type CIC/TC - 40°C outdoor FT4, CSA 22.2 No 38, CSA 22.22 No 239, CSA 22.2 No 230	XLPE	-	-	Galvanized Steel Wire	1), 3), 4), 5)
ÖLFLEX® CONTROL NAVAL SWB 713 H	RE4OAM1 0,6/1 Kv, IEC 60092-353	XLPE	-	-	Galvanized Steel Wire	1), 3), 5)
ÖLFLEX® CONTROL NAVAL SWB F90 714 H	RTE4OAM1 0,6/1 Kv IEC 60092-353, IEC 60331-21	XLPE, over MICA-tape wrapped conductor	-	-	Double Steel tape	1), 3), 4), 5)
ÖLFLEX® CONTROL NAVAL SWB 715 H	FE4OAM1 0,6/1 Kv, IEC 60092-353	XLPE	-	-	-	1), 3), 4), 7), 6)
ÖLFLEX® CONTROL NAVAL SWB F90 716 H	FTE4OAM1 0,6/1 Kv IEC 60092-353, IEC 60331-21	XLPE, over MICA-tape wrapped conductor	-	-	-	1), 2), 3), 4), 6), 7)

1. CEI 20-34/0
2. IEC 60331-21
3. IEC 60332-1-2

4. IEC 60332-3-22 (Cat. A)
5. IEC 60754-1 (max 20%)
6. IEC 60754-1 and 2

7. IEC 61034-1 and 2
8. IEC 60331-23 (90 min./750°C)
9. NF M 87-202



## EXTENSION AND COMPENSATING



### Design

- **Conductor:** Solid or stranded alloys according to IEC 60584-3, ISA MC 96.1
- **Core insulation:** XLPE/ PVC/LSZH/XLPO
- **Screen:** IS/OS Aluminum/PET + TC Drain wire, Copper Braid, Copper Tape
- **Armour:** Galvanized Steel Wire, Galvanized Steel Wire Braid, Galvanized Steel Tape
- **Chemical Barrier:** Lead sheath, AL/HDPE/PA
- **Outer sheath:** LSZH/PVC/XLPO color in accordance with IEC 60584-3, or ISA MC 96.1

## THERMOCOUPLE CABLES



#### Core identification code:

In accordance with IEC 60584-3, or ISA MC 96.1



#### Insulation resistance:

PVC 100 MOhm x km  
XLPO 1000 MOhm x km  
PE/XLPE 5000 MOhm x km



#### Conductor stranding:

Solid or stranded alloys  
Size 0.5 - 0.8 - 1.3 mm<sup>2</sup>, 16 -18 - 20 AWG



#### Nominal Voltage U<sub>0</sub>/U:

300/300 V



#### Test voltage:

C/C 1500 V x 1 minute



#### Temperature range:

during operation: -30° to +70°C or -40 to +125°C  
depending on construction  
during installation: -5° to +50°C



#### Minimum Bending Radius:

8 x Outer Diameter not armoured cables  
10 x Outer Diameter armoured cables  
15 x Outer Diameter lead or AL/HDPE/PA & armoured cables

### Benefits

- Sunlight resistant
- Hydrocarbon and Chemical resistant
- Oil resistant
- Temperature resistant
- Halogen free
- Low smoke
- Fire behaviour

### Product features

Thermocouple cable is required to make the connection between the thermocouple and the measuring instrument. The construction is very similar to the Instrument cables a part the material of the conductors. Thermocouple Extension cables use the same alloys as the thermocouple. Compensating cables use different alloys that have a matched EMF output over the appropriate temperature range. The Extension cables are more accurate but more expensive than Compensating.

Thermocouple Cables are designed and manufactured following well known international standards like EN-50288-7, IEC 60584-3, ISA MC 96.1.

### Norm references / Approvals

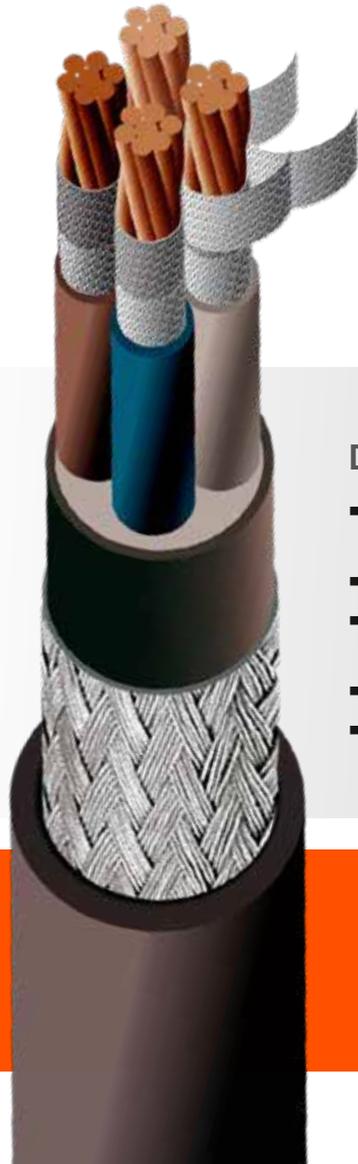
- **Hydrocarbon & Oil resistance:** CEI 20-34/0
- **Halogen acid gas:** IEC 60754-1 (max 20%)for PVC cables, IEC 60754-1 and 2 for LSZH cables
- **Fire behaviour:** IEC 60332-1-2 (flame retardant), IEC 60332-3-22 (Cat. A) (fire retardant)
- **Smoke:** IEC 61034-1 and 2

CABLES	NOMENCLATURE	CORE INSULATION	SCREEN	CHEMICAL BARRIER	ARMOUR	REFERENCE NORMS
TT PVC-oST-PVC	TT URXOHR 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	PVC	OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 5)
TT PVC-IST-oST-PVC	TT URXHOHR 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	PVC	IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 5)
TT PVC-oST-PVC-SWA-PVC	TT URXOHRFR 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	PVC	OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 5)
TT PVC-IST-oST-PVC-SWA-PVC	TT URXHOHRFR 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	PVC	IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 5)
TT XLPE-oST-LSZH	TT UE4XOHM1 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	XLPE	OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
TT XLPE-IST-oST-LSZH	TT UE4XOHM1 300 V, EN 50288-7 IEC 60584-3, ISA MC 96.1	XLPE	IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
TT XLPE-oST-LSZH-SWA-LSZH	TT UE4XOHM1FM1 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPE	OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
TT XLPE-IST-oST-LSZH-SWA-LSZH	TT UE4XOHM1FM1 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPE	IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
TT XLPO-oST-XLPO	TT UG10XOHM2 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPO	OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
TT XLPO-IST-oST-XLPO	TT UG10XOHM2 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPO	IS/OS Aluminum/PET + TC Drain wire	-	-	1), 3), 4), 7), 6)
TT XLPO-oST-XLPO-SWA-XLPO	TT UG10XOHM2FM2 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPO	OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
TT XLPO-IST-oST-XLPO-SWA-XLPO	TT UG10XOHM2FM2 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPO	IS/OS Aluminum/PET + TC Drain wire	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
TT XLPE-IST-oST-PVC-LEAD-PVC-SWA-PVC	TT UE4XOHRFR 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPE	IS/OS Aluminum/PET + TC Drain wire	Lead sheath	Galvanized Steel Wire	1), 3), 4), 5)
TT XLPE-IST-oST-AL/HDPE/PA-SWA-PVC	TT UE4XOH5ER4FR 300 V EN 50288-7, IEC 60584-3, ISA MC 96.1	XLPE	IS Aluminum/PET + TC Drain wire, OS Aluminum longitudinal tape (AL)	AL/HDPE/PA	-	1), 3), 5)

- 1. CEI 20-34/0
- 2. IEC 60331-21
- 3. IEC 60332-1-2
- 4. IEC 60332-3-22 (Cat. A)
- 5. IEC 60754-1 (max 20%)
- 6. IEC 60754-1 and 2
- 7. IEC 61034-1 and 2
- 8. IEC 60331-23 (90 min./750°C)
- 9. NF M 87-202



## POWER AND EARTHING CABLES



### Design

- **Conductor:** Stranded Annealed Copper, Tinned Copper
- **Core insulation:** PE/XLPE/HEPR/PVC/LSZH/XLPO
- **Armour:** Galvanized Steel Wire, Galvanized Steel Wire Braid, Galvanized Steel Tape
- **Chemical Barrier:** Lead sheath, AL/HDPE/PA
- **Outer sheath:** LSZH/PVC

**ÖLFLEX® POWER**



#### Core identification code:

WITH PROTECTIVE CONDUCTOR: according to HD 308 - 1 core green/yellow; 3 cores green/yellow, blue, brown; 4 cores green/yellow, brown, black, grey; 5 cores green/yellow, blue, brown, black, grey.

WITHOUT PROTECTIVE CONDUCTOR: according to HD 308 - 1 core black; 2-cores blue, brown - 3 cores brown, black, grey; 4 cores blue, brown, black, grey; 5 cores blue, brown, black, grey, black.



#### Conductor stranding:

Class 2 or Class 5 IEC 60228  
Size up to 240 mm<sup>2</sup> multicore and 630 mm<sup>2</sup> single core



**Nominal Voltage U<sub>0</sub>/U:**  
600/1000 V



**Test voltage:**  
C/C 3500 V x 5 minutes



#### Temperature range:

during operation: -30° to +70°C or -40 to +125°C depending on construction  
during installation: -5° to +50°C  
available upon request constructions from -60 °C



#### Minimum Bending Radius:

8 x Outer Diameter not armoured cables  
10 x Outer Diameter armoured cables  
5 x Outer Diameter lead or AL/HDPE/PA & armoured cables

### Benefits

- Sunlight resistant
- Hydrocarbon and Chemical resistant
- Oil resistant
- Temperature resistant
- Halogen free
- Low smoke
- Fire behaviour

### Product features

A power cable is used for transmission of electrical power. They are typically composed up to five conductors for the following purposes:

- 3 cores for each phase (R, S, T)
- 1 core for neutral (N)
- 1 core for protection earth (PE)

Power Cables are designed and manufactured following well known international standards like EN 50288-7, IEC 60502-1, IEC 60092-353, CEI 20-20/3.

### Norm references / Approvals

- **Hydrocarbon & Oil resistance:** CEI 20-34/0
- **Halogen acid gas:** IEC 60754-1 (max 20%) for PVC cables, IEC 60754-1 and 2 for LSZH cables
- **Fire behaviour:** IEC 60332-1-2 (flame retardant), IEC 60332-3-22 (Cat. A) (fire retardant), IEC 60331-21 (fire resistant)
- **Smoke:** IEC 61034-1 and 2

CABLES	NOMENCLATURE	CORE INSULATION	CHEMICAL BARRIER	ARMOUR	REFERENCE NORMS
N07V-K	FR 450/750 V, CEI 20-20 CEI UNEL 357523, CEI 20-22 II	PVC, Type R2	-	-	3), CEI 20-22 II
H07V-K	FR 450/750 V CEI 20-20/3	PVC	-	-	3)
H07V-R	RR 450/750 V CEI 20-20/3	PVC	-	-	3)
ÖLFLEX® POWER 106	RE4OR 0,6/1 kV IEC 60502-1	XLPE	-	-	1), 3), 4), 5)
ÖLFLEX® POWER SWA 108	RE4OFR 0,6/1 kV IEC 60502-1	XLPE	-	Galvanized Steel Wire	1), 3), 4), 5)
ÖLFLEX® POWER 110	RROR 0,6/1 kV IEC 60502-1	PVC	-	-	1), 3), 4), 5)
ÖLFLEX® POWER SWA 111	RROFR 0,6/1 kV IEC 60502-1	PVC	-	Galvanized Steel Wire	1), 3), 4), 5)
ÖLFLEX® POWER SWA LEAD 187	RE4ORLRFR 0,6/1 kV IEC 60502-1	XLPE	Lead sheath	Galvanized Steel Wire	1), 3), 4), 5)
ÖLFLEX® POWER SWA AL/HDPE/PA 188	RE4OH5ER4FR 0,6/1 kV Gen. to IEC 60502-1, EN 50288-7	XLPE	AL/HDPE/PA	Galvanized Steel Wire	1), 3), 5)
ÖLFLEX® POWER 190 H	RG100M2 0,6/1 kV IEC 60092-353	XLPO	-	-	1), 3), 4), 7), 6)
ÖLFLEX® POWER SWB 191 H	RG100M2AM2 0,6/1 kV IEC 60092-353	XLPO	-	Galvanized steel wire braid	1), 3), 4), 7), 6)
ÖLFLEX® POWER F90 192 H	RTG100M2 0,6/1 kV IEC 60092-353, 2)	XLPO, over MICA-tape wrapped conductor	-	-	1), 3), 4), 2), 7), 6)
ÖLFLEX® POWER SWB F90 193 H	RTG100M2AM2 0,6/1 kV IEC 60092-353, 2)	XLPO, over MICA-tape wrapped conductor	-	Galvanized steel wire braid	1), 3), 4), 2), 7), 6)
ÖLFLEX® POWER 204 H	RE4OM1 0,6/1 kV IEC 60502-1	XLPE	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
ÖLFLEX® POWER SWA 205 H	RE4OFM1 0,6/1 kV IEC 60502-1	XLPE	-	Galvanized Steel Wire	1), 3), 4), 7), 6)
ÖLFLEX® POWER F90 304 H	RTE4OM1 0,6/1 kV IEC 60502-1, 2)	XLPE, over MICA-tape wrapped conductor	-	-	1), 3), 4), 2), 7), 6)
ÖLFLEX® POWER SWA F90 306 H	RTE4OFM1 0,6/1 kV IEC 60502-1, 2)	XLPE, over MICA-tape wrapped conductor	-	Galvanized Steel Wire	1), 3), 4), 2), 7), 6)

1. CEI 20-34/0
2. IEC 60331-21
3. IEC 60332-1-2

4. IEC 60332-3-22 (Cat. A)
5. IEC 60754-1 (max 20%)
6. IEC 60754-1 and 2

7. IEC 61034-1 and 2
8. IEC 60331-23 (90 min./750°C)
9. NF M 87-202



# COPPER AND FIBER OPTIC

## Application range

- Heavy industrial areas
- For indoor or outdoor use
- Methods of deployment: empty plastic pipes, ducts and trays

And for the LEAD or AL/HDPE/PA sheathed versions

- Harsh oil and chemical environments
- For direct burial, especially in the presence of oil and aggressive chemical substances

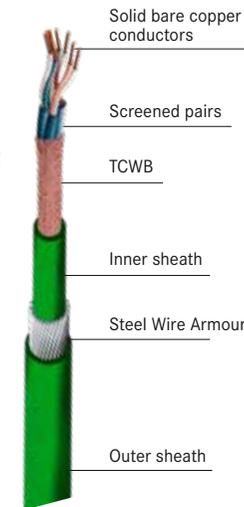
## Benefits

- High mechanical protection against accidental impacts
- Excellent rodent protection
- Suitable for direct burial
- UV and water-resistant
- Protection against hydrocarbons and other chemicals (Lead or AL/HDPE/PA sheathed versions)

## DATA & BUS

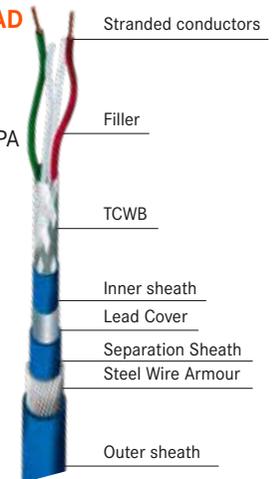
### ETHERLINE® ARMOUR SWA CAT. 7

Lan cables with steel wire armouring (SWA)



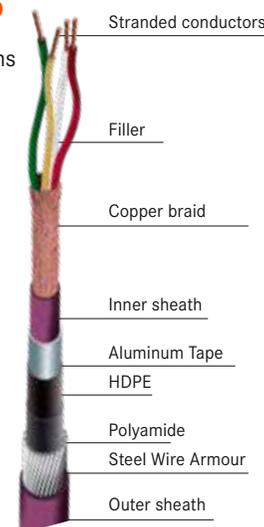
### UNITRONIC® ARMOUR SWA LEAD BUS PA

Cables for bus systems PROFIBUS® PA with extruded lead armouring for chemical protection



### UNITRONIC® ARMOUR SWA AL/ HDPE/PA BUS LD

Cable for bus systems RS485/RS422 with aluminum tape and additional HDPE and PA sheaths for water and chemical protection



### HITRONIC® FIRE

Safety cable with central loose tube, LSZH inner and outer sheath, corrugated steel tape; halogen-free



CABLES	NOMENCLATURE	CORE INSULATION	SCREEN	CHEMICAL BARRIER	ARMOUR	REFERENCE NORMS
UNITRONIC® BUS PA	PA = Process Automation Variant with UL/CSA CMG	foam - skin PE	TCWB	UPON REQUEST	UPON REQUEST	IEC 60332-1-2, IEC 61158-2
UNITRONIC® BUS LD	LD is a LAPP abbreviation for long distance	special PE	TCWB	UPON REQUEST	UPON REQUEST	IEC 60332-1-2
UNITRONIC® BUS PB	Lapp Kabel is a member of the PROFIBUS User Organisation (PNO) A for Advanced here: UL and CSA approvals	foam - skin PE	Aluminum/PET + TCWB	UPON REQUEST	UPON REQUEST	IEC 60332-1-2, DIN 19245, EN 50170
ETHERLINE® CAT.6A + CAT.7	Industrial Ethernet cable For PROFINET applications with 4 pairs CAT.6A and Cat.7 qualified for 10Gbit/s	foam - skin PE	Aluminum/PET + TCWB	UPON REQUEST	UPON REQUEST	IEC 60332-2-3-25, IEC 60754, EN 50173-3 ISO/IEC 24702
HITRONIC® HUN UNIVERSAL CABLE	A/J-DQ(ZN)BH or U-DQ(ZN)BH Universal cable with central loose tube and non-metallic strain relief	LSZH outer sheath	-		UPON REQUEST	
HITRONIC® HQN OUTDOOR CABLE	A-DQ(ZN)B2Y Outdoor cable with central loose tube and non-metallic strain relief	PE outer sheath	-	UPON REQUEST	UPON REQUEST	IEC 60754-1, Environmental and mechanical tests comply to EN 187000 and IEC 60794
HITRONIC® FIRE	A/J-DQ(ZN)BH(SR)H or U-DQ(ZN)BH(SR)H Fire-resistant cable designed according to IEC 60331-25 System integrity for at least 90 minutes in the event of fire	LSZH inner and outer sheaths	-		UPON REQUEST	IEC 60754-1, IEC 61034-2, IEC 60331-25, IEC 60332-1-1

1. CEI 20-34/0
2. IEC 60331-21
3. IEC 60332-1-2

4. IEC 60332-3-22 (Cat. A)
5. IEC 60754-1 (max 20%)
6. IEC 60754-1 and 2

7. IEC 61034-1 and 2
8. IEC 60331-23 (90 min./750°C)
9. NF M 87-202

# Extreme Series Cables

Camuna Cavi solutions for extreme environments

## MUD

NEK TS 606:2016  
Mud resistance



### Cable Features & Applications

Instrumentation, Control & LV Power cables jacketed with LSZH Compound Type SHF2 IEC 60092-360, it is particularly suggested for applications in harsh environments, where superior performances as for contact with organic fluids are required:

- Resistance to Oils IRM 902 and 903 for 7 days @ 100°C
- Resistance to Calcium Bromide for 56 days @ 70°C

Additional requirement NEK TS 606 2016 version

- Resistance to Oil EDC 95-11 for 56 days @ 70°C



## GAS TIGHT

IEC 60079-14 ANNEX E  
Restricted breathing cables



### Cable Features & Applications

The new Gas Tight Instrumentation, Control & LV Power cables designed for and installed in explosive atmospheres and hazardous locations. It prevents gas and vapor migration through the interstices between individual cable cores.

Camuna Cavi can provide in-house testing solution and test report Certificate of our “gas tight” multi-conductors, multi-pairs and multi-triads cables according to IEC standard Annex E.



# DESERT

ISO 4892-2

Weathering resistance



## Cable Features & Applications

Instrumentation, Control & LV Power cables are in compliance with the Weathering test mentioned in ISO 4892-2 (720 h @ method A)  
Strong jacket suitable for installation in desert locations having good performance of Tear resistance as per BS 6469 section 99.1.  
Reproduction of the weathering effects (temperature, humidity and/or wetting) that occur when materials are exposed in actual end-use environments to daylight.  
Severe field test performance simulation with SWA armored cables bended below the typical bending radius carried out in desert locations.



# POLAR

IEC 60811 Cold bend, impact and elongation down to  $-60^{\circ}\text{C}$



## Cable Features & Applications

The new Polar grade Instrumentation, Control & LV Power cables meet the requirements to operate in extremely cold climate conditions like Arctic regions.

Cold bending test as per IEC 60811-504@ $-60^{\circ}\text{C}$   
Cold elongation test as per IEC 60811-505@ $-60^{\circ}\text{C}$   
Cold impact test as per IEC 60811-506@ $-60^{\circ}\text{C}$



# The Construction Products Regulation “CPR”

With effect from 1<sup>st</sup> July 2017 it is obligatory for cables, having an intended use for permanent installation in buildings and construction works into the EU, to be accompanied by a Declaration of Performance (DoP) and to have CE marking under the CPR. This requirement relates only to the Reaction to Fire performance of the cables. All types of cable (copper and fibre, shielded and unshielded) are covered with exception to cables having Resistance to Fire, meaning retention of functionality during a fire, that are not covered by the requirement now being introduced (today covered by IEC60331). They are scheduled to be covered at an, as yet, unknown date in the future. The classification splits cables into 7 classes in respect of their reaction to fire. They range from

Class A<sub>ca</sub>, being essentially non-combustible, through to class F<sub>ca</sub>, which is for cables having no measurable resistance to the spread of flames. National regulations prescribe specific classes based on environment and installation rules and they can differ from country to country.

Low-smoke, zero-halogen (LSZH) cables were built to meet three IEC standards: IEC60332 for flame spread, IEC60754 for smoke acidity and IEC61034 for Smoke emission. CPR applies new criteria and testing procedures to promote a more harmonized standard describing cable fire performance.

## The 7 CPR EuroClasses are:

### Smoke opacity classification: this

classification provides information about the opacity of the emitted smoke (s: smoke).

- **s1:** TSP1200s ≤ 50 m<sup>2</sup> and peak SPR ≤ 0.25 m<sup>2</sup> / s;
- **s1a:** s1 and transmittance according to EN 61034-2 ≥80%;
- **s1b:** s1 and transmittance according to EN 61034-2 ≥60% <80% ;
- **s2:** TSP1200s ≤ 400 m<sup>2</sup> and peak SPR ≤ 1.5 m<sup>2</sup> / s;
- **s3:** neither s1 nor s2.

### Flaming droplets classification: this

classification provides information about the dripping of burning material during the fire (d: droplet).

- **d0:** no burning droplets or particles;
- **d1:** No burning droplets or particles that last more than 10 seconds;
- **d2:** neither d0 nor d1.

**Acidity classification:** this classification provides information about the emission of acid gases during the fire (a: acidity).

- **a1:** Conductivity < 2.5 μS/mm, pH > 4.3;
- **a2:** Conductivity < 10 μS/mm, pH > 4.3;
- **a3:** neither a1 nor a2.

Class	Test method	Classification criteria	Additional Criteria
A <sub>ca</sub>	EN ISO 1716	PCS ≤ 2,0 MJ/kg	
B1 <sub>ca</sub>	EN 50399 30 kW Burner Special assembly EN 60332-1-2	FS ≤ 1,75 m T; HR <sub>1200s</sub> ≤ 10 MJ; HRR max. ≤ 20 kW; FIGRA ≤ 120 W/s; H ≤ 425 mm	Smoke production (s) Flaming droplets (d) Acidity (a)
B2 <sub>ca</sub>	EN 50399 20,5 kW Burner	FS ≤ 1,5 m; THR <sub>1200s</sub> ≤ 15 MJ; HRR max. ≤ 30 kW; FIGRA ≤ 150 W/s	Smoke production (s) Flaming droplets (d) Acidity (a)
	EN 60332-1-2	H ≤ 425 mm	
C <sub>ca</sub>	EN 50399 20,5 kW Burner EN 60332-1-2	FS ≤ 2,0 m; THR <sub>1200s</sub> ≤ 30 MJ; HRR max. ≤ 60 kW; FIGRA ≤ 300 W/s; H ≤ 425 mm	Smoke production (s) Flaming droplets (d) Acidity (a)
D <sub>ca</sub>	EN 50399 20,5 kW Burner	THR1200s ≤ 70 MJ; HRR max. ≤ 400 kW; FIGRA ≤ 1300 W/s	Smoke production (s) Flaming droplets (d) Acidity (a)
	EN 60332-1-2	H ≤ 425 mm	
E <sub>ca</sub>	EN 60332-1-2	H ≤ 425 mm	

### Classification parameters:

- **PCS:** Gross Heat of Combustion
- **FS:** Flame Spread (test EN 50399)
- **THR<sub>1200s</sub>:** Total Heat Release
- **Peak HRR:** Peak of Heat Release Rate
- **FIGRA:** Fire Growth Rate Index
- **H:** Flame Spread (test EN 60332-1-2)



Cables manufactured by Camuna Cavi can be certified on request under one of the classes from F<sub>ca</sub> to B2<sub>ca</sub>. Camuna Cavi has already been approved after FPC (Factory Production Control) as required by CPR EU 35/2011 procedures.

As a general information we have seen that trend for future regulation (or de-facto practices) seems to be (with varying levels for smoke, acidity and droplets):

- **Euroclass B2<sub>ca</sub> - s1a, d1, a1**: for areas with high fire risks, typically underground railways, tunnels, airports, etc.
- **Euroclass C<sub>ca</sub> - s1b, d1, a1**: for areas with medium fire risks, such as public buildings, hotels, schools, escape routes
- **Euroclass E<sub>ca</sub>**: for areas with medium or low fire risks, such as residential or standard industrial premises

Cables manufactured by Camuna Cavi Srl can be certified on request under one of classes from F<sub>ca</sub> to B2<sub>ca</sub>. Camuna Cavi has already been approved after FPC (Factory Production Control) as required by CPR EU 35/2011 procedures.

Instrumentation and control cables by Camuna Cavi Srl will be in general covered by Euroclass C<sub>ca</sub> - s1b, d1, a1 (to be read as: C<sub>ca</sub> for areas with high fire risks, s1b smoke opacity transmittance >60% and <80%, d1 No burning droplets or particles that last more than 10 seconds, a1 smoke acidity conductivity < 2.5 μS/mm pH > 4.3). Other Euroclasses will be available on request.

# Mechanical and chemical cable protection

The primary purpose of armor is to protect the cable against mechanical damage during installation and operation. The most common armor designs with their most important features are the following:



### Armor of galvanized round steel wires

Armor with good mechanical protection, suitable for tensile loads. It allows a good cable flexibility; the coverage degree is up to 90%. It is possible to add a counterspiral in galvanized steel tape for a better mechanical protection.



### Armour of galvanized steel tapes

Dual helicoid armor with overlap. Excellent protection against shocks, compression and rodents, but not suitable for tensile loads. It imparts the best protection from electromagnetic fields with compared to other armors.



### Armour of galvanized steel wire braid

Lightweight armor to withstand tensile loads; permits the smallest bending radius of all armor designs. A coverage of at least 80 % and a wire diameter of 0.3 mm are recommended to achieve sufficient mechanical protection.



### Lead sheath

The safest, though most expensive protection against aggressive chemicals. It increase weight and bending radius of the cable. Normally and additional armoring is required to protect it from crushing.



### Multilayer AL/HDPE/PA sheath

Same as lead protection against aromatic hydrocarbons and aggressive chemicals. This design combining aluminum tape and high-density polyethylene HDPE sheath with a covering of polyamide PA (Nylon), represents an excellent barrier against penetrating chemicals, corrosion and humidity. It can be used as an alternative to lead sheath. Advantage: lighter, smaller diameter, environment protection



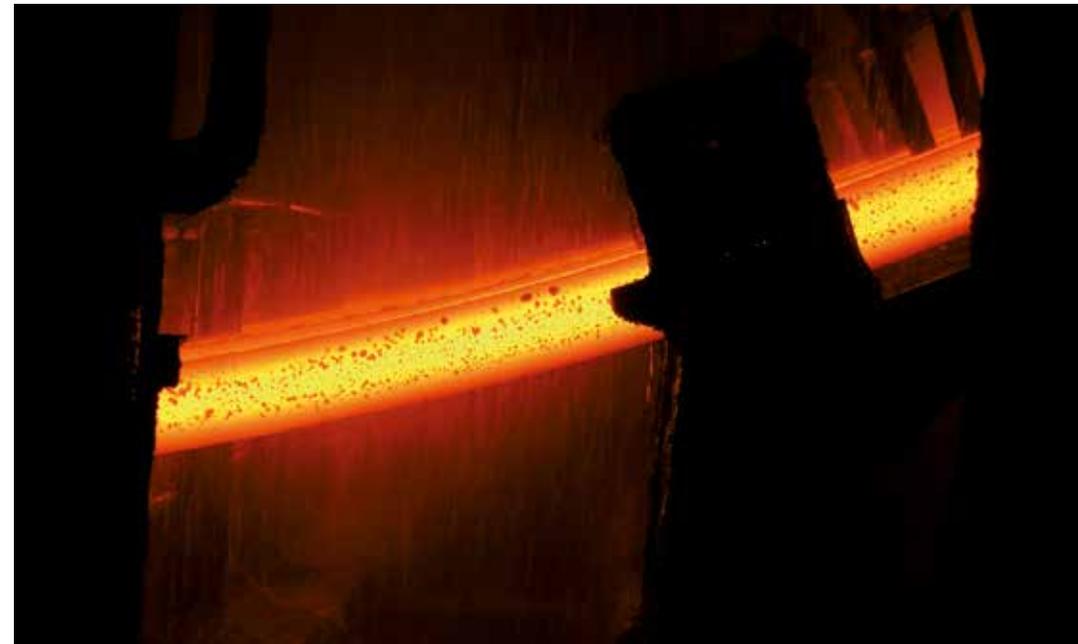
# Common Test Methods for Cables under Fire Conditions

## Reaction to Fire - IEC Standards

No.	Title
<b>IEC 60332</b>	<b>Tests on electric and optical cables under fire conditions</b>
-1-1	Test on a single vertical insulated wire or cable, Apparatus
-1-2	Test on a single vertical insulated wire or cable, Procedure
-1-3	Test on a single vertical insulated wire or cable, Procedure for determination of flaming droplets/particles
<b>IEC 60332</b>	<b>Tests on electric cables under fire conditions</b>
-2-1	Test on a single vertical insulated wire or cable - Apparatus
-2-2	Test on a single vertical insulated wire or cable - Procedure
<b>IEC 60332-3</b>	<b>Tests on bunched wires or cables</b>
-10	Apparatus
-21	Procedures Category A F/R
-22	Procedures Category A
-23	Procedures Category B
-24	Procedures Category C
-25	Procedures - small cables
<b>IEC 60754</b>	<b>Tests on gases evolved during combustion of materials from cables</b>
-1	Determination of amount of halogen acid gas
-2	Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity
<b>IEC 61034</b>	<b>Measurement of smoke density of cables burning under defined conditions</b>
-1	Test apparatus
-2	Test procedure and requirements

## Reaction to Fire - IEC Standards

No.	Title
<b>IEC 60331</b>	<b>Tests for electric cables under fire conditions, Circuit Integrity</b>
-11	Apparatus, Fire alone at temperature of at least 750°C
-21	Procedures and requirements, Cables of rated voltage up to and including 0,6/1 kV Procedures Category A
-22	Procedures and requirements, Cables of rated voltage greater than 1 kV (under consideration)
-23	Proc. and requirements, Electric data cables
-25	Proc. and requirements, Optical fibres cables



# Cable's identification code GEN to CEI-UNEL 35011

## JACKETS

## ARMOURS

## SHIELDS

## CABLE'S SHAPE

## INSULATIONS

20

## CONDUCTORS

- U** Solid Conductor
- R** Stranded Conductor
- F** Flexible Conductor
- FF** Extra Flexible Conductor

### Insulations

- R** PVC
- R2** PVC Type R2
- R3** PVC 105°C
- R7** PVC 90°C
- E** Polyethylene
- E4** Cross-linked Polyethylene (XLPE)
- G4** Silicon Rubber
- G7** High Module Ethylene Propylene Rubber (HEPR)
- G10** Low Smoke Cross-Linked Polyolefin (XLPO)
- T** Mica Glass Tape

### Cable's shape

- O** Round shape cable
- D** Flat Cable
- X** Cores twisted in pairs, triad, quad

### Shields

- C** Copper Concentric conductor
- H** Aluminium Polyester Tape
- H1** Copper tape or Copper wires shield
- H2** Copper Braid Shield
- H3** Double Copper Braid Shield
- H5** Longitudinal Aluminium Tape

### Armours

- A** Steel Wire Braid
- F** Steel Wires
- N** Steel Tape
- Z** Steel Stripes
- L** Lead Jacket
- H4** Longitudinal Corrugated Steel Tape

### Jackets

- R** PVC
- R4** Polyamide (nylon)
- E** Polyethylene
- E4** Cross-linked Polyethylene (XLPE)
- G** Cross-linked Elastomer
- M1** Low Smoke Halogen Free Thermoplastic Material
- M2** Low Smoke Halogen Free cross-linked Material
- T** Textile Braid
- T1** Glass Type
- T2** Special Textile
- P** Polyurethane
- Tpe** Thermoplastic Elastomer

## Our global corporate network

### America

Brazil	Cabos Lapp Brasil LTDA.
Canada	Lapp Canada Inc.
Mexico	Lapp Mexico S de RL de CV
Panama	Lapp Panamá S.A.
USA	Lapp Cable Works Inc. Lapp Tannehill Inc. Phoenix Wire & Cable Inc.

### Europe

Austria	Lapp Austria GmbH
Benelux	Lapp Benelux B.V.
Czech Republic	Lapp Kabel s.r.o.
Denmark	Lapp Miltronic AB
Estonia	Lapp Miltronic SIA
Finland	Lapp Automaatio Oy Lapp Connecto Oy
France	Lapp France S.A.R.L. Câbleries Lapp S.A.R.L. Lapp Muller SAS
Germany	U.I. Lapp GmbH Lapp GmbH Kabelwerke Lapp Systems GmbH Contact GmbH Elektrische Bauelemente
Great Britain	Lapp Limited
Hungary	Lapp Hungária Kft.
Ireland	Lapp Limited Ireland
Italy	Lapp Italia s.r.l. Camuna Cavi s.r.l. Ceam Cavi Speciali S.r.l. Lapp Sistemi Italia s.r.l.
Latvia	Lapp Miltronic SIA
Lithuania	Lapp Miltronic UAB
Norway	Miltronic AS
Poland	Lapp Kabel SP. z.o.o Lapp Connecto Polska Sp. z.o.o.
Portugal	Policabos - Soluções Técnicas De Condutores, S.A

Romania	Lapp Kabel Romania SRL S. C. Fender Cables S.r.l.
Slovenia	Lapp, d.o.o.
Spain	Lapp Kabel España S.L.U.
Sweden	Miltronic AB Fleximark AB
Switzerland	Lapp Tec AG
Turkey	Lapp Kablo San. ve. Tic.Ltd.Sti.
Ukraine	Lapp Ukraine LLC

### Africa

South Africa	Lapp Southern Africa (PTY) Ltd.
--------------	---------------------------------

### Asia

China	Lapp Kabel Shanghai Co. Ltd.
India	Shanghai Co. Ltd. India

Indonesia	JJ-Lapp Cable (I) SMI
Japan	Lapp Japan K.K.
Kazakhstan	Lapp Kazakhstan LLP
Malaysia	JJ-Lapp Cable (M) Sdn Bhd
Philippines	JJ-Lapp Cable (P) Inc.
Russia	Lapp Russia OOO
Singapore	JJ-Lapp Cable (S) Pte. Ltd. Lapp Logistics Pte. Ltd.
South Korea	Lapp Korea LLC.
Thailand	JJ-Lapp Cable (T) Ltd.
United Arab Emirates	LAPP Cables Middle East FZE
Vietnam	JJ-Lapp Cable (V) Ltd.

### Australia

Australia	LAPP Australia Pty Ltd
-----------	------------------------



**Global networking -  
that's what proximity  
means to us**

Find other sales partners in your location:

[www.lappgroup.com](http://www.lappgroup.com)  
[www.camunacavi.it](http://www.camunacavi.it)

## **LAPPCAMUNACAVI**

### **CAMUNA CAVI S.R.L.**

Operation: Via General Treboldi 128 · 25048 · Edolo (BS) · Italy

Sales: Via Laboratori Autobianchi 1 · 20832 · Desio (MB) · Italy

[www.camunacavi.it](http://www.camunacavi.it) · [info@camunacavi.it](mailto:info@camunacavi.it)

Tel.: +39 0364 773411

**A LAPP Company**

Follow LAPP on



### **Terms of Trade:**

Our general conditions of sale

can be downloaded from our website

[www.lappgroup.com/terms](http://www.lappgroup.com/terms)



**ÖLFLEX®**  
Power and control cables



**UNITRONIC®**  
Data communication systems



**ETHERLINE®**  
Data communication systems  
for ETHERNET technology



**HITRONIC®**  
Optical transmission systems



**EPIC®**  
Industrial connectors



**SKINTOP®**  
Cable glands



**SILVYN®**  
Protective cable conduit systems  
and cable carrier systems



**FLEXIMARK®**  
Marking systems