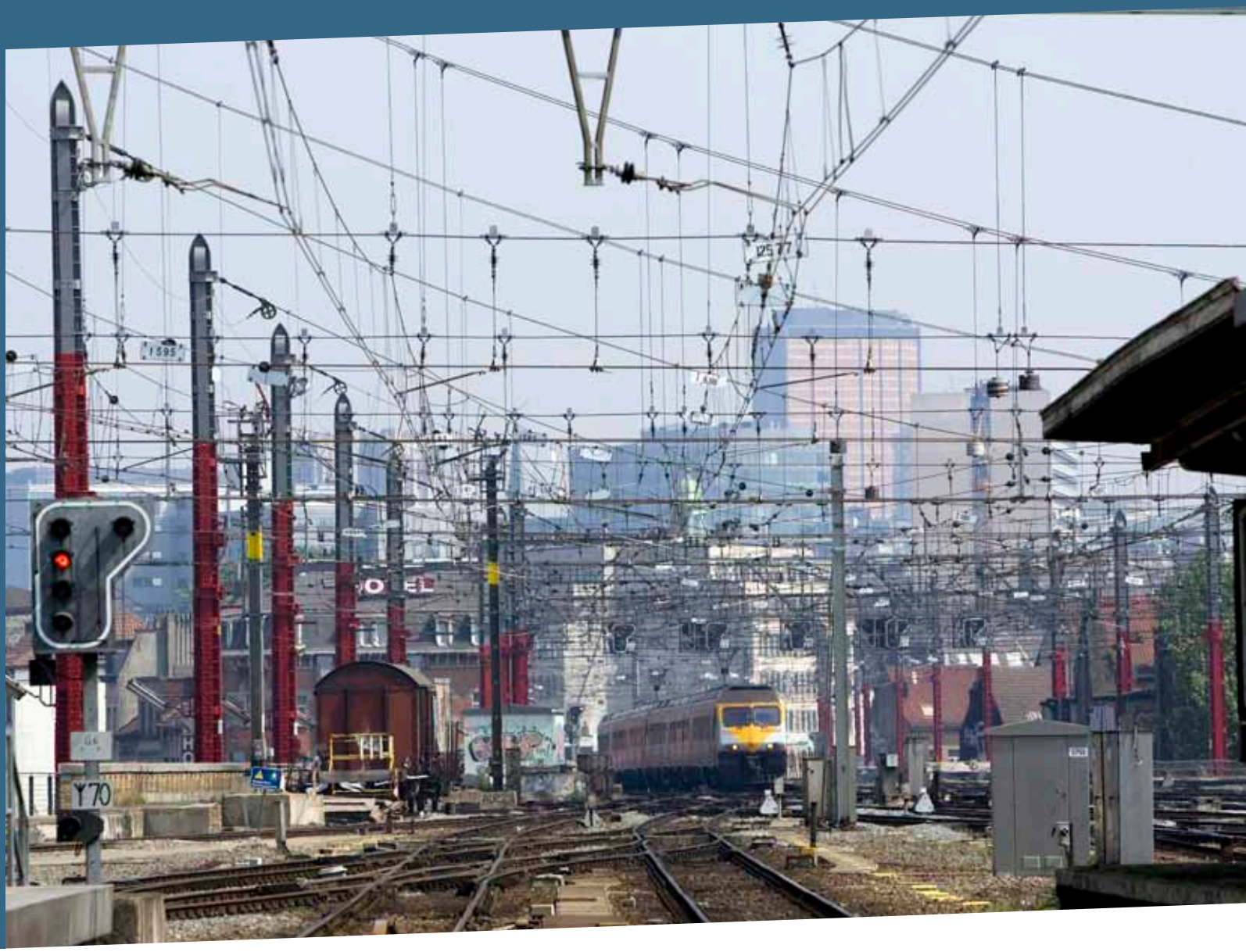
Prysmian Group

# Railway Infrastructure Cables

General Catalogue






PRYSMIAN

Draka

# Railway Infrastructure Cables

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# Linking the Future

As the worldwide leader in the cable industry, Prysmian Group believes in the effective, efficient and sustainable supply of energy and information as a primary driver in the development of communities.

With this in mind, we provide major global organisations in many industries with best-in-class cable solutions, based on state-of-the-art technology.

Through two renowned commercial brands - Prysmian and Draka - based in almost 50 countries, we're constantly close to our customers, enabling them to further develop the world's energy and telecoms infrastructures, and achieve sustainable, profitable growth.

In our energy business, we design, produce, distribute and install cables and systems for the transmission and distribution of power at low, medium, high and extra-high voltage.

In telecoms, the Group is a leading manufacturer of all types of copper and fibre cables, systems and accessories - covering voice, video and data transmission.

Drawing on over 130 years' experience and continuously investing in R&D, we apply excellence, understanding and integrity to everything we do, meeting and exceeding the precise needs of our customers across all continents, at the same time shaping the evolution of our industry.

# What links global expertise to the wheels of industry?

## High-performing cable solutions to keep the wheels of industry turning

On every continent, in applications that range from rolling stock and vehicles for high-speed trains and urban mass transit lines, to all types of rail transport infrastructure, Prysmian's specialist cable solutions sit at the heart of significant international projects; supporting the work of major customers, with high-performing, durable and safe technology.

As the world leader in cabling, we draw on global expertise and local presence to work in close proximity with our customers, delivering products and service platforms built on easy contact, bespoke solutions and effective supply chain, meeting their specialised requirements, to help them drive the wheels of industry and achieve sustainable growth and profitability.

# Railway Infrastructure Cables

## History of the railways

When George Stephenson's steam locomotive „The Rocket" emerged as the winner of the ‚Rainhill Race' in 1829, with an average speed of 12.5 mph = 20 km/h, no one could predict the triumphant progress the railways would make in the almost 200 year period that followed. Within just a few decades, the railway developed into a broadly integrated transport system, which drastically reduced travelling times, and made it possible to develop travel, especially in the New World - within that huge country of America. The triumph of the railways, which began around the year 1830 with a distance of about 330 km of railway line, developed over the next fifty years almost exponentially to become almost 370,000 km. Today, this extends to over more than 1.1 million km!

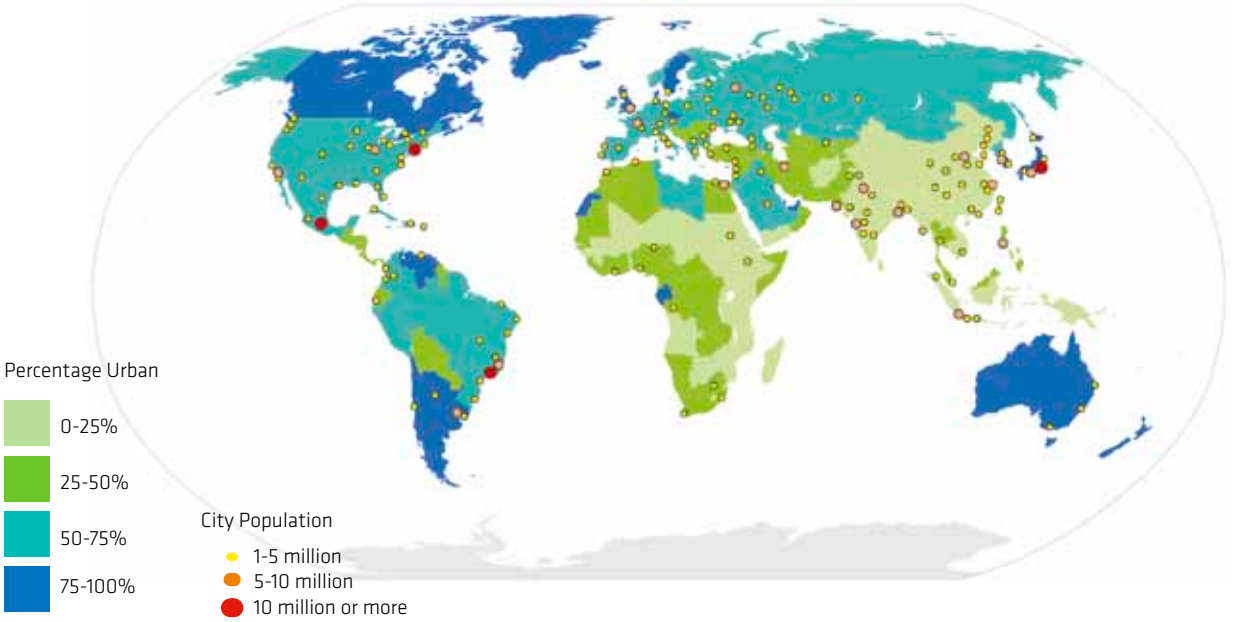
With the advent of civil aviation, the railway lost its role as the main means of transport for middle and long distances and has long been regarded as an outdated, slow and uncomfortable means of transportation. But in recent years, the railway has experienced a revival. With the introduction of electronic interlocking technology and agreement (for the time being) on a European system for the management and control of railway transport (ERTMS - European rail traffic management system), the railway is once again able to assume an important role in the transport infrastructure - especially over medium distances. Thanks to a variety of European, internationally operating system providers in the field of interlocking technology, the originally European system ERTMS has been experiencing an explosive worldwide spread over the past few years.

## Urbanisation

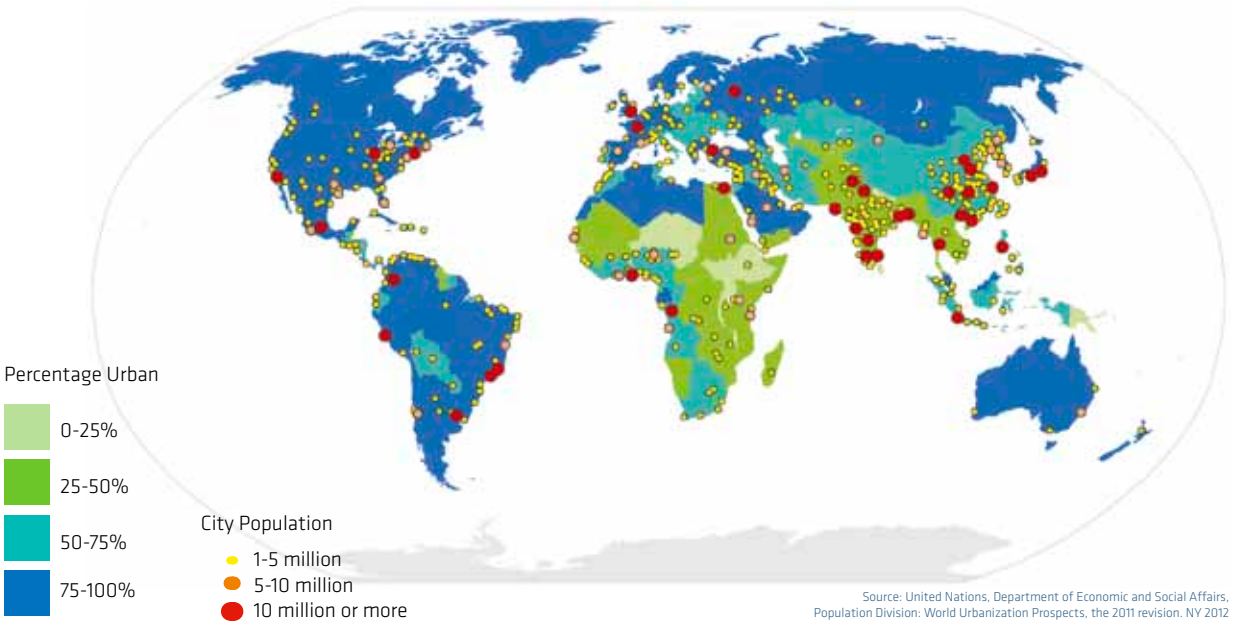
A major challenge for the railways as a means of mass transport, which is also an unparalleled opportunity, is represented by the increasing urbanisation of the world's population. In 2013, approximately 51% of almost 7 billion people lived on our planet in an urban environment. By 2050, not only will the world's population have increased to approximately 9 billion people, but the proportion of citizens living in cities will have grown to about 70%. Thus, some 6.3 billion people will reside every day in large cities and be on the move. Car-bound private transport is thus destined to collapse and a changeover to rail-based transportation is therefore without rival.

Tram and metro systems, regional trains and light rail vehicles will interconnect the cities into low-emission zones. Megacities are already in planning, such as the Chinese project „Turn The Pearl Delta Into One", in which nine cities with a total of 42 million people are to be merged into a single city. The most modern railway systems will form the backbone of this metropolis. A total of 29 lines with a network of altogether 1500 km will supply the region and allow transit times of maximum one hour from one end of town to the other.

## Percentage of urban population and agglomerations by size, class 1980




## Percentage of urban population and agglomerations by size, class 2025




Source: United Nations, Department of Economic and Social Affairs, Population Division: World Urbanization Prospects, the 2011 revision. NY 2012

# Development of technology

The safety requirements for the technology behind the visible rail are extraordinary and similar to that in aviation and aerospace. Rail vehicles cannot leave their track in case of imminent collision by opposing traffic on the same track. Single-track lines are frequently used in both directions to increase traffic volume. A continuous monitor providing permanent communication between the train driver's cab and the railway control center is essential for a railway line to be used safely.

This is where different technologies may intervene, which in the past were brought about by regional, country-specific developments. In Europe, there were and still are a number of train control technologies that work well in themselves, however, lead to considerable additional costs when it comes to cross-border traffic. Locomotives have more than one train control system installed these days, in order to be able to safely participate in railway traffic in neighbouring countries, without the need to change locomotives.

To clearly reduce the number of systems in the future, research was already started in the 80s on behalf of the International Union of Railways (UIC) and the European Rail Research Institute (ERRI), to develop a uniform operational management approach for railways across Europe. In April 2000, the guidelines for adopting a functional specification were decided under the name ERTMS (European Rail Traffic Management System).

The ERTMS system mainly consists of the following components:

- ETCS (European Train Control System) as a train control system, which is intended to prevent a train entering an occupied sector, or running at too high a speed, using interlocking electronic control systems, with integrated train and trackside elements.
- GSM-R (Global System for Mobile Communications - Railway) as a mobile communications system to meet the needs of the railway with regard to data and voice communications between moving trains and fixed location facilities and designed to satisfy the highest safety standards.

ERTMS was specifically developed for the routes of Trans-European Networks (TEN) and is also intended to be mainly used there. As already mentioned, ERTMS is gaining worldwide attention and will also be increasingly used globally.

Now, there are not only inter-city trains, but also urban rail traffic. Underground railways, light rail and trams are popular and used in urban areas preferably as short-haul transportation systems. Also, in this case, electronics is becoming more important, in the form of CBTC (Communication Based Train Control).

The ideas behind ETCS and CBTC are similar:
- high safety-level in traffic and
- high traffic density.

CBTC goes even one step further and offers fully automated train operation. The train starts and stops automatically without a driver.

CBTC also complies with international standards, yet, the systems of each individual manufacturer are not freely replaceable. The implementation of CBTC is highly complex and significantly more expensive than ERTMS would be on comparable routes. However, CBTC is unbeatable when it comes to achieving the shortest possible intervals between trains. Intervals of 60-90 seconds between trains are possible. During the peak morning and evening periods, thousands of commuters can comfortably be transported and hence the streets can be relieved of congestion.


Prysmian and Draka have accompanied this development from the outset and today are able to offer a full range of cables for all applications in the railway sector.

Prysmian Group has the experience and the know-how to assist you and your projects worldwide.

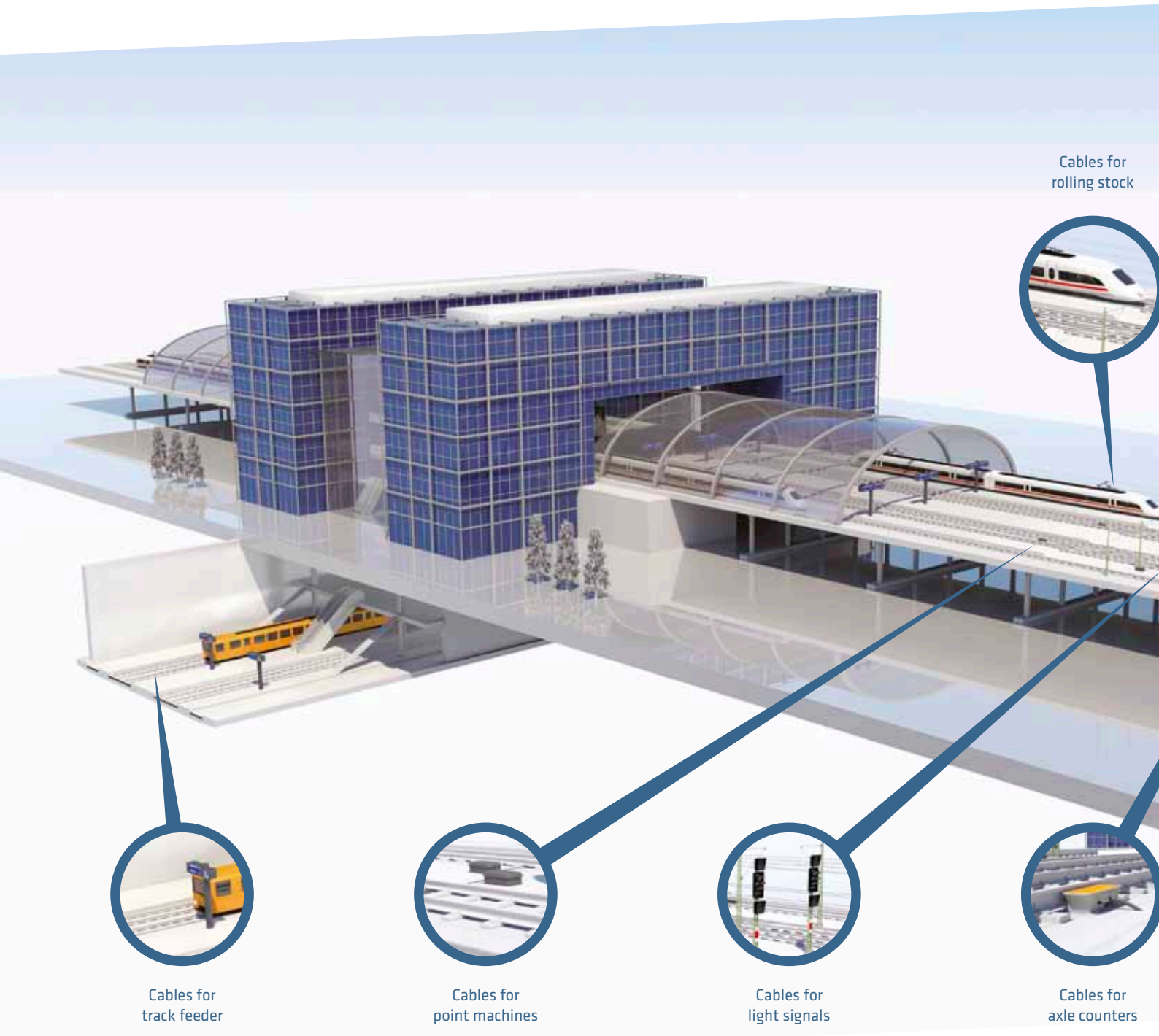
Railway projects are unique!

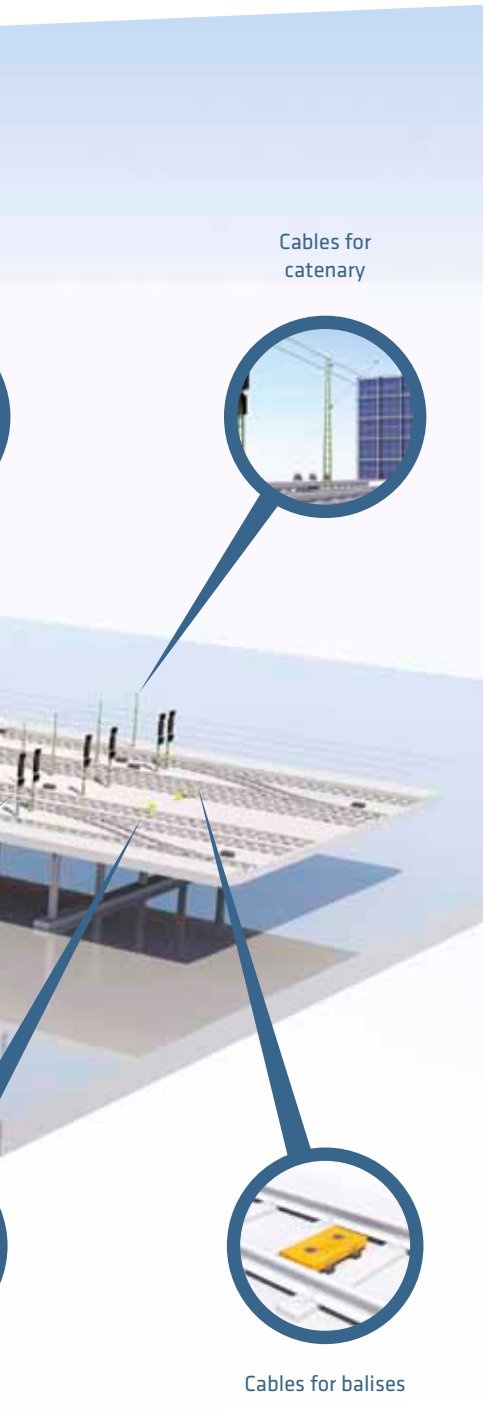
# Railway Infrastructure Cables

# Index

# Railway Infrastructure Cables

## Cables for any application






In principle, applications in the inter-city, metro and/or local traffic transport sectors are the same: the power supply of the trains, earth cables, points machines, signal lights, axle counters and beacons, as well as wireless technology such as GSM-R or radio communication. For all of these applications cables are needed.

**Power supply of trains**
- AC or DC, continuous load
- High currents and tensions
- Large conductor cross-sections

**Earthing**
- High return current flows
- Medium conductor cross-sections

**Point machines**
- Only short-term power load, no continuous load, ≤ 380 V
- Small conductor cross-sections up to 2.5 mm² normally sufficient

**Signal lights**
- Continuous load, low tensions and currents, 24-48 V
- Small conductor cross-sections up to 2.5 mm² sufficient

**Axle counters**
- Hf requirements
- No continuous load
- Small conductor cross-sections up to 2.5 mm² are sufficient

**Beacon cables**
- Hf requirements
- No continuous load
- Small conductor cross-sections up to 2.5 mm² are sufficient as a rule

**GSM-R/radio communication**
- Data supply via fibre optic cables
- Use of radiating coaxial cables in tunnels
- Telecommunication and data cables

# Railway Cable Standards

Historically, a variety of national regulations and standards has evolved within Europe for cables used in railway infrastructures. The specifications of Deutsche Bahn (Germany), SNCF (France) and adif (Spain) are considered to be leading and globally more or less a quasi standard for certain applications and regions. Other countries such as Italy, Romania, Norway, England and many others maintain their own national standards.

| Country | Operator | Standard | Cable type |
|---|---|---|---|
| Germany | DB | PH 416.0113 v1.1 | A-2Y2YB2Y n x 1 x 0.9/1.4/1.8 mm S (H115/H145) |
| | | | AJ-2Y2YDB2Y n x 1 x 0.9/1.4/1,8 mm S (H115/145) |
| | | PH 416.0113 v2.1 | A-2YOF(L)2YB2Y n x 1 x 0.9/1.4/1.8 mm S (H115/H145) |
| | | | AJ-2YOF(L)2YDB2Y n x 1 x 0.9/1.4/1,8 mm S (H115/145) |
| | | PH 416.0114 v2.1 | A-2YOF(L)2YB2Y n x 1 x 1.4/1.8 mm S (H95) |
| | | | AJ-2YOF(L)2YDB2Y n x 1 x 1.4/1,8 mm S (H95) |
| | | PH 416.0115 v1.1 | A-2Y(L)2YB2Y n x 4 x 0.9/1.4 mm S (H45) |
| | | | AJ-2Y(L)2YDB2Y n x 4 x 0.9/1.4 mm S (H45) |
| | | PH 416.113 v1.1 (based on) | A-HHBH n x 1 x 0.9/1.4/1.8 mm S (H115/H145) |
| | | | A-H(L)HBH n x 1 x 0.9/1.4 mm S (H45) |
| | | PH 416.0120 | A-2Y(L)2YB2Y 1 x 4 x 1.4 / 1.53 mm Balise |
| | | | AJ-2Y(L)2YDB2Y 1 x 4 x 1.4 / 1.53 mm Balise |
| | | PH 416.0118 | A-2Y(L)2Y2YV n x 4 x 0.9/1.4 mm + m x 1 x 0.9/1.4/1.8 mm combi cable |
| | | | A-2Y(L)2YB2Y n x 4 x 0.9/1.4 mm + m x 1 x 0.9/1.4/1.8 mm combi cable |
| | | | AJ-2Y(L)2YDB2Y n x 4 x 0.9/1.4 mm + m x 1 x 0.9/1.4/1.8 mm combi cable |
| | | Arcor TNP 02/05 | AJ-02YSTF(L)2YDB2Y n x 4 x 0.9 / 1.4 mm STI LG |
| Austria | ÖBB | ÖVE-K10 | S-2Y2YBY n x 0.75 / 1.5 / 2.5 / 4 / 6 mm² RE |
| | | | S-2Y2YB2Y n x 0.75 / 1.5 / 2.5 / 4 / 6 mm² RE |
| | | | S-2Y2YCB2Y n x 1.5 / 2.5 / 4 mm² RE (J 0.65) HD |
| | | | S-2Y2YBY n x 4 x 0.9 / 1.4 / 1.8 mm |
| | | | S-2Y2YCBY n x 4 x 0.9 / 1.4 / 1.8 mm RE (J 0.65) HD |
| Switzerland | SBB | I-PS 3001.82.1000 | Sw-CLT n x 4 x 1.5 / 2.2 mm |
| | | I-AT-FS 3001.52.2000 | PE-ALT-CLT 1 x 4 x 1.53 mm balise cable |
| Hungary | MÁV | P-12440/2002 | BRQKAtQAhVQ n x 1 x 1.5 mm / 2.5 mm |
| | | P-6014/2012 (TEBF amend. No. 3) | ERQ 1 x 4 x 1.53 mm |
| | | P-2518/2002 (P-3197/2008 amend.1) | HvrQ n x 4 x 0.8 mm |
| | | P-12440/2002 (P-3196/2008 amend.1, P-692/2011 amend.2) | JRQ n x 4 x 1.5 / 1.8 mm |

Prysmian has been offering cables and solutions for these standards and has been supplying many of these countries for many years.

The following overview provides an extract of the most common cables. Many other cable designs are available upon request.

| | Insulation material | Twisting | Watertightness | Moisture barrier sheath | Screen/ induction protection | Armour | Outer sheath material | Reduction factor |
|---|---|---|---|---|---|---|---|---|
| | PE | cores | - | - | - | steel tape | PE | - |
| | PE | cores | - | - | CU wires | steel tape | PE | yes |
| | PE | cores | jelly filling | AL/PET-PE | - | steel tape | PE | - |
| | PE | cores | jelly filling | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | cores | jelly filling | AL/PET-PE | - | steel tape | PE | - |
| | PE | cores | jelly filling | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | quads | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | cores | - | - | - | steel tape | LSZH-FR | - |
| | PE | quads | - | AL/PET-PE | - | steel tape | LSZH-FR | - |
| | PE | quads | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | quads/cores | - | AL/PET-PE | - | - | PE | - |
| | PE | quads/cores | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | quads/cores | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | foam-skin-PE | quads | swellable yarns/fleeces | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | cores | - | - | - | steel tape | PVC | - |
| | PE | cores | - | - | - | steel tape | PE | - |
| | PE | cores | - | - | CU wires | steel tape | PE | yes |
| | PE | quads | - | - | - | steel tape | PE | - |
| | PE | quads | - | - | CU wires | steel tape | PE | yes |
| | PE | quads | - | - | - | steel tape | PE | - |
| | PE | quads | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | cores | - | AL/PET-PE | AL tape | steel tape | PE | yes |
| | PE | quads | - | AL/PET-PE | - | steel tape | PE | - |
| | foam-skin-PE | quads | jelly filling | AL/PET-PE | CU wires | - | PE | yes |
| | PE | quads | - | - | CU wires | steel tape | PE | yes |

# Railway Cable Standards

| Country | Operator | Standard | Cable type |
|---|---|---|---|
| Spain | adif/RENFE | E.T. 03.365.051.6 | EAPSP n x 1 x 0.9/1.4 mm |
| | | | EAPSP n x 4 x 0.9/1.4 mm |
| | | | EAPSP-R n x 1 x 0.9/1.4 mm |
| | | | EAPSP-R n x 4 x 0.9/1.4 mm |
| | | | EATST n x 1 x 0.9/1.4 mm |
| | | | EATST n x 4 x 0.9/1.4 mm |
| | | | CCPSSP-FR0.3 n x 1 x 0.9/1.4 mm |
| | | | CCPSSP-FR0.1 n x 1 x 0.9/1.4 mm |
| | | | CCPSSP-FR0.3 n x 4 x 0.9/1.4 mm |
| | | | CCPSSP-FR0.1 n x 4 x 0.9/1.4 mm |
| | | | CCTSST-FR0.3 n x 1 x 0.9/1.4 mm |
| | | | CCTSST-FR0.1 n x 1 x 0.9/1.4 mm |
| | | | CCTSST-FR0.3 n x 4 x 0.9/1.4 mm |
| | | | CCTSST-FR0.1 n x 4 x 0.9/1.4 mm |
| France | SNCF | NF F 55-698 & CT445 | ZPAU n x 2 x 1.0 mm² |
| | | | ZPFU n x 2 x1.0 mm² |
| | | | ZC03 4 x 4 x 1.0 mm² |
| Belgium | Infrabel | S-21, I-I.313 | SXCAV n x 2 x 1.5 mm² |
| Norway | Jernbaneverket | | FTGS n x 4 x 0.9 / 1.4 mm |
| | | | FEBI n x 1.5 / 2.5 mm² |
| Czech/Slovakia | ČD / ŽSR | TP31.30.13 KD-001/96 | TCEKPFLEY n x 2 x 1.0 mm type „C“ or „D“ |
| | | | TCEKPFLEZE n x 2 x 1.0 mm type „C“ or „D“ |
| Romania | CFR/AFER | STAS 8779-86 | CS2YAb2YFR1 n x 1 x 1.0 / 1.5 / 2.5 mm² |
| | | | CS2YEAlAb2YFR1 n x 1 x 1.0 / 1.5 / 2.5 mm² |
| Turkey | TCDD | PYSEK-R | AJ-2Y2Y(St)2YB2Y-FR0.3 n x 1 x 0.9 mm / 1.4 mm |
| | | | AJ-2Y2Y(St)2YB2Y-FR0.3 n x 4 x 0.9 mm / 1.4 mm |
| | | | AJ-02YS2YD2YB2Y-FR0.1 n x 4 x 0.9 mm |
| Italy | RFI | STF DTCSTSSTB SF IS 06 200 | UG7OG7KNR / RG7OG7KNR n x 1 / 2.5 / 4 / 6 / 10 / 16 / 25 mm² |
| | | Digicode | DIGICODE 2 x 2 x 1.4 + 1 x 2 x 0.6 mm |

| | Insulation material | Twisting | Watertightness | Moisture barrier sheath | Screen/ induction protection | Armour | Outer sheath material | Reduction factor |
|---|---|---|---|---|---|---|---|---|
| | PE | cores | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | quads | - | AL/PET-PE | - | steel tape | PE | - |
| | PE | cores | jelly filling | AL/PET-PE | - | steel tape | PE | - |
| | PE | quads | jelly filling | AL/PET-PE | - | steel tape | PE | - |
| | PE | cores | - | AL/PET-PE | - | steel tape | LSZH-FR | - |
| | PE | quads | - | AL/PET-PE | - | steel tape | LSZH-FR | - |
| | PE | cores | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | cores | - | AL/PET-PE | CU wires | steel tapes | PE | yes |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | PE | yes |
| | PE | cores | - | AL/PET-PE | CU wires | steel tape | LSZH-FR | yes |
| | PE | cores | - | AL/PET-PE | CU wires | steel tape | LSZH-FR | yes |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | LSZH-FR | yes |
| | PE | quads | - | AL/PET-PE | CU wires | steel tape | LSZH-FR | yes |
| | PE | pairs | - | - | CU wires | steel tape | PVC | yes |
| | PE | pairs | - | - | - | steel tape | PVC | - |
| | PE | quads | - | - | CU wires | steel tape | PVC | yes |
| | XLPE | pairs | - | - | CU wires | steel tape | PVC | yes |
| | PE | quads | - | - | CU wires | - | LSZH-FR | - |
| | PE | cores | jelly filling | - | - | steel tape | LSZH-FR | - |
| | PE | pairs | jelly filling | AL/PET-PE | - | - | PE/PVC | - |
| | PE | pairs | jelly filling | AL/PET-PE | AL wires | - | PE/PVC | yes |
| | PE | cores | - | - | - | steel tape | LSZH-FR | - |
| | PE | cores | - | - | AL wires | steel tape | LSZH-FR | yes |
| | PE | cores | - | - | CU tape | steel tape | PE | yes |
| | PE | quads | - | - | CU tape | steel tape | PE | yes |
| | foam-skin-PE | quads | - | - | CU tape | steel tape | PE | yes |
| | HEPR | cores | - | - | - | steel tape | PVC | - |
| | foam-skin-PE | pairs | - | AL/PET-PE | - | steel tape | LSZH-FR | - |

# VDE designation codes for cables

**1. Cable Type**

| | |
|---|---|
| A- | Outdoor cable |
| AJ- | Outdoor cable with protection against inductive interference |

**2. Cable Design**

| | |
|---|---|
| 2Y | Polyethylene (PE) insulation material |
| 02Y | Cellular polyethylene (PE) insulation material |
| 02YS | Foam-skin polyethylene (PE) insulation material |
| DF | Loose tube (fibre optic cable) |
| F | Petroleum jelly filling compound |
| OF | Low capacitance filling compound |
| TF | Filling with water swellable yarns and fleeces |
| (L)2Y | Moisture barrier sheath (laminated AL-foil bonded to PE sheath) |
| (St) | Screen of copper tape |
| D | Screen of concentrically positioned copper wires |
| Z | Screen of concentrically positioned aluminium wires |
| (ZN) | Non-metallic tensile strength elements |
| (SR) | Armouring of corrugated steel tape, longitudinally apllied |
| B | Armouring of helically applied steel tape |
| Y | Polyvinyl chloride (PVC) sheathing material |
| 2Y | Polyethylene (PE) sheathing material |
| 4Y | Polyamid (PA) sheathing material |
| H | Halogen free, flame retardant sheathing material |
| V | Reinforced sheathing |

LSZH-FR

| | |
|---|---|
| LS | Low smoke |
| ZH | Zero halogen |
| FR | Flame/Fire retardant |

# Explanation of symbols

**Ambient temperature**

Permissible ambient temperature ranges.
[ °C during installation ]
[ °C during operation and storage ]

**Short circuit temperature**


Maximum permissible short circuit temperature at conductor [ °C ]

**Fire behaviour**

EN/IEC 60332-1 flame retardant or
EN/IEC 60332-3 fire retardant or
EN/IEC 50200 fire resistant (only if applicable)

**Smoke emission**


EN/IEC 61034

**Toxicity/Acidity**

EN/IEC 60754-1
EN/IEC 60695

**Insect resistance**

Insect and termite resistant

**Bending radius**


Minimum bending radius for installed cables in fixed applications.
[for multiple bending]
[for final bending]
D = outer cable diameter

# Railway Infrastructure Cables

# Popular railway cable data sheets

## Index of data sheets

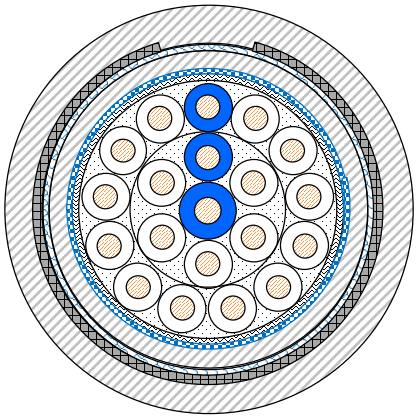


Many more cable types and tailor-made cables are available for your individual application.

# Signalling Cable

## A-2YOF(L)2YB2Y (H115/H145)

### n x 1 x 0.9 mm / 1.4 mm / 1.8 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment, up to 420 V AC / 600 V DC.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm or 1.8 mm of diameter

**Insulation**
PE, natural coloured, with one blue marker core in each layer

**Twisting**
Cores laid up in layers

**Filling**
Special filling compound

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Optional without armouring as A-2YOF(L)2YV.
- Detailed data sheet available upon request.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to PH 416.0113 V2.1 of Deutsche Bahn
> Logitudinally watertight
> Core stranded, steel tape armoured

| Characteristics | Unit | 0.9 mm | 1.4 mm | 1.8 mm |
|---|---|---|---|---|
| Conductor resistance | Ω/km | ≤ 28.9 | ≤ 11.9 | ≤ 7.2 |
| Insulation resistance | GΩxkm | ≥ 1.5 | ≥ 1.5 | ≥ 1.5 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 115 [1)] | ≤ 145 [2)] | ≤ 145 [2)] |
| Operating voltage DC/AC | V | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 |
| Test voltage at 50 Hz - 1 min | | | | |
| core/core | $V_{rms}$ | 2500 | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 | 2500 |

[1)] ≤ 120 nF/km for single core in center
[2)] ≤ 155 nF/km for single core in center

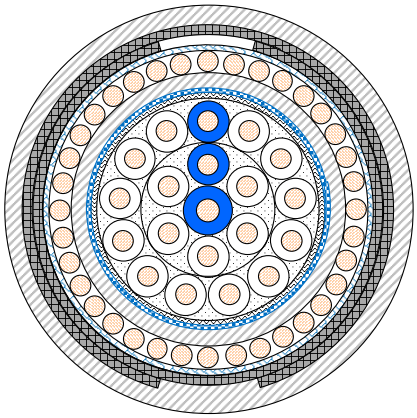
## A-2YOF(L)2YB2Y

| No. of cores | n x 1 x 0.9 mm (H115) | | | n x 1 x 1.4 mm (H145) | | | n x 1 x 1.8 mm (H145) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 2 | 13.0 | 160 | 1000 | - | - | - | - | - | - |
| 4 | 13.0 | 170 | 1000 | 14.0 | 240 | 1000 | 16.0 | 300 | 1000 |
| 7 | 14.0 | 220 | 1000 | 17.0 | 320 | 1000 | 19.0 | 430 | 1000 |
| 10 | 17.0 | 290 | 1000 | 18.0 | 410 | 1000 | 21.0 | 560 | 1000 |
| 14 | 17.0 | 300 | 1000 | 19.0 | 490 | 1000 | 22.0 | 680 | 1000 |
| 20 | 18.0 | 380 | 1000 | 22.0 | 630 | 1000 | 25.0 | 890 | 1000 |
| 24 | 20.0 | 460 | 1000 | 23.0 | 730 | 1000 | 27.0 | 1060 | 1000 |
| 30 | 20.0 | 490 | 1000 | 24.0 | 840 | 1000 | 29.0 | 1230 | 1000 |
| 40 | 21.0 | 590 | 1000 | 27.0 | 1050 | 1000 | 32.0 | 1560 | 1000 |
| 50 | 23.0 | 700 | 1000 | 29.0 | 1280 | 1000 | 36.0 | 1940 | 1000 |
| 60 | 25.0 | 800 | 1000 | 32.0 | 1490 | 1000 | 38.0 | 2280 | 1000 |
| 80 | 26.0 | 1000 | 1000 | 35.0 | 1920 | 1000 | 42.0 | 2920 | 1000 |
| 100 | 27.5 | 1250 | 1000 | 39.0 | 2350 | 1000 | 47.0 | 3630 | 500 |
| 120 | 32.0 | 1390 | 1000 | 41.0 | 2730 | 1000 | 49.0 | 4230 | 500 |
| 140 | 35.0 | 1650 | 1000 | 44.0 | 3140 | 1000 | 53.0 | 4890 | 500 |
| 160 | 36.0 | 1790 | 1000 | 46.0 | 3540 | 500 | 55.0 | 5490 | 500 |
| 180 | 39.0 | 2030 | 1000 | 49.0 | 3970 | 500 | 59.0 | 6160 | 500 |
| 200 | 39.0 | 2150 | 1000 | 50.0 | 4310 | 500 | 60.0 | 6710 | 500 |

# Signalling Cable

## AJ-2YOF(L)2YDB2Y (H115/H145)

### n x 1 x 0.9 mm / 1.4 mm / 1.8 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment, up to 420 V AC / 600 V DC. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm or 1.8 mm of diameter

**Insulation**
PE, natural coloured, with one blue marker core in each layer

**Twisting**
Cores laid up in layers

**Filling**
Special filling compound

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Shielding**
Concentrically positioned copper wires

**Armouring**
Two layers of galvanized steel tape 0.5 mm or 0.8 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to PH 416.0113 V2.1 of Deutsche Bahn
> Logitudinally watertight
> Core stranded, steel tape armoured
> Protected against inductive interference

| Characteristics | Unit | 0.9 mm | 1.4 mm | 1.8 mm |
|---|---|---|---|---|
| Conductor resistance | Ω/km | ≤ 28.9 | ≤ 11.9 | ≤ 7.2 |
| Insulation resistance | GΩxkm | ≥ 1.5 | ≥ 1.5 | ≥ 1.5 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 115 [1] | ≤ 145 [2] | ≤ 145 [2] |
| Operating voltage DC/AC | V | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 |
| Test voltage at 50 Hz - 1 min | | | | |
| core/core | $V_{rms}$ | 2500 | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 | 2500 |

[1] ≤ 120 nF/km for single core in center
[2] ≤ 155 nF/km for single core in center

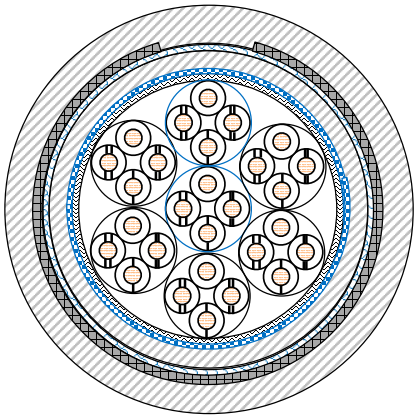
## AJ-2YOF(L)2YDB2Y

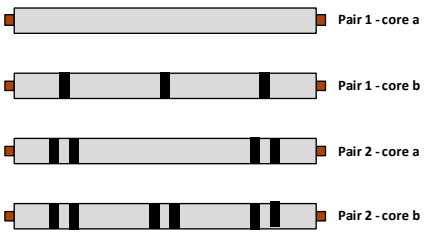
| | | n x 1 x 0.9 mm (H115) | | | n x 1 x 1.4 mm (H145) | | | n x 1 x 1.8 mm (H145) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of cores | Reduction factor class $r_k$ | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 10 | 600 | 21.0 | 650 | 1000 | 22.0 | 790 | 1000 | 25.0 | 1010 | 1000 |
| 20 | 600 | 22.0 | 750 | 1000 | 26.0 | 1090 | 1000 | 29.0 | 1420 | 1000 |
| 30 | 600 | 24.0 | 900 | 1000 | 28.0 | 1350 | 1000 | 33.0 | 1840 | 1000 |
| 50 | 600 | 27.0 | 1190 | 1000 | 33.0 | 1890 | 1000 | 39.0 | 2670 | 1000 |
| 80 | 600 | 30.0 | 1560 | 1000 | 32.0 | 2630 | 1000 | 42.0 | 3770 | 500 |
| 120 | 600 | 35.0 | 2040 | 1000 | 44.0 | 3560 | 1000 | 52.0 | 5210 | 500 |
| 160 | 600 | 39.0 | 2500 | 1000 | 49.0 | 4460 | 500 | 58.0 | 6600 | 500 |
| 200 | 600 | 41.0 | 2930 | 1000 | 53.0 | 5290 | 500 | 63.0 | 7900 | 250 |
| 10 | 500 | 21.0 | 750 | 1000 | 22.0 | 920 | 1000 | 25.0 | 1150 | 1000 |
| 20 | 500 | 22.0 | 870 | 1000 | 26.0 | 1230 | 1000 | 29.0 | 1570 | 1000 |
| 30 | 500 | 24.0 | 1040 | 1000 | 28.0 | 1490 | 1000 | 33.0 | 2010 | 1000 |
| 50 | 500 | 27.0 | 1320 | 1000 | 33.0 | 2080 | 1000 | 32.0 | 2870 | 1000 |
| 80 | 500 | 30.0 | 1740 | 1000 | 38.0 | 2850 | 1000 | 46.0 | 4090 | 500 |
| 120 | 500 | 35.0 | 2230 | 1000 | 45.0 | 3380 | 500 | 53.0 | 5560 | 500 |
| 160 | 500 | 39.0 | 2720 | 1000 | 50.0 | 4790 | 500 | 59.0 | 6980 | 250 |
| 200 | 500 | 41.0 | 3160 | 1000 | 54.0 | 5650 | 500 | 64.0 | 8320 | 250 |
| 30 | 400 | - | - | - | - | - | - | 36.0 | 2690 | 1000 |
| 50 | 400 | - | - | - | 36.0 | 2770 | 1000 | 43.0 | 3800 | 500 |
| 80 | 400 | - | - | - | 42.0 | 3770 | 500 | 49.0 | 5100 | 500 |
| 120 | 400 | - | - | - | 48.0 | 4870 | 500 | 56.0 | 6730 | 500 |
| 160 | 400 | - | - | - | 53.0 | 5880 | 500 | 62.0 | 8290 | 250 |
| 200 | 400 | - | - | - | 57.0 | 6830 | 500 | 67.0 | 9730 | 250 |

# Axle Counter Signalling Cable

## A-2Y(L)2YB2Y (H45)

### n x 4 x 0.9 mm / 1.4 mm






## APPLICATION

In railway signalling applications for transmission of low frequent signal through symmetric circuits, for example axle counter devices and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, natural coloured with ring marking, each first quad in layer carries a blue helix, all other quads carry white helixes

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Optional without armouring as A-2Y(L)2YV.
- Detailed data sheet available upon request.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to PH 416.0115 V1.1 of Deutsche Bahn
> Star quad stranded, steel tape armoured

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor loop resistance | Ω/km | ≤ 56.6 | ≤ 23.4 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 45 [1)] | ≤ 45 [1)] |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ (100 % / 50 % of all values) | pF/500 m | ≤ 650 / ≤ 150 | ≤ 650 / - |
| $k_{9\text{-}12}$ neighboured quads | pF/500 m | ≤ 500 / ≤ 150 | ≤ 500 / - |
| $k_{9\text{-}12}$ over-neighboured quads | pF/500 m | ≤ 150 | ≤ 150 |
| $e_{a1/2}$ | pF/500 m | ≤ 1300 | ≤ 1300 |
| Far-end crosstalk attenuation at 90 kHz | | | |
| 100 % / 80 % of all values | dB/km | ≥ 58 / ≥ 62 | ≥ 33 / - |
| Attenuation at 90 kHz | dB/km | ≤ 3.3 | ≤ 2.6 |
| Test voltage at 50 Hz - 1 min | | | |
| core/core | $V_{rms}$ | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 |

[1)] ≤ 52 nF/km for 1 x 4 x ø and for central quads, where 1st layer consist only of one quad, as well as in the outer layer of armoured cables.

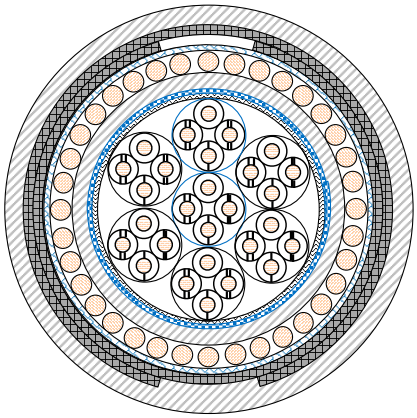
## A-2Y(L)2YB2Y

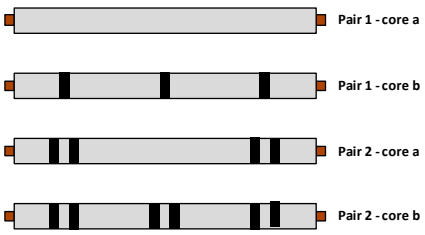
| No. of quads | n x 4 x 0.9 mm (H45) | | | n x 4 x 1.4 mm (H45) | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 12.0 | 190 | 1000 | 14.0 | 260 | 1000 |
| 3 | 17.0 | 330 | 1000 | 21.0 | 570 | 1000 |
| 5 | 19.0 | 470 | 1000 | 24.0 | 820 | 1000 |
| 7 | 21.0 | 580 | 1000 | 26.0 | 1020 | 1000 |
| 10 | 24.0 | 750 | 1000 | 33.0 | 1190 | 1000 |
| 14 | 27.0 | 940 | 1000 | 36.0 | 1550 | 1000 |
| 20 | 30.0 | 1030 | 1000 | 42.0 | 2070 | 1000 |
| 30 | 36.0 | 1430 | 1000 | 49.0 | 2900 | 1000 |
| 40 | 40.0 | 1810 | 1000 | 55.0 | 3730 | 500 |

# Axle Counter Signalling Cable

## AJ-2Y(L)2YDB2Y (H45)

### n x 4 x 0.9 mm / 1.4 mm






## APPLICATION

In railway signalling applications for transmission of low frequent signal through symmetric circuits, for example axle counter devices and similar wayside equipment. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, natural coloured with ring marking, each first quad in layer carries a blue helix, all other quads carry white helixes

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Shielding**
Concentrically positioned copper wires

**Armouring**
Two layers of galvanized steel tape 0.5 mm or 0.8 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D

EN/IEC 61034

> Signalling cable acc. to PH 416.0115 V1.1 of Deutsche Bahn
> Star quad stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor loop resistance | Ω/km | ≤ 56.6 | ≤ 23.4 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 45 [1)] | ≤ 45 [1)] |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ (100 % / 50 % of all values) | pF/500 m | ≤ 650 / ≤ 150 | ≤ 650 / - |
| $k_{9\text{-}12}$ neighboured quads | pF/500 m | ≤ 500 / ≤ 150 | ≤ 500 / - |
| $k_{9\text{-}12}$ over-neighboured quads | pF/500 m | ≤ 150 | ≤ 150 |
| $e_{a1/2}$ | pF/500 m | ≤ 1300 | ≤ 1300 |
| Far-end crosstalk attenuation at 90 kHz | | | |
| 100 % / 80 % of all values | dB/km | ≥ 58 / ≥ 62 | ≥ 33 / - |
| Attenuation at 90 kHz | dB/km | ≤ 3.3 | ≤ 2.6 |
| Test voltage at 50 Hz - 1 min | | | |
| core/core | $V_{rms}$ | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 |

[1)] ≤ 52 nF/km for 1 x 4 x ø and for central quads, where 1st layer consist only of one quad, as well as in the outer layer of armoured cables.

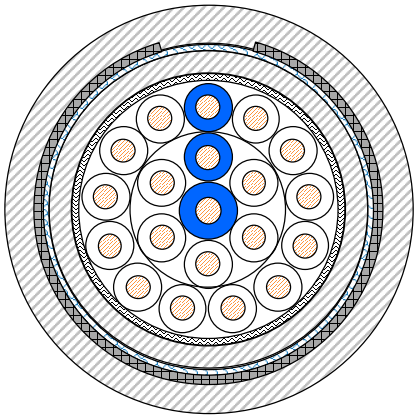
## AJ-2Y(L)2YDB2Y

| | | n x 4 x 0.9 mm (H45) | | | n x 4 x 1.4 mm (H45) | | |
|---|---|---|---|---|---|---|---|
| No. of quads | Reduction factor class $r_k$ | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 3 | 600 | 21.0 | 800 | 1000 | - | - | - |
| 5 | 600 | 23.0 | 1010 | 1000 | - | - | - |
| 10 | 600 | 28.0 | 1430 | 1000 | - | - | - |
| 20 | 600 | 35.0 | 2130 | 1000 | - | - | - |
| 30 | 600 | 40.0 | 2800 | 1000 | - | - | - |
| 40 | 600 | 45.0 | 3380 | 1000 | - | - | - |
| 3 | 500 | - | - | - | 25.0 | 1350 | 1000 |
| 5 | 500 | - | - | - | 29.0 | 1760 | 1000 |
| 10 | 500 | - | - | - | 37.0 | 2620 | 1000 |
| 20 | 500 | - | - | - | 47.0 | 4040 | 500 |
| 30 | 500 | - | - | - | 54.0 | 5330 | 500 |
| 40 | 500 | - | - | - | 61.0 | 6550 | 500 |
| 5 | 400 | - | - | - | 31.0 | 2470 | 1000 |
| 10 | 400 | 31.0 | 2250 | 1000 | 39.0 | 3610 | 1000 |
| 20 | 400 | 38.0 | 3240 | 1000 | 49.0 | 5260 | 500 |
| 30 | 400 | 43.0 | 4080 | 500 | 56.0 | 6690 | 500 |
| 40 | 400 | 48.0 | 4800 | 500 | 63.0 | 8070 | 250 |

# Signalling Cable for Tunnels

## A-HHBH (H115/H145)

### n x 1 x 0.9 mm / 1.4 mm / 1.8 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment, up to 420 V AC / 600 V DC. For use in areas with risk of fire, indoor or in tunnel sections.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm or 1.8 mm of diameter

**Insulation**
LSZH PE, natural coloured, with one blue marker core in each layer

**Twisting**
Cores laid up in layers

**Inner sheath**
LSZH-FR PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
LSZH-FR PE, black

## Notes

- Optional without armouring as A-HHV.
- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C


≥ 10 x D
≥ 7.5 x D

EN/IEC 61034


EN/IEC 60754-1


EN/IEC 60332-3

> Signalling cable based on PH 416.0113 V1.1 of Deutsche Bahn
> Core stranded, steel tape armoured
> Low smoke, halogen free and flame retardant design

| Characteristics | Unit | 0.9 mm | 1.4 mm | 1.8 mm |
|---|---|---|---|---|
| Conductor resistance | Ω/km | ≤ 28.9 | ≤ 11.9 | ≤ 7.2 |
| Insulation resistance | GΩxkm | ≥ 1.5 | ≥ 1.5 | ≥ 1.5 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 115 [1)] | ≤ 145 [2)] | ≤ 145 [2)] |
| Operating voltage DC/AC | V | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 | ≤ 600/ ≤ 420 |
| Test voltage at 50 Hz - 1 min | | | | |
| core/core | $V_{rms}$ | 2500 | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 | 2500 |

[1)] ≤ 120 nF/km for single core in center
[2)] ≤ 155 nF/km for single core in center

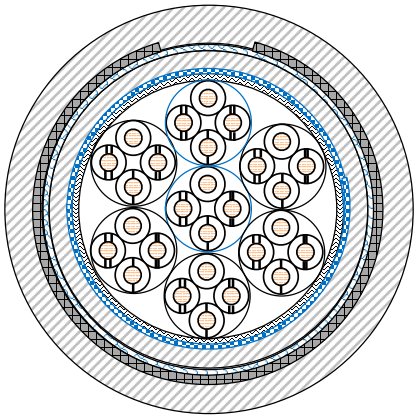
## A-HHBH

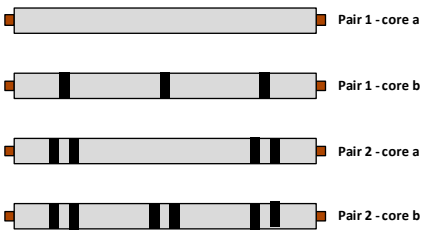
| No. of cores | n x 1 x 0.9 mm (H115) | | | n x 1 x 1.4 mm (H145) | | | n x 1 x 1.8 mm (H145) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 2 | 12.0 | 190 | 1000 | - | - | - | - | - | - |
| 4 | 12.5 | 209 | 1000 | 14.0 | 280 | 1000 | 15.5 | 330 | 1000 |
| 7 | 13.5 | 254 | 1000 | 15.5 | 358 | 1000 | 17.0 | 440 | 1000 |
| 10 | 15.0 | 315 | 1000 | 17.5 | 457 | 1000 | 20.0 | 580 | 1000 |
| 14 | 15.5 | 355 | 1000 | 18.5 | 547 | 1000 | 21.0 | 710 | 1000 |
| 20 | 16.5 | 421 | 1000 | 20.0 | 682 | 1000 | 24.0 | 925 | 1000 |
| 24 | 18.5 | 489 | 1000 | 22.0 | 785 | 1000 | 26.0 | 1060 | 1000 |
| 30 | 19.0 | 537 | 1000 | 23.0 | 901 | 1000 | 27.0 | 1240 | 1000 |
| 40 | 20.0 | 631 | 1000 | 24.5 | 1098 | 1000 | 30.0 | 1560 | 1000 |
| 50 | 22.0 | 746 | 1000 | 27.5 | 1319 | 1000 | - | - | - |
| 60 | 23.0 | 840 | 1000 | 29.0 | 1506 | 1000 | - | - | - |
| 80 | 25.0 | 1023 | 1000 | - | - | - | - | - | - |
| 100 | 28.0 | 1228 | 1000 | 36.0 | 2324 | 1000 | - | - | - |
| 120 | 29.0 | 1389 | 1000 | - | - | - | - | - | - |
| 140 | 31.0 | 1575 | 1000 | 40.5 | 3062 | 1000 | - | - | - |

# Axle Counter Signalling Cable for Tunnels

## A-H(L)HBH (H45)

### n x 4 x 0.9 mm / 1.4 mm






## APPLICATION

In railway signalling applications for transmission of low frequent signal through symmetric circuits, for example axle counter devices and similar wayside equipment. For use in areas with risk of fire, indoor or in tunnel sections.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
LSZH PE, natural coloured with ring marking, each first quad in layer carries a blue helix, all other quads carry white helixes

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
LSZH-FR PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
LSZH-FR PE, black

## Notes

- Optional without armouring as A-H(L)HV.
- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C


≥ 10 x D
≥ 7.5 x D

EN/IEC 61034


EN/IEC 60754-1


EN/IEC 60332-3

> Signalling cable based on PH 416.0115 V1.1 of Deutsche Bahn
> Star quad stranded, steel tape armoured
> Low smoke, halogen free and flame retardant design

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor loop resistance | Ω/km | ≤ 56.6 | ≤ 23.4 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 45 [1)] | ≤ 45 [1)] |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ (100 % / 50 % of all values) | pF/500 m | ≤ 650 / ≤ 150 | ≤ 650 / - |
| $k_{9\text{-}12}$ neighboured quads | pF/500 m | ≤ 500 / ≤ 150 | ≤ 500 / - |
| $k_{9\text{-}12}$ over-neighboured quads | pF/500 m | ≤ 150 | ≤ 150 |
| $e_{a1/2}$ | pF/500 m | ≤ 1300 | ≤ 1300 |
| Far-end crosstalk attenuation at 90 kHz | | | |
| 100 % / 80 % of all values | dB/km | ≥ 58 / ≥ 62 | ≥ 33 / - |
| Attenuation at 90 kHz | dB/km | ≤ 3.3 | ≤ 2.6 |
| Test voltage at 50 Hz - 1 min | | | |
| core/core | $V_{rms}$ | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 |

[1)] ≤ 52 nF/km for 1 x 4 x ø and for central quads, where 1st layer consist only of one quad, as well as in the outer layer of armoured cables.

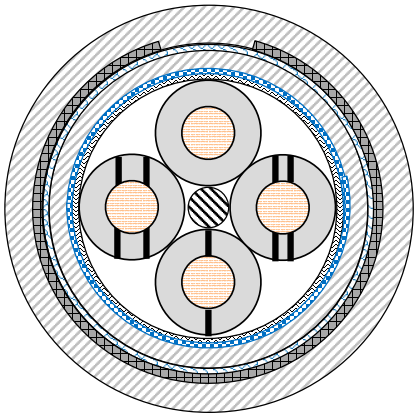
## A-H(L)HBH

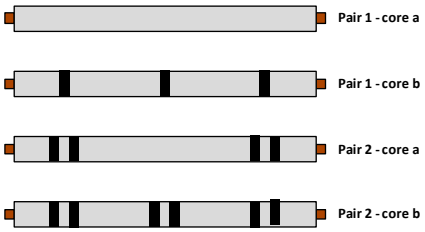
| No. of quads | n x 4 x 0.9 mm (H45) | | | n x 4 x 1.4 mm (H45) | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 13.5 | 260 | 1000 | 15.5 | 350 | 1000 |
| 3 | 18.0 | 450 | 1000 | 22.5 | 680 | 1000 |
| 5 | 20.5 | 580 | 1000 | 26.0 | 930 | 1000 |
| 7 | 22.0 | 680 | 1000 | 28.5 | 1130 | 1000 |
| 10 | 25.5 | 860 | 1000 | 33.5 | 1480 | 1000 |
| 14 | 28.0 | 1050 | 1000 | 37.5 | 1860 | 1000 |
| 20 | - | - | - | 42.5 | 2440 | 1000 |

# Balise Signalling Cable

## A-2Y(L)2YB2Y Balise Cable

### n x 4 x 1.4 mm / 1.53 mm






## APPLICATION

For railway safety equipment, used for train detection according to ETCS (European Train Control System) technology. Max. installation distance up to 2000 m.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1.4 mm or 1.53 mm of diameter

**Insulation**
PE, natural coloured with ring marking

**Twisting**
Cores twisted to star quad

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Optional with protection against inductive interference as AJ-2Y(L)2YDB2Y.
- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D

EN/IEC 61034

> Balise cable acc. to PH 416.0120 V0.4 of Deutsche Bahn
> Star quad stranded, steel tape armoured

| Characteristics | Unit | 1.4 mm | 1.53 mm |
|---|---|---|---|
| Max. installation distance | m | 500 | 2000 |
| Conductor cross-section | mm² | 1.5 | 1.8 |
| Conductor loop resistance | Ω/km | ≤ 23.4 | ≤ 19.8 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 - 1000 Hz | nF/km | ≤ 52 | ≤ 43 |
| Capacitance unbalance at 800 -1000 Hz | | | |
| $k_1$ | pF/500 m | ≤ 650 | ≤ 240 |
| $e_{1/2}$ | pF/500 m | ≤ 1300 | ≤ 650 |
| Impedance at | | | |
| 8.8 kHz | Ω | 147 ± 15 % | 147 ± 15 % |
| 200 - 600 kHz | Ω | 120 ± 10 % | 120 ± 10 % |
| 1800 kHz | Ω | - | 120 ± 10 % |
| Attenuation at | | | |
| 8.8 kHz | dB/km | ≤ 2 | ≤ 0.8 |
| 280 kHz | dB/km | ≤ 5 | ≤ 3 [1)] |
| 560 kHz | dB/km | ≤ 7 | ≤ 4.2 |
| 1800 kHz | dB/km | - | ≤ 8 |
| Near-end crosstalk attenuation at 1 MHz | dB | ≥ 55 | ≥ 60 |
| Test voltage at 50 Hz - 1 min | | | |
| core/core | $V_{rms}$ | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 |

[1)] The attenuation at 280 kHz must not be more than 1.8 dB/km smaller than the attenuation at 560 kHz.

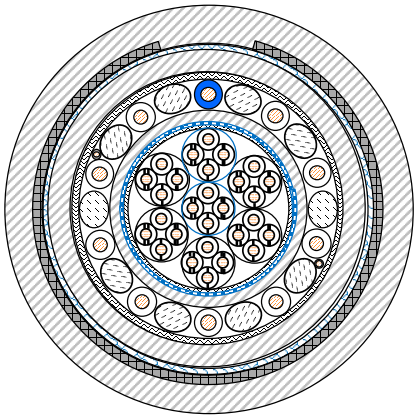
## A-2Y(L)2YB2Y Balise Cable

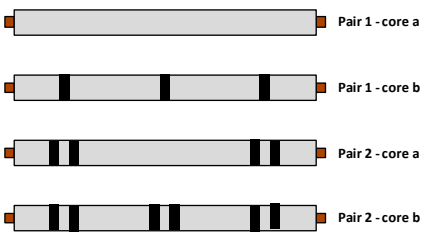
| No. of quads | n x 4 x 1.4 mm | | | n x 4 x 1.53 mm | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 14.0 | 260 | 2000 | 18 | 350 | 2000 |

# Signalling Cable

## A-2Y(L)2Y2YB2Y Combi Cable

### n x 4 x 0.9 / 1.4 mm + m x 1 x 0.9 / 1.4 / 1.8 mm






## APPLICATION

For railway signalling applications for transmission of low frequent signal through symmetric circuits, for example axle counter devices and similar wayside equipment with simultan power supply to the line side units.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm, 1.4 mm or 1.8 mm of diameter

**Insulation**
Data cores: PE, natural coloured with ring marking, each first quad in layer carries a blue helix, all other quads carry white helixes
Power cores: PE, natural coloured, with one blue marker core in each layer

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with inner sheath PE, black

**Stranding**
Power cores laid up in layers

**Intermediate sheath**
PE, black

**Armouring**
One layer of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Optional with protection against inductive interference as AJ-2Y(L)2YDB2Y and without armouring as A-2Y(L)2Y2YV.
- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D

EN/IEC 61034

> Combi cable acc. to PH 416.0118 of Deutsche Bahn
> Star quad + single core stranded, steel tape armoured
> Optional with protection against inductive interference

| Characteristics | Unit | Data quads | | Power cores | | |
|---|---|---|---|---|---|---|
| | | 0.9 mm | 1.4 mm | 0.9 mm | 1.4 mm | 1.8 mm |
| Conductor loop resistance | Ω/km | ≤ 56.6 | ≤ 23.4 | - | - | - |
| Conductor resistance | Ω/km | - | - | ≤ 28.9 | ≤ 11.9 | ≤ 7.2 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 | ≥ 10 | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 45 [1] | ≤ 45 [1] | ≤ 120 | ≤ 120 | ≤ 120 |
| Capacitance unbalance at 800 Hz | | | | - | - | - |
| $k_1$ | pF/500 m | ≤ 650 | ≤ 650 | - | - | - |
| $k_{9\text{-}12}$ adjacent quads | pF/500 m | ≤ 500 | ≤ 500 | - | - | - |
| $k_{9\text{-}12}$ over-adjacent quads | pF/500 m | ≤ 150 | ≤ 150 | - | - | - |
| $e_{a1/2}$ | pF/500 m | ≤ 1300 | ≤ 1300 | - | - | - |
| Near-end crosstalk attenuation at 40 kHz | | | | - | - | - |
| in quad, average value | dB | ≥ 65 | ≥ 65 | - | - | - |
| minimum single value | dB | ≥ 60 | ≥ 60 | - | - | - |
| adjacent quad, average value | dB | ≥ 65 | ≥ 65 | - | - | - |
| minimum single value | dB | ≥ 60 | ≥ 60 | - | - | - |
| over-adjacent quad, average value | dB | ≥ 70 | ≥ 70 | - | - | - |
| minimum single value | dB | ≥ 60 | ≥ 60 | - | - | - |
| quad in adjacent lay, average value | dB | ≥ 75 | ≥ 75 | - | - | - |
| minimum single value | dB | ≥ 65 | ≥ 65 | - | - | - |
| Characteristic impedance at 40 kHz | Ω | 130 ± 12 % | 130 ± 12 % | - | - | - |
| Attenuation at 40 kHz | dB/km | ≤ 2.6 | ≤ 1.5 | - | - | - |
| Test voltage at 50 Hz - 1 min | | | | | | |
| core/core | $V_{rms}$ | 2500 | 2500 | 2500 | 2500 | 2500 |
| core/screen | $V_{rms}$ | 2500 | 2500 | 2500 | 2500 | 2500 |

[1] ≤ 52 nF/km for 1 x 4 x ø and for central quads, where 1st layer consist only of one quad, as well as in the outer layer of armoured cables.

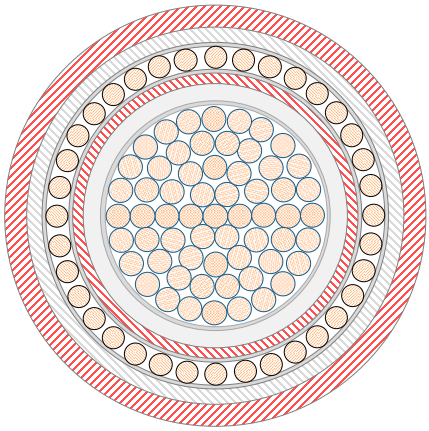
## A-2Y(L)2Y2YB2Y und AJ-2Y(L)2YDB2Y Combi Cable

| Dimension | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
|---|---|---|---|
| A-2Y(L()2Y2YV 1 x 4 x 0.9 + 4 x 1 x 1.4 S | 19.0 | 350 | 1000 |
| A-2Y(L()2YB2Y 1 x 4 x 0.9 + 4 x 1 x 1.4 S | 23.0 | 520 | 1000 |
| A-2Y(L()2YDB2Y 1 x 4 x 0.9 + 4 x 1 x 1.4 S rk600 | 27.0 | 1100 | 1000 |
| A-2Y(L()2YDB2Y 1 x 4 x 0.9 + 4 x 1 x 1 .4 S rk500 | 27.0 | 1150 | 1000 |
| A-2Y(L()2YDB2Y 1 x 4 x 0.9 + 4 x 1 x 1.4 S rk400 | 29.0 | 1870 | 1000 |
| A-2Y(L()2Y2YV 7 x 4 x 1.4 + 10 x 1 x 1.8 S | 35.5 | 1360 | 1000 |
| A-2Y(L()2YB2Y 7 x 4 x 1.4 + 10 x 1 x 1.8 S | 39.0 | 1670 | 1000 |
| A-2Y(L()2YDB2Y 7 x 4 x 1.4 + 10 x 1 x 1.8 S rk600 | 39.0 | 2400 | 1000 |
| A-2Y(L()2YDB2Y 7 x 4 x 1.4 + 10 x 1 x 1.8 S rk500 | 40.0 | 2660 | 1000 |
| A-2Y(L()2YDB2Y 7 x 4 x 1.4 + 10 x 1 x 1.8 S rk400 | 42.0 | 3820 | 1000 |

# Track Feeder Cable

## GGSG 1.8/3 kV

### 1 x 300 RF / 95 F



## APPLICATION

Track feeder cable for indoor and outdoor use, in areas with difficult installation conditions and risk of vibration. Suitable for installation in ducts and pipes, on ballast and for direct burial.

## CONSTRUCTION

**Conductor**
Bare round copper conductor, stranded class 5, soft annealed

**Separation layer**
Optional

**Insulation**
Extruded rubber compound 3GI3 acc. DIN VDE 0207-20, natural coloured

**Inner sheath**
Extruded rubber compound 5GM3 acc. DIN VDE 0207-21, red coloured

**Separation layer**
Optional

**Screen**
Screen of copper wires 95 mm²

**Separation layer**
Optional

**Insulation**
Extruded rubber compound 3GI3 acc. DIN VDE 0207-20, natural coloured

**Outer sheath**
Extruded rubber compound 5GM5 acc. DIN VDE 0207-21, red coloured

## Notes

- Detailed data sheet available upon request.

- 5°C; + 50°C
- 25°C; + 70°C

> 250 mm
> 150 mm

EN/IEC 60332-1-1
EN/IEC 60332-1-2


250 °C

> Track feeder cable
> Single core design, screened
> Excellent mechanical characteristics

| Characteristics | Unit | Value |
|---|---|---|
| Conductor cross-section | mm² | 300 |
| Conductor resistance | Ω/km | max. 0.0641 |
| Max.continuous conductor temperature | °C | ≤ 90 |
| Operating voltage $U_0$ / U | V | 1800 / 3000 |
| Voltage test 50 Hz | $V_{rms}$ | 6000 |

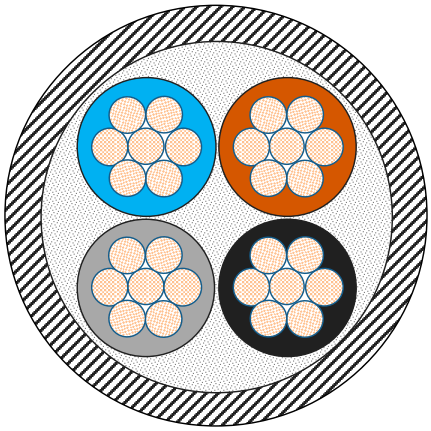
## GGSG

| Cross-section [mm²] | Diameter over conductor [mm] | Wall thickness insulation [kg/km] | Wall thickness inner sheath [Ω/km] | Diameter over inner sheath [mm] | Diameter over screen [mm] | Wall thickness insulation [mm] | Wall thickness outer sheath [mm] | Outer cable diameter [mm] |
|---|---|---|---|---|---|---|---|---|
| 1x300/95 | 24 | 2.4 | 1.4 | 32 | 38 | 1.5 | 2.1 | 46 |

# Power Cable

## N2XH-O 0.6/1 kV

### 4 x 35 mm² RM



## APPLICATION

Used as power supply cable indoor or outdoor, in tunnels or railway stations with improved fire behaviour. Not suitable for direct burial.

## CONSTRUCTION

**Conductor**
Bare round copper conductor class 1 (≤ 16 mm²) or class 2 (≤ 35 mm²) or class 2 sector shaped (> 35 mm²), soft annealed

**Insulation**
Cross-linked PE, colour code: blue, brown black, grey

**Outer sheath**
Afumex LSOH compound, black

## Notes

- Detailed data sheet available upon request.


- 5°C; + 50°C
- 25°C; + 60°C

> 12 x D

EN/IEC 61034


EN/IEC 60332-3

> Power cable acc. to DIN VDE 0276/604.5G
> Multi core design
> Low smoke, halogen free and flame retardant design

| Characteristics | Unit | Value |
|---|---|---|
| Conductor resistance | Ω/km | see table below |
| Max.continuous conductor temperature | °C | ≤ 90 |
| Voltage test | kV/1 min | 4 |

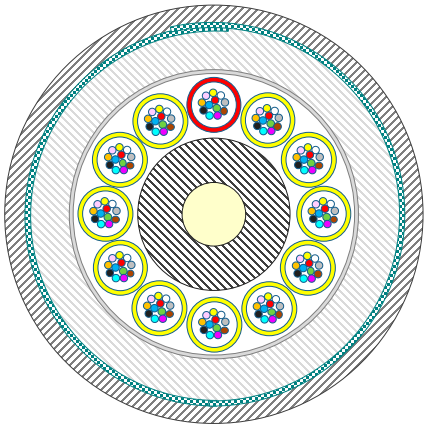
## N2XH-O 0.6/1 kV

| Cross-section [mm²] | Conductor resistance [Ω/km] | Outer diameter [mm] | Cable weight [kg/km] |
|---|---|---|---|
| 4 x 6 RE | 3.08 | 14 | 390 |
| 4 x 10 RE | 1.83 | 17 | 610 |
| 4 x 16 RE | 1,15 | 19 | 870 |
| 4 x 25 RM | 0.727 | 24 | 1350 |
| 4 x 35 RM | 0.524 | 27 | 1800 |
| 4 x 50 SM | 0.387 | 28 | 2150 |
| 4 x 70 SM | 0.268 | 34 | 3100 |
| 4 x 95 SM | 0.193 | 38 | 4100 |
| 4 x 120 SM | 0.153 | 41 | 5150 |
| 4 x 150 SM | 0.124 | 46 | 6300 |

# Fibre Optic Cable

## A-DF(ZN)2Y(SR)2Y

### E9/125 0.36 F3.5 / 0.23 H18 LG



## APPLICATION

Outdoor fibre optic cable for telecommunication applications in pipes or ducts along railway tracks.

## CONSTRUCTION

**Central strength member (CSM)**
Glass fibre reinforced plastic rod (FRP) with or without plastic oversheathing

**Loose tube**
Thermoplastic material up to 12 fibres and filled with suitable water tightness compound

**Filler elements**
Thermoplastic rods (in case needed)

**Stranding**
Loose tubes (and fillers), SZ-stranded around CSM

**Filling**
Suitable filling compound for longitudinal water tightness

**Tensile strength elements**
Aramid yarns

**Inner sheath**
PE, black

**Armouring**
Coated, corrugated steel tape, longitudinally applied with overlap

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 5°C; + 50°C
- 25°C; + 60°C

> 20 x D
> 15 x D

> Fibre optic cable acc. to Dlk 1.011.003y of Deutsche Bahn
> Single mode E9/125
> Steel tape armoured

| Characteristics | Unit | Value | |
|---|---|---|---|
| Wave length | nm | 1310 | 1550 |
| Attenuation | dB/km | ≤ 0.36 | ≤ 0.26 |
| Dispersion | ps/(nm*km) | ≤ 3.5 | ≤ 18 |
| Tensile strength (12-96 fibres) | N | 2500 | |
| Tensile strength (144 fibres) | N | 3500 | |

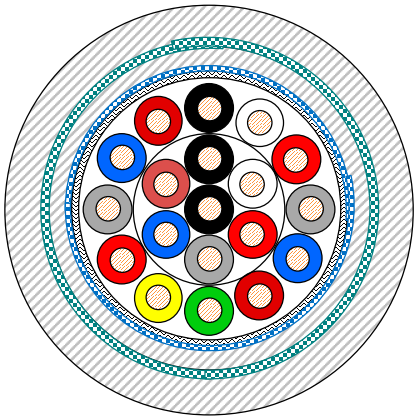
## A-DF(ZN)2Y(SR)2Y

| No. of fibres | Design | Diameter loose tube [mm] | Diameter CSM [mm] | Wall thickness inner sheath [mm] | Wall thickness outer sheath [mm] | Outer cable diameter [mm] | Cable weight [kg/km] | Standard length [m] |
|---|---|---|---|---|---|---|---|---|
| 12 | 6 x 2 | 2.0 | 2.1 | 2.0 | 1.4 | 15 | 210 | 2000 |
| 24 | 6 x 4 | 2.0 | 2.1 | 2.0 | 1.4 | 15 | 210 | 2000 |
| 48 | 4 x 12 | 2.8 | 2.1 | 2.0 | 1.4 | 17 | 260 | 2000 |
| 60 | 5 x 12 | 2.8 | 2.1 | 2.0 | 1.4 | 17 | 260 | 2000 |
| 72 | 6 x 12 | 2.8 | 3.0 | 2.0 | 1.4 | 17.5 | 285 | 2000 |
| 84 | 7 x 12 | 2.8 | 3.0 | 2.0 | 1.4 | 18.5 | 310 | 2000 |
| 96 | 8 x 12 | 2.8 | 3.0 | 2.0 | 1.4 | 19.5 | 340 | 2000 |
| 144 | 12 x 12 | 2.8 | 3.5 | 2.0 | 1.4 | 23 | 470 | 2000 |

# Signalling Cable

## EAPSP

### n x 1 x 0.9 mm / 1.4 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, color code by layer: starter core black, direction core white, all other cores red, grey, blue, brown, green, yellow - repetitive

**Twisting**
Cores laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.2 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
Coated, corrugated steel tape, longitudinally applied with overlap

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.
- Optional in halogen free, flame retardant version as EATST.
- Also available in pair twisting or with individual shielded pairs.
- Optional available in a longitudinal watertight version EAPSP-R.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to E.T. 03.365.051.6, 03/2005 of adif
> Core stranded, steel tape armoured

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor resistance, mean value | Ω/km | 28.9 | 11.7 |
| Resistance unbalance | % | 2 | 2 |
| Insulation resistance | GΩxkm | ≥ 25 | ≥ 25 |
| Dielectric strength at 50 Hz, 1 min | | | |
| core/core | $V_{rms}$ | 2100 | 2100 |
| core/screen | $V_{rms}$ | 2500 | 2500 |
| core/armouring | $V_{rms}$ | 2000 | 2000 |

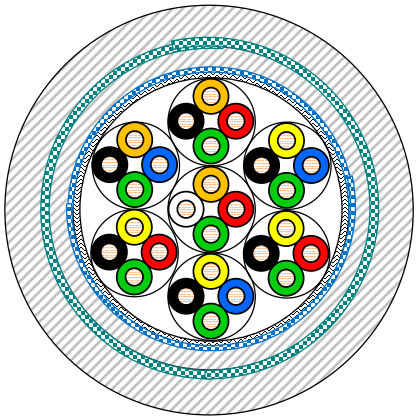
## EAPSP

| No. of cores | n x 1 x 0.9 mm | | | n x 1 x 1.4 mm | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 4 | - | - | - | 16.0 | 270 | 1000 |
| 7 | - | - | - | 17.5 | 350 | 1000 |
| 9 | - | - | - | 20.0 | 420 | 1000 |
| 12 | 17.0 | 290 | 1000 | 20.5 | 440 | 1000 |
| 19 | 19.0 | 365 | 1000 | 22.0 | 560 | 1000 |
| 27 | 21.0 | 460 | 1000 | 14.5 | 740 | 1000 |
| 37 | 23.0 | 565 | 1000 | 26.5 | 930 | 1000 |
| 48 | 25.0 | 685 | 1000 | 29.5 | 1160 | 1000 |
| 61 | - | - | - | 32.0 | 1490 | 1000 |

# Signalling Cable

## EAPSP

### n x 4 x 0.9 mm / 1.4 mm



## APPLICATION

For railway signalling applications, for example axle counter, level crossing gates and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, color code see specification adif

**Twisting**
Cores twisted to star quads, star quads laid up in layers

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.2 mm, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
Coated, corrugated steel tape, longitudinally applied with overlap

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.
- Optional in halogen free, flame retardant version as EATST.
- Also available in pair twisting or with individual shielded pairs.
- Optional available in a longitudinal watertight version as EAPSP-R.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to E.T. 03.365.051.6, 03/2005 of adif
> Star quad stranded, steel tape armoured

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor resistance, mean value | Ω/km | 28.5 | 11.7 |
| Resistance unbalance | % | 1 | 1 |
| Insulation resistance | GΩxkm | ≥ 25 | ≥ 25 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 41 | ≤ 45 |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ mean/individual value | pF/460 m | ≤ 35 / 250 | ≤ 35 / 250 |
| $k_{9\text{-}12}$ mean/individual value | pF/460 m | ≤ 35 / 250 | ≤ 35 / 250 |
| $e_{a1/2}$ mean/individual value | pF/460 m | ≤ 320 / 1200 | ≤ 320 / 1200 |
| Attenuation at 1 kHz | dB/km | ≤ 0.7 | ≤ 0.46 |
| Dielectric strength at 50 Hz, 1 min | | | |
| core/core | $V_{rms}$ | 2100 | 2100 |
| core/screen | $V_{rms}$ | 2500 | 2500 |
| core/armouring | $V_{rms}$ | 2000 | 2000 |

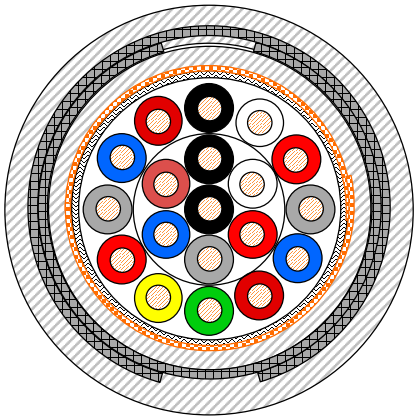
## EAPSP

| No. of quads | n x 4 x 0.9 mm | | | n x 4 x 1.4 mm | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 15.0 | 205 | 1000 | 17.0 | 275 | 1000 |
| 3 | 19.0 | 315 | 1000 | 23.0 | 490 | 1000 |
| 5 | 21.5 | 430 | 1000 | 26.0 | 690 | 1000 |
| 7 | 23.0 | 500 | 1000 | 30.0 | 885 | 1000 |
| 10 | 27.5 | 750 | 1000 | 34.0 | 1185 | 1000 |
| 14 | 30.0 | 920 | 1000 | 38.0 | 16650 | 500 |
| 19 | - | - | - | 43.0 | 2120 | 500 |

# Signalling Cable

## CCPSSP-FR0.3

### n x 1 x 1.4 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1.4 mm of diameter

**Insulation**
PE, color code see specification adif

**Twisting**
Cores laid up in layers

**Screen**
Corrugated copper tape with overlap, longitudinally applied

**Inner sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.5 or 0.8 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.
- Optional in core stranded version.
- Optional in halogen free, flame retardant version as CCTSST-FR0.3.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to E.T. 03.365.051.6, 03/2005 of adif
> Core stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 1.4 mm |
|---|---|---|
| Conductor resistance, mean value | Ω/km | 11.7 |
| Resistance unbalance | % | 2 |
| Insulation resistance | GΩxkm | ≥ 35 |
| Dielectric strength at 50 Hz, 1 min | | |
| core/core | $V_{rms}$ | 2100 |
| core/screen | $V_{rms}$ | 2500 |
| Reduction factor at 50 Hz, 110-320 V/km | $r_k$ | ≤ 0.3 |

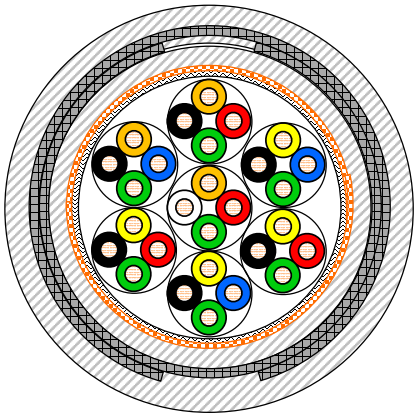
## CCPSSP-FR0.3

| No. of cores | n x 1 x 1.4 mm | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 2 | 16.5 | 530 | 1000 |
| 4 | 17.5 | 610 | 1000 |
| 7 | 19.0 | 720 | 1000 |
| 9 | 22.7 | 915 | 1000 |
| 12 | 23.2 | 977 | 1000 |
| 19 | 25.2 | 1185 | 1000 |
| 27 | 28.1 | 1440 | 1000 |
| 37 | 31.4 | 1755 | 1000 |
| 48 | 34.2 | 2065 | 1000 |

# Signalling Cable

## CCPSSP-FR0.3

### n x 4 x 0.9 mm / 1.4 mm



## APPLICATION

For railway signalling applications, for example axle counter, level crossing gates and similar wayside equipment. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, color code see specification adif

**Twisting**
Cores twisted to star quads, star quads laid up in layers

**Screen**
Corrugated copper tape with overlap, longitudinally applied

**Inner sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.5 or 0.8 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.
- Optional in core stranded version.
- Optional in halogen free, flame retardant version as CCTSST-FR0.3.

- 10°C; + 60°C
- 40°C; + 60°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to E.T. 03.365.051.6, 03/2005 of adif
> Star quad stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor resistance, mean value | Ω/km | 28.5 | 11.7 |
| Resistance unbalance | % | 1 | 1 |
| Insulation resistance | GΩxkm | ≥ 25 | ≥ 25 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 41 | ≤ 45 |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ mean/individual value | pF/460 m | ≤ 35 / 250 | ≤ 35 / 250 |
| $k_{9\text{-}12}$ mean/individual value | pF/460 m | ≤ 35 / 250 | ≤ 35 / 250 |
| $e_{a1/2}$ mean/individual value | pF/460 m | ≤ 320 / 1200 | ≤ 320 / 1200 |
| Attenuation at 1 kHz | dB/km | ≤ 0.7 | ≤ 0.46 |
| at 10 kHz | dB/km | ≤ 1.6 | ≤ 0.85 |
| at 30 kHz | dB/km | ≤ 2.1 | ≤ 1.3 |
| Dielectric strength at 50 Hz, 1 min | | | |
| core/core | $V_{rms}$ | 2100 | 2100 |
| core/screen | $V_{rms}$ | 2500 | 2500 |
| Reduction factor at 50 Hz, 110-320 V/km | $r_k$ | ≤ 0.3 | ≤ 0.3 |

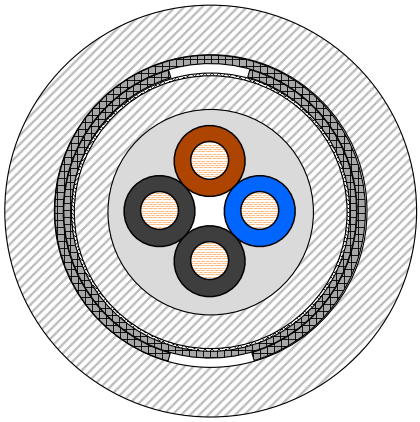
## CCPSSP-FR0.3

| No. of quads | n x 4 x 0.9 mm | | | n x 4 x 1.4 mm | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 17.0 | 590 | 1000 | 19.0 | 740 | 1000 |
| 3 | 21.5 | 830 | 1000 | 27.0 | 1260 | 1000 |
| 5 | 24.5 | 990 | 1000 | 31.0 | 1620 | 1000 |
| 7 | 26.0 | 1120 | 1000 | 34.0 | 1850 | 1000 |
| 10 | 29.0 | 1340 | 1000 | 39.0 | 2330 | 1000 |
| 14 | 32.5 | 1620 | 1000 | 43.0 | 2815 | 500 |
| 19 | 36.0 | 1950 | 1000 | 47.0 | 3470 | 500 |
| 27 | - | - | - | 54.0 | 4460 | 500 |

# Signalling Cable

## UG70G7KNR - RG70G7KNR

### n x 1 / 2.5 / 4 / 6 / 10 / 16 / 25 mm²



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment. For external circuits.

## CONSTRUCTION

**Conductor**
Bare copper conductor, soft annealed,
- solid, class 1 for ≤ 6 mm² (UG70G7KNR) and
- stranded class 2 for ≥ 10 mm² (RG70G7KNR) of cross section

**Insulation**
HEPR, high module rubber based elastomeric compound crosslinked by vulcanization, color code see CEI-UNEL 0722

**Twisting**
Cores laid up in layers

**Inner Covering**
HEPR, high module rubber based elastomeric compound crosslinked by vulcanization

**Inner sheath**
Elastomeric compound crosslinked by vulcanization plus separation tape

**Armouring**
Two layers of galvanized steel tape 0.2, helically applied

**Outer sheath**
PVC, black

## Notes

- Detailed data sheet available upon request.
- Optional in non-armoured version.
- Optional in LSOH version for internal use acc. to specification IS 409.


- 5°C; + 60°C
- 40°C; + 60°C


≥ 14 x D


EN/IEC 60332-1

> Signalling cable acc. to STF DTCSTSSTB SF IS 06 200 Rev. E of RFI
> Core stranded, steel tape armoured

| Characteristics | Unit | 1 mm² | 2.5 mm² | 4 mm² | 6 mm2 | 10 mm² | 16 mm2 | 25 mm² |
|---|---|---|---|---|---|---|---|---|
| Conductor resistance | Ω/km | ≤ 18.2 | ≤ 7.56 | ≤ 4.70 | ≤ 3.11 | ≤ 1.84 | ≤ 1.16 | ≤ 0.734 |
| Insulation resistance | MΩxkm | ≥ 1007 | ≥ 765 | ≥ 641 | ≥ 534 | ≥ 428 | ≥ 352 | ≥ 363 |
| Operating voltage $U_0$ / U | V | 450 / 750 | | | | | | |
| Dielectric strength at 50 Hz | $V_{rms}$ | 3000 | | | | | | |

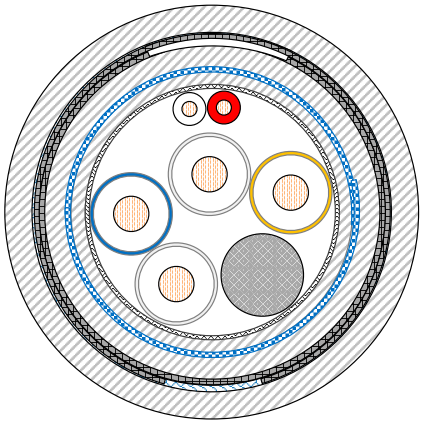
## UG7OG7KNR - RG7OG7KNR

| Dimension | Wall thickness inner sheath [mm] | Wall thickness outer sheath [mm] | Outer diameter max. [mm] | Cable weight [kg/km] |
|---|---|---|---|---|
| 4 x 1 mm² | 1.4 | 1.8 | 17.8 | 380 |
| 8 x 1 mm² | 1.6 | 1.8 | 21.5 | 500 |
| 16 x 1 mm² | 1.8 | 1.8 | 25.0 | 730 |
| 2 x 2.5 mm² | 1.6 | 1.8 | 18.5 | 410 |
| 4 x 2.5 mm² | 1.6 | 1.8 | 19.9 | 500 |
| 2 x 4 mm² | 1.6 | 1.8 | 19.5 | 470 |
| 2 x 6 mm² | 1.6 | 1.8 | 20.5 | 560 |
| 3 x 4 mm² | 1.6 | 1.8 | 20.5 | 520 |
| 3 x 6 mm² | 1.6 | 1.8 | 21.1 | 630 |
| 3 x 10 mm² | 2.0 | 1.8 | 25.0 | 840 |
| 3 x 16 mm² | 2.0 | 1.8 | 26.6 | 1070 |
| 3 x 25 mm² | 2.0 | 1.9 | 30.4 | 1480 |

# Signalling Cable

## DIGICODE Cable

### 2 x 2 x 1.4 mm + 1 x 2 x 0.6 mm



## APPLICATION

For railway signalling applications and transmission of track circuit digicode signals up to 30 kHz. For indoor and outdoor use.

## CONSTRUCTION

**Conductor**
Bare solid copper conductor, soft annealed,
- 0.6 mm of diameter for service pair and
- 1.4 mm of diameter for transmission pairs

**Insulation**
- Service pair: PE, colours red/white
- Transmission pair: Foam-skin-PE, colours white/blue and white/orange

**Twisting**
Cores twisted to pairs

**Inner sheath**
PE, black

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.2 mm, both side copolymer coated, bonded with

**Separation sheath**
LSZH-FR PE, green

**Armouring**
Two layers of galvanized steel tape, helically applied

**Outer sheath**
LSZH-FR PE, green

## Notes

- Detailed data sheet available upon request.
- Optional in non-armoured version.
- Optional in PE for external use.


- 5°C; + 50°C
- 10°C; + 70°C


≥ 20 x D

EN/IEC 61034


EN/IEC 60754-1


EN/IEC 60332-1
EN/IEC 60332-3

> Signalling cable for transmission of digicode signals
> Transmission pairs and sevice pairs included
> Pair stranded, steel tape armoured

| Characteristics | Unit | Transmission pair | Service pair |
|---|---|---|---|
| Conductor diameter | mm | 1.4 mm | 0.6 mm |
| Conductor resistance | Ω/km | ≤ 12.1 | - |
| Insulation resistance | MΩxkm | > 5000 | > 5000 |
| Mutual capacitance | nF/km | ≤ 45 | 50 |
| Characteristic impedance (nom.) at 1 MHz | Ω | 110 ± 10 | - |
| Near-end crosstalk attenuation | | | |
| at 4.1 kHz | dB | > 54 | - |
| at 20.7 kHz | dB | > 42 | - |
| Far-end crosstalk attenuation | | | |
| at 4.1 kHz | dB/km | > 59 | - |
| at 20.7 kHz | dB/km | > 48 | - |
| Attenuation | | | |
| at 2.1 kHz | dB/km | ≤ 0.64 | - |
| at 4.1 kHz | dB/km | ≤ 0.76 | - |
| at 9.5 kHz | dB/km | ≤ 1.05 | - |
| at 20.7 kHz | dB/km | ≤ 1.28 | - |
| Rated voltage (between pair conductors) | $V_{rms}$ | ≤ 220 | - |
| Rated current | $A_{rms}$ | ≤ 1 | - |
| Dielectric strength at 50 Hz, 1 min | | | |
| core/core | $V_{rms}$ | 1000 | 1000 |
| core/screen | $V_{rms}$ | 3000 | 3000 |

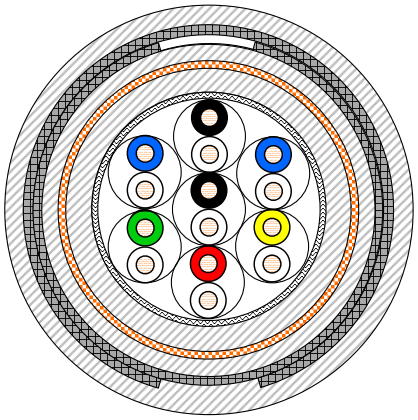
## DIGICODE cable

| Dimension | Wall thickness separation sheath [mm] | Wall thickness outer sheath [mm] | Outer diameter [mm] | Cable weight [kg/km] |
|---|---|---|---|---|
| 1 x 2 x 1.4 mm + 1 x 2 x 0.6 mm | 1.3 | 1.5 | 16.4 | 375 |
| 2 x 2 x 1.4 mm + 1 x 2 x 0.6 mm | 1.3 | 1.5 | 19.3 | 500 |

# Signalling Cable

## ZPAU

### n x 2 x 1 mm²



## APPLICATION

For railway signalling applications, for example point machines, light signals, axle counter, level crossing gates and similar wayside equipment. Protected against inductive interferences, for example of on AC electrifed railroad.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1 mm² of cross section

**Insulation**
PE, color code see specification SNCF

**Twisting**
Cores twisted to pairs, pairs laid up in layers

**Inner sheath**
PE, black

**Screen**
Corrugated copper tape, longitudinally applied

**Intermediate bedding**
PE, black

**Armouring**
Two layers of high permeability steel tape 0.2 mm to 0.5 mm, helically applied

**Outer sheath**
PVC, black

## Notes

- Detailed data sheet available upon request.


- 0°C; + 50°C
- 25°C; + 60°C

≥ 24 x D
≥ 15 x D


EN/IEC 60332-1

> Signalling cable acc. to NF F 55-698 & CT445 of SNCF
> Pair stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 1 mm² |
|---|---|---|
| Conductor resistance | Ω/km | ≤ 18.1 |
| Insulation resistance | GΩxkm | ≥ 5 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 55 |
| Capacitance unbalance at 800 Hz | pF/500 m | ≤ 200 |
| Characteristic impedance | | |
| at 20 - 45 kHz | Ω | 120 ± 10 |
| at 45 - 80 kHz | Ω | 115 ± 10 |
| Attenuation | | |
| at 20 - 45 kHz | dB/km | ≤ 2.5 |
| at 45 - 80 kHz | dB/km | ≤ 3 |
| Operating voltage AC / DV | $V_{rms}$ / V | 450/750 |
| peak value AC | $V_{rms}$ | 900 |
| Dielectric strength at 50 Hz, 3 min | | |
| core/core | $V_{rms}$ | 3000 |
| core/screen | $V_{rms}$ | 3000 |

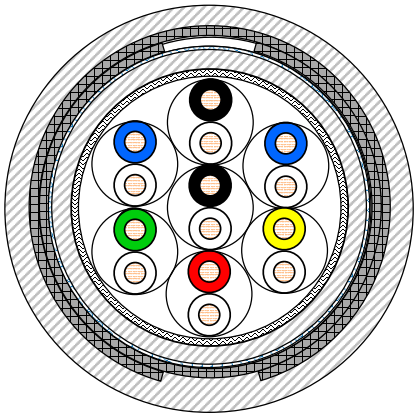
## ZPAU

| No. of pairs | n x 2 x 1 mm² | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 2 | 18.2 | 530 | 1000 |
| 4 | 23.8 | 665 | 1000 |
| 7 | 26.7 | 845 | 1000 |
| 14 | 31.0 | 1200 | 1000 |
| 21 | 35.5 | 1570 | 1000 |
| 28 | 39.5 | 1910 | 500 |
| 56 | 49.5 | 3100 | 500 |

# Signalling Cable

## ZPFU

### n x 2 x 1 mm²



## APPLICATION

For railway signalling applications, for example point machines, light signals, axle counter, level crossing gates and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1 mm² of cross section

**Insulation**
PE, color code see specification SNCF

**Twisting**
Cores twisted to pairs, pairs laid up in layers

**Inner bedding**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.15 to 0.5 mm, helically applied

**Outer sheath**
PVC, black

## Notes

- Detailed data sheet available upon request.

- 0°C; + 50°C
- 25°C; + 60°C

≥ 24 x D
≥ 15 x D

EN/IEC 60332-1

> Signalling cable acc. to NF F 55-698 & CT445 of SNCF
> Pair stranded, steel tape armoured

| Characteristics | Unit | 1 mm² |
|---|---|---|
| Conductor resistance | Ω/km | ≤ 18.1 |
| Insulation resistance | GΩxkm | ≥ 5 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 55 |
| Capacitance unbalance at 800 Hz | pF/500 m | ≤ 200 |
| Characteristic impedance | | |
| at 20 - 45 kHz | Ω | 120 ± 10 |
| at 45 - 80 kHz | Ω | 115 ± 10 |
| Attenuation | | |
| at 20 - 45 kHz | dB/km | ≤ 2.5 |
| at 45 - 80 kHz | dB/km | ≤ 3 |
| Operating voltage AC / DV | $V_{rms}$ / V | 450/750 |
| peak value AC | $V_{rms}$ | 900 |
| Dielectric strength at 50 Hz, 3 min | | |
| core/core | $V_{rms}$ | 3000 |
| core/screen | $V_{rms}$ | 3000 |

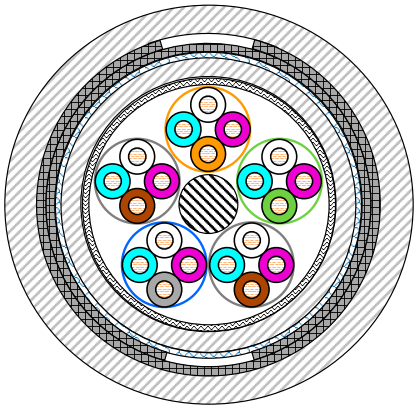
## ZPFU

| No. of pairs | n x 2 x 1 mm² | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 12.5 | 160 | 1000 |
| 2 | 13.7 | 235 | 1000 |
| 4 | 18.6 | 350 | 1000 |
| 7 | 22.4 | 670 | 1000 |
| 14 | 28.0 | 1000 | 1000 |
| 21 | 32.4 | 1360 | 1000 |
| 28 | 36.5 | 1660 | 500 |
| 56 | 47.8 | 2900 | 500 |

# Signalling Cable

## Sw-CLT

### n x 4 x 1.5 mm / 2.2 mm



## APPLICATION

In railway signalling applications for transmission of low frequent signal through symmetric circuits, for example axle counter devices and similar wayside equipment.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1.5 mm or 2.2 mm of diameter

**Insulation**
PE, coloured

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Inner sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.15 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 5°C; + 50°C
- 30°C; + 70°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to I-PS 3001.82.1000 of SBB
> Star quad stranded, steel tape armoured

| Characteristics | Unit | 1.5 mm | 2.2 mm |
|---|---|---|---|
| Conductor loop resistance | Ω/km | ≤ 20.9 | ≤ 10.0 |
| Insulation resistance | GΩxkm | ≥ 10 | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 52 | ≤ 60 |
| Capacitance unbalance at 800 Hz | | | |
| $k_1$ | pF/km | ≤ 400 | ≤ 400 |
| $k_{9-12}$ | pF/km | ≤ 400 | ≤ 400 |
| $e_{a1/2}$ | pF/km | ≤ 650 | ≤ 650 |
| Operating voltage (16.7 Hz / DC) | $V_{rms}$/V | 500/800 | 500/800 |
| Test voltage at 50 Hz - 1 min | | | |
| core/core | $V_{rms}$ | 2000 | 2000 |
| core/armour | $V_{rms}$ | 4000 | 4000 |

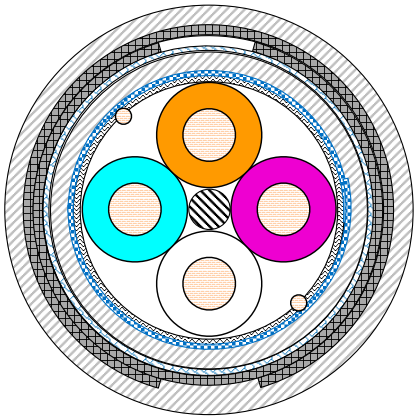
## Sw-CLT

| | n x 4 x 1.5 mm | | | n x 4 x 2.2 mm | | |
|---|---|---|---|---|---|---|
| No. of quads | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 15.5 | 240 | 2000 | 16.5 | 360 | 2000 |
| 3 | 23.5 | 560 | 1000 | 28.0 | 890 | 1000 |
| 5 | 28.5 | 800 | 1000 | 33.5 | 1320 | 1000 |
| 10 | 36.0 | 1390 | 1000 | 44.5 | 2370 | 500 |
| 15 | 41.5 | 1920 | 1000 | 51.5 | 3380 | 500 |
| 20 | 46.5 | 2450 | 1000 | 58.5 | 4440 | 500 |
| 25 | 52.5 | 3050 | 1000 | 66.5 | 5470 | 500 |
| 30 | 55.0 | 3490 | 1000 | 68.0 | 6410 | 500 |

# Balise Signalling Cable

## PE-ALT-CLT Balise Cable

### 1 x 4 x 1.53 mm



## APPLICATION

For railway safety equipment, used for train detection according to ETCS (European Train Control System) technology.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1.53 mm of diameter

**Insulation**
PE, color code circuit 1: white/orange, circuit 2: turquoise/violet

**Twisting**
Cores twisted to one star quad

**Moisture barrier sheath**
Two tinned copper drain wires 0.8 mm, laminated sheath made of aluminium tape, one side copolymer coated, bonded with

**Inner sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.2 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.
- Optional in halogen free, flame retardant version as PE-ALT-CLN.

- 5°C; + 50°C
- 30°C; + 70°C

≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Balise cable acc. to I-AT-FS 3001.52.2000 of SBB
> Star quad stranded, steel tape armoured

| Characteristics | Unit | 1.53 mm |
|---|---|---|
| Conductor loop resistance | Ω/km | ≤ 19.8 |
| Insulation resistance | kΩxkm | ≥ 10000 |
| Mutual capacitance at 800 - 1000 Hz | nF/km | 42.3 ± 15 % |
| Capacitance unbalance at 800 - 1000 Hz | | |
| $k_1$ | pF/km | ≤ 240 |
| $e_a$ | pF/km | ≤ 640 |
| Characteristic impedance at | | |
| 560/800 kHz | Ω | 120 ± 10 % |
| 1800 kHz | Ω | 120 ± 5 % |
| Attenuation at | | |
| 8.82 kHz | dB/100 m | ≤ 0.08 |
| 560 kHz | dB/100 m | ≤ 0.4 |
| 800 kHz | dB/100 m | ≤ 0.5 |
| 1800 kHz | dB/100 m | ≤ 0.8 |
| Dielectric strength at 50 Hz, 2 min | | |
| core/core | $V_{rms}$ | 2500 |
| core/screen | $V_{rms}$ | 2500 |

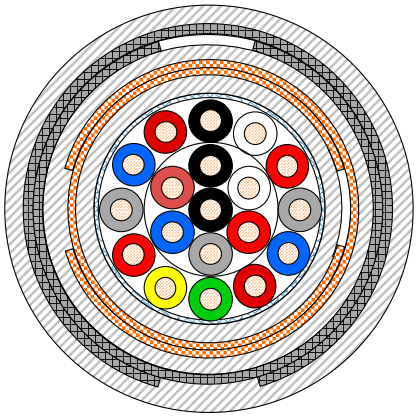
## PE-ALT-CLT Balise Cable

| No. of quads | n x 4 x 1.53 mm | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 18.0 | 390 | 2000 |

# Signalling Cable

## AJ-2Y2Y(St)2YB2Y-FR0.3

### n x 1 x 0.9 mm / 1.4 mm



## APPLICATION

For railway signalling applications, wiring of light signals, point machines and similar wayside equipment. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or 1.4 mm of diameter

**Insulation**
PE, color code by layer: starter core black, direction core white, all other cores red, grey, blue, brown, green, yellow - repetitive

**Twisting**
Cores laid up in layers

**Inner sheath**
PE, black

**Screen**
Two layers of copper tape, helically applied with overlap

**Intermediate sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.5 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 10°C; + 50°C
- 40°C; + 70°C


≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to specification of TCDD
> Core stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 0.9 mm | 1.4 mm |
|---|---|---|---|
| Conductor resistance | Ω/km | ≤ 28.8 | ≤ 11.9 |
| Insulation resistance | GΩxkm | ≥ 35 | ≥ 35 |
| Dielectric strength at 50 Hz, 5 min | | | |
| core/core | $V_{rms}$ | 3000 | 3000 |
| core/armouring | $V_{rms}$ | 3000 | 3000 |
| Reduction factor at 50 Hz, 100-350 V/km | $r_k$ | ≤ 0.3 | ≤ 0.3 |

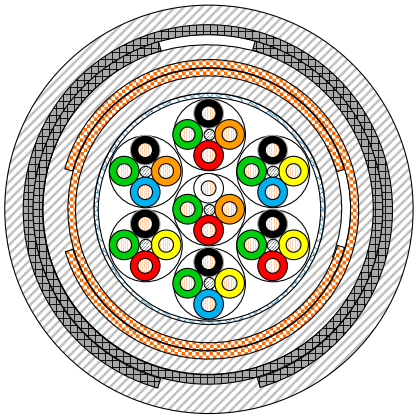
## AJ-2Y2Y(St)2YB2Y-FR0.3

| No. of cores | n x 1 x 0.9 mm | | | n x 1 x 1.4 mm | | |
|---|---|---|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 4 | 20 | 610 | 1000 | 21 | 640 | 1000 |
| 7 | - | - | - | 22 | 770 | 1000 |
| 8 | 21 | 735 | 1000 | - | - | - |
| 9 | - | - | - | 25 | 935 | 1000 |
| 10 | 24 | 870 | 1000 | - | - | - |
| 12 | - | - | - | 26 | 1025 | 1000 |
| 19 | - | - | - | 29 | 1270 | 1000 |
| 20 | 26 | 1050 | 1000 | - | - | - |
| 27 | - | - | - | 32 | 1565 | 1000 |
| 30 | 30 | 1300 | 1000 | - | - | - |
| 37 | - | - | - | 35 | 1875 | 500 |
| 40 | 32 | 1490 | 1000 | - | - | - |
| 48 | - | - | - | 39 | 2245 | 500 |
| 60 | 37 | 1880 | 1000 | - | - | - |

# Signalling Cable

## AJ-2Y2Y(St)2YB2Y-FR0.3

### n x 4 x 1.4 mm



## APPLICATION

For railway signalling applications, for example axle counter, level crossing gates and similar wayside equipment. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 1.4 mm of diameter

**Insulation**
PE, color code see specification TCDD

**Twisting**
Cores twisted to star quads, star quads laid up in layers

**Inner sheath**
PE, black

**Screen**
Two layers of copper tape, helically applied with overlap

**Intermediate sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.5 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 10°C; + 50°C
- 40°C; + 70°C


≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Signalling cable acc. to specifiation of TCDD
> Star quad stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 1.4 mm |
|---|---|---|
| Conductor resistance, mean value | Ω/km | ≤ 11.9 |
| Insulation resistance | GΩxkm | ≥ 35 |
| Mutual capacitance at 800 Hz (mean) | nF/km | ≤ 41 |
| Mutual capacitance at 800 Hz (max.) | nF/km | ≤ 48 |
| Capacitance unbalance at 800 Hz | | |
| $k_1$ max. individual value | pF/460 m | ≤ 250 |
| $k_{9-12}$ max. individual value | pF/460 m | ≤ 250 |
| $e_{a1/2}$ max. individual value | pF/460 m | ≤ 1200 |
| Attenuation at 1 kHz | dB/km | ≤ 0.46 |
| at 10 kHz | dB/km | ≤ 0.85 |
| Dielectric strength at 50 Hz, 5 min | | |
| core/core | $V_{rms}$ | 3000 |
| core/armouring | $V_{rms}$ | 3000 |
| Reduction factor at 50 Hz, 100-350 V/km | $r_k$ | ≤ 0.3 |

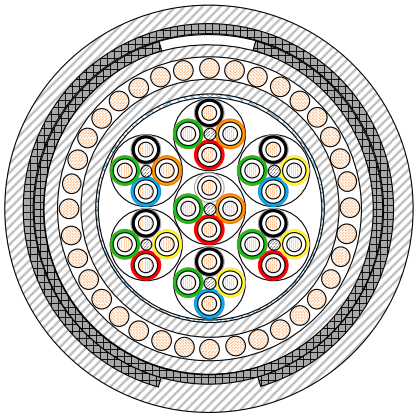
## AJ-2Y2Y(St)2YB2Y-FR0.3

| No. of quads | n x 4 x 1.4 mm | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 20 | 650 | 1000 |
| 3 | 28 | 1150 | 500 |
| 5 | 32 | 1490 | 500 |
| 7 | 34 | 1730 | 500 |
| 9 | 40 | 2170 | 500 |
| 11 | 43 | 2410 | 500 |
| 12 | 43 | 2480 | 500 |

# Communication Cable

## AJ-02YS2YD2YB2Y-FR0.1

### n x 4 x 0.9 mm



## APPLICATION

For railway communication applications. Protected against inductive interferences, for example on AC electrifed railroads.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm or diameter

**Insulation**
PE, color code see specification TCDD

**Twisting**
Cores twisted to star quads, star quads laid up in layers

**Inner sheath**
PE, black

**Screen**
Concentrically positioned copper wires

**Intermediate sheath**
PE, black

**Armouring**
Two layers of galvanized steel tape 0.8 mm, helically applied

**Outer sheath**
PE, black

## Notes

- Detailed data sheet available upon request.

- 10°C; + 50°C
- 40°C; + 70°C


≥ 10 x D
≥ 7.5 x D


EN/IEC 61034

> Communication cable acc. to specifiation of TCDD
> Star quad stranded, steel tape armoured
> With protection against inductive interference

| Characteristics | Unit | 0.9 mm |
|---|---|---|
| Conductor resistance | Ω/km | 27.5 ± 1 |
| Resistance difference | % | ≤ 2 |
| Insulation resistance | GΩxkm | ≥ 35 |
| Mutual capacitance at 800 Hz (mean) | nF/km | ≤ 38 |
| Mutual capacitance at 800 Hz (max.) | nF/km | ≤ 45 |
| Capacitance unbalance at 800 Hz | | |
| $k_1$ mean/max. individual value | pF/460 m | ≤ 35 / 250 |
| $k_{9-12}$ mean/max. individual value | pF/460 m | ≤ 35 / 250 |
| $e_{a1/2}$ mean/max. individual value | pF/460 m | ≤ 320 / 1200 |
| Attenuation at 1 kHz | dB/km | ≤ 0.62 |
| at 10 kHz | dB/km | ≤ 1.5 |
| at 30 kHz | dB/km | ≤ 2.0 |
| NEXT at 30 kHz | dB | ≥ 65 |
| Dielectric strength at 50 Hz, 5 min | | |
| core/core | $V_{rms}$ | 500 |
| core/armouring | $V_{rms}$ | 2100 |
| Reduction factor at 50 Hz | | |
| 11 V/km | $r_k$ | ≤ 0.19 |
| 20 V/km | $r_k$ | ≤ 0.16 |
| 50 V/km | $r_k$ | ≤ 0.11 |
| 110 V/km | $r_k$ | ≤ 0.08 |
| 200 V/km | $r_k$ | ≤ 0.05 |
| 300 V/km | $r_k$ | ≤ 0.05 |
| 500 V/km | $r_k$ | ≤ 0.07 |

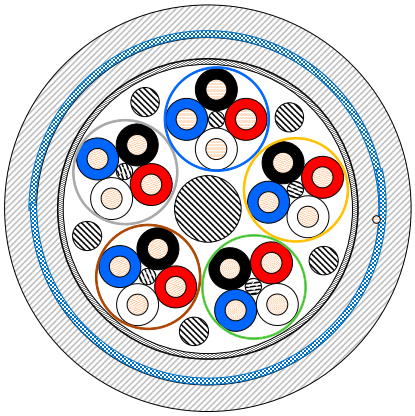
## AJ-02YS2YD2YB2Y-FR0.1

| No. of quads | n x 4 x 0.9 mm | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 27.5 | 1520 | 500 |
| 2 | 31.5 | 1880 | 500 |
| 3 | 31.5 | 1900 | 500 |
| 5 | 38 | 2530 | 500 |
| 12 | 46 | 3420 | 500 |

# Axle Counter Signalling Cable

## A-2YTF2Y(L)2Y4Y

### n x 4 x 0.9 mm



## APPLICATION

In railway signalling applications for transmission of low frequent signal through symmetric circuits, for example AzLM axle counter applications and similar wayside equipment. Insect and termite resistant.

## CONSTRUCTION

**Conductor**
Bare, solid copper conductor, soft annealed, 0.9 mm of diameter

**Insulation**
PE, red/white/blue/black per quad, and additional coloured helix for identification of quads

**Twisting**
Cores twisted to star quads, quads laid up in layers

**Filling**
Special filling compound

**Inner sheath**
PE, black

**Moisture barrier sheath**
Laminated sheath made of aluminium tape 0.15 mm, one side copolymer coated, bonded with

**Intermediate sheath**
PE, black

**Outer sheath**
Nylon, UV, insect and termite resistant plus blue sacrificial jacket

## Notes

- Detailed data sheet available upon request.


- 10°C; + 60°C
- 40°C; + 60°C


≥ 10 x D
≥ 7.5 x D

EN/IEC 61034


Termite resistant

> Signalling cable based on PH 416.0115 V1.1 of Deutsche Bahn
> Longitudinally watertight
> Star quad stranded, PA outer sheath (insect and termite resistant)

| Characteristics | Unit | 0.9 mm |
|---|---|---|
| Conductor resistance | Ω/km | ≤ 27.9 |
| Insulation resistance | GΩxkm | ≥ 10 |
| Mutual capacitance at 800 Hz | nF/km | ≤ 50 |
| Test voltage at 50 Hz - 2 min | | |
| core/core | $V_{rms}$ | 2500 |
| core/screen | $V_{rms}$ | 2500 |

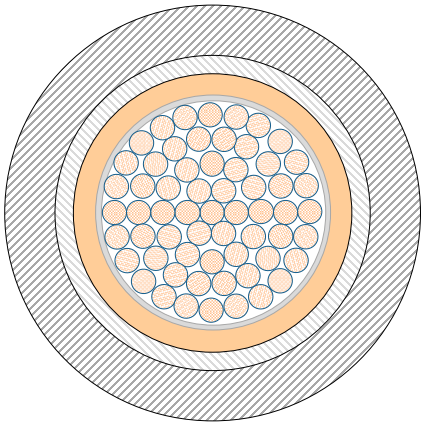
## A-2YTF2Y(L)2Y4Y

| No. of quads | n x 4 x 0.9 mm (H45) | | |
|---|---|---|---|
| | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
| 1 | 13 | 145 | 2000 |
| 5 | 23 | 425 | 1000 |

# Track Feeder Cable

## EPROTENAX SUBAQUA AT 1.8/3 kV

### 1 x 35 / 50 / 185 / 240 / 400 mm²



## APPLICATION

Track feeder cable, developed for Singapore metro. Suitable for installation and use underwater. Halogen free and flame retardant with excellent mechanical characteristics.

## CONSTRUCTION

**Conductor**
Watertight bare copper conductor class 2, soft annealed

**Separator**
Polyester tape, helically applied

**Insulation**
Cross-linked ethylene propylene rubber HEPR, natural colour

**Inner sheath**
LSOH compound, flame retardant

**Outer sheath**
Afumex LSOH compound, anti-termite, black

## Notes

- Detailed data sheet available upon request.


- 5°C; + 50°C
- 25°C; + 70°C


≥ 10 x D
≥ 5 x D

EN/IEC 61034


EN/IEC 60332-3


Termite resistant

> Track feeder cable based on IEC 60502-1
> Single core design
> Excellent mechanical characteristics, termite resistant

| Characteristics | Unit | Value |
|---|---|---|
| Conductor resistance | Ω/km | see table below |
| Max. continuous conductor temperature | °C | ≤ 90 |
| Operating voltage $U_0$ / U | V | 1800 / 3000 |
| Voltage test AC | kV/5 min | 6.5 |

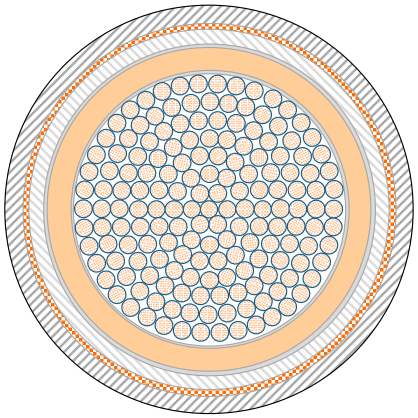
## Eprotenax Subaqua AT 1.8/3 kV

| Cross-section [mm²] | Conductor resistance [Ω/km] | Conductor diameter [mm] | Wall thickness insulation [mm] | Wall thickness inner sheath [mm] | Wall thickness outer sheath [mm] | Outer diameter [mm] | Cable weight [kg/km] |
|---|---|---|---|---|---|---|---|
| 1 x 35 | 0.524 | 7.0 | 2.2 | 1.0 | 2.0 | 21.0 ± 1.2 | 730 |
| 1 x 50 | 0.387 | 8.2 | 2.2 | 1.5 | 2.5 | 24.0 ± 1.2 | 900 |
| 1 x 185 | 0.100 | 16.2 | 2.4 | 1.5 | 2.5 | 32.4 ± 1.3 | 2345 |
| 1 x 240 | 0.0754 | 18.3 | 2.4 | 1.5 | 2.5 | 34.6 ± 1.4 | 2945 |
| 1 x 400 | 0.0470 | 23.1 | 2.6 | 2.0 | 2.5 | 40.9 ± 1.5 | 4515 |

# Track Feeder Cable

## CU/EPR/WBT/DBT/LSOH 1.8/3 kV

**1 x 800 mm²**



### APPLICATION

Track feeder cable, halogen free and flame retardant. Excellent mechanical characteristics.

### CONSTRUCTION

**Conductor**
Tinned copper conductor class 2, soft annealed

**Separator**
Polyester tape, helically applied

**Insulation**
Cross-linked ethylene propylene rubber EPR, natural colour

**Water blocking**
Water blocking tape, helically applied

**Inner sheath**
LSOH compound

**Armouring**
Brass copper tape

**Outer sheath**
Afumex LSOH compound, ordinary oil-resistant, black

### Notes

- Detailed data sheet available upon request.


- 5°C; + 50°C
- 25°C; + 70°C


760 mm

EN/IEC 61034


EN/IEC 60332-3

> Track feeder cable based on IEC 60502-1
> Single core design, armoured
> Excellent mechanical characteristics

| Characteristics | Unit | 800 mm² |
|---|---|---|
| Conductor resistance | Ω/km | 0.0224 |
| Max. continuous conductor temperature | °C | ≤ 90 |
| Operating voltage $U_0$ / U | V | 1800 / 3000 |
| Voltage test AC | kV/5 min | 6.5 |

## CU/EPR/WBT/DBT/LSOH 1.8/3 kV

| Cross-section [mm²] | Conductor resistance [Ω/km] | Outer diameter [mm] | Cable weight [kg/km] | Standard length [m] |
|---|---|---|---|---|
| 1 x 800 | 0.0224 | 50 | 8620 | 1000 |

# GILA®-Duct

## GILA®-Duct
### Galvanized InterLocking Armor

## APPLICATION

GILA-Duct® is a specially manufactured HPDE duct that is used where additional mechanical protection of cable is of primary importance. Suitable for both aerial and buried installations, this construction combines the protection of a metal armor with the low cable pulling friction and the low dielectric constant of HDPE. GILA-Duct can be supplied empty, with a pull line, or with Draka cables pre-installed. It is shipped with sealed ends to prevent entry of moisture and other contaminants.
Conductors available include THHN/THWN, EPR-USE, XHHW-2, RHH/RHW-2, XLP-USE, L-824 B or C airport lighting cable, fiber optic cable, paired communication/coax cables, aluminum conductors and medium voltage cables.
Tests have shown that the average lightning resistivity of GILA-Duct is up to 200kV.

## CONSTRUCTION

**Inner duct**
Black high density polethylene (HDPE) meeting ASTM 3350 requirements with TC-7 wall thickness

**Armouring**
Galvanized steel tape 25 mils thick, interlocked and helically applied

**Jacket**
60 mils thick HDPE meeting ASTM 3350, nominally orange or black but can be coloured to customer's specification

## Notes
- Detailed data sheet available upon request.

- 5°C; + 50°C
- 40°C; + 70°C


EN/IEC 61034

> PE conduit acc. to ASTM D3485
> Galvanized steel tape, interlocked
> Excellent mechanical characteristics

## GILA®-Duct

| Duct trade size [in/mm] | Nominal inner diameter [mm] | Nominal outside diameter [mm] | Nominal weight [kg/km] | Minimum bending radius [mm] | Maximum pulling tension [N] |
|---|---|---|---|---|---|
| 0.75 / 19.1 | 23.1 | 35.8 | 1000 | 440 | n/a |
| 1.00 / 25.4 | 29.2 | 44.2 | 1380 | 540 | 6360 |
| 1.25 / 31.8 | 36.6 | 53.3 | 1775 | 640 | 7640 |
| 1.50 / 38.1 | 41.8 | 59.4 | 2050 | 720 | 15430 |
| 2.00 / 50.8 | 52.6 | 69.9 | 2660 | 840 | 19130 |
| 3.00 / 76.2 | 77.5 | 104 | 4400 | 1250 | 27260 |

## SPECIFICATIONS and RATINGS

- ASTM D3485 – Standard specification for smooth wall coilable polyethylene (PE) conduit (duct) for preassembled wire and cable
- HDPE meets the requirements (Class C, Grade PE33) of ASTM D3350 Standard specification for polyethylene plastics pipe and fittings material

**RATING:** The duct is composed of black (other colors available), high-density polyethylene meeting the requirements (Class C, Grade PE33) of ASTM 3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Material.

# Cables with reduction factor

On electrified tracks which are operated using alternating current or under high-voltage power lines, parallel laid railway cables are exposed at the same time to the influence of electromagnetic fields. These electromagnetic fields induce current in the cables, which can lead to disturbances and destruction of the equipment connected to them as well as present a hazard to life and limb. In order to reduce this influence to a non-hazardous level, the cables are provided with a metallic shield according to their cross-section. This shield has to be earthed on both sides of the cable.

The measure of quality used to shield cables in railway applications is referred to as the reduction factor. The reduction factor is the ratio of induced tension with shielding to the induced tension without shielding. A reduction factor of 1 would mean "no shielding effect". A reduction factor of 0.5, for example, would mean a reduction of the induced tension by one half.

The effect of shielding of the materials used (copper, steel, aluminium, etc.) is dependent on the conducting cross-section of shielding as well as the frequency of the interfering signal.

Depending upon the local circumstances, the cable design and hence the resultant reduction factor can be optimised to best match the expected field strength along the railway track. A typical description for the request for a cable protected against inductive interference shall include disturbing frequency and field intensity as well as the requested reduction factor. For example:

- Reduction factor < 0.5 at 16.7 Hz in the range of 80 – 150 V/km or
- Reduction factor < 0.3 at 50 Hz in the range of 80 – 250 V/km.

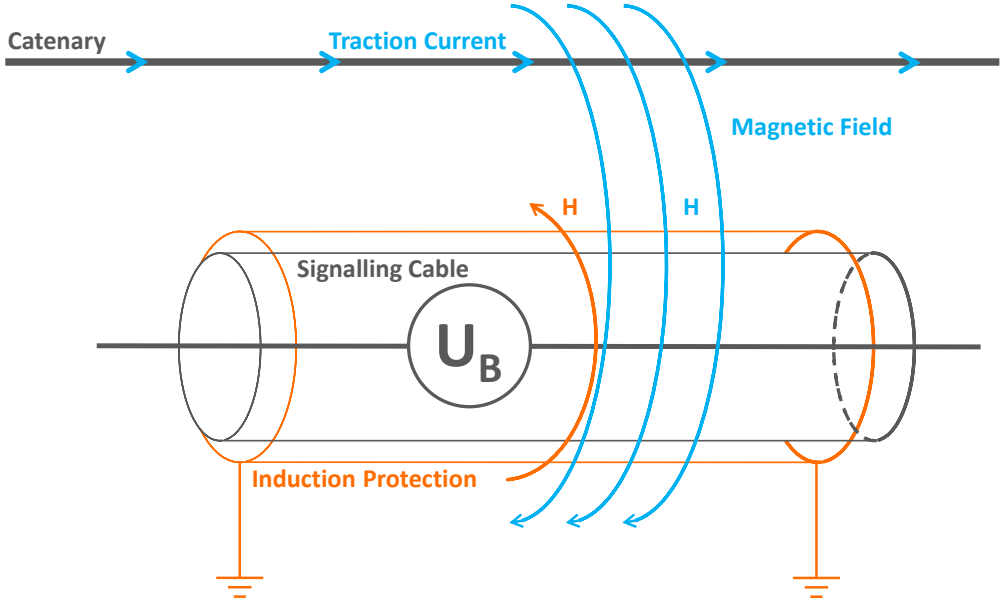
The tension induced in the cable increases with the length the cable is exposed to the electrical field. A cable which is exposed over a length of 2000 m to the field can require a lower (better) reduction factor than the same cable, which is only exposed to the induced field over a length of 1000 m.

The calculation of the actually required reduction factor is very complicated and depends on a multitude of different parameters:

- Distance of the cable to be shielded from the interfering cable (overhead line...),
- Type of installation (underground, in conduits, on the ground...),
- Characteristics of the ground,
- etc.

A respective calculation of the required reduction factor can only be carried out by experts. The cable manufacturer then develops the correct cable design based on the given factors.

As a supplier of cables for railway applications and development partners of well-known European railway operators of long standing, Prysmian offers an extensive portfolio of different cables with reduction factor. Upon request we shall be pleased to develop the right cable design for a customer's purposes.




Picture: Magnetic field compensation by inductive protection


Picture: Cable AJ-2Y(L)2YDB2Y 10x4x1.4 mm S (H45) rk 600 of Deutsche Bahn with protection against inductive interference

# Requirements for fire characteristics of cable installations in tunnels or stations

Prysmian provides a complete product range of cables and circuits for the railway infrastructure sector. We also take into consideration the special requirements needed for laying cables in closed environments.

Most railway infrastructure operators specify cables with a black polyethylene (PE) outer sheath for use in the open air. PE is extremely robust and resistant, has very good UV resistance due to the black colouring and guarantees a cable life of about 35 years. PE is halogen-free and burns with low smoke emissions without releasing toxic gases. In the open, such cable fires are rarely life-threatening, as escape routes are open in all directions.

The situation is, however, quite different in cable installations in tunnels: in this case one is confronted with narrow spaces, without a possibility to extract smoke and gases, darkness, and only a few escape routes. A fire in a tunnel can have disastrous consequences! The use of PE, which actually burns halogen free and has a low smoke producing potential, is not self-extinguishing, however. PE contributes to the further propagation of the fire.

The fire can penetrate into adjacent rooms and cause more damage. Cables with PVC outer casings are no alternative, however, although PVC is flame retardant and is usually self-extinguishing. PVC burns producing dark soot and releases corrosive and toxic gases. In a very short time, the tunnel would be impassable and any persons inside would suffocate. An ideal material combines the advantages of PE and PVC: it is halogen free, produces little smoke, flame retardant and self-extinguishing. Such materials exist and are also manufactured, refined and improved in Prysmian's material laboratories.

Known halogen-containing materials are, for example, chloroprene rubber (CR), ethylene tetrafluoroethylene (ETFE), perfluoroethylene propylene (FEP) or polyvinyl chloride (PVC).

Halogen-free materials are, among others, silicone rubber (SIR), polyamide (PA), ethylene propylene polymers (EPR), thermoplastic elastomers (PE) or polyethylene (PE).

There are European and international standards regarding the unique and comparable classification of flammability properties of cables. We want to briefly introduce to you the most important test procedures.

# Fire testing

**EN/IEC 60332-1**
(Tests on electric and optical fibre cables under fire conditions: test for vertical flame propagation for single insulated wire or cable)

The flame propagation is tested according to IEC 332-1 on a single cable. A vertical sample of cable about 600 mm in length is exposed to a flame for 60 s and/or 120 s in an area 100 mm above the lower end with a 1 kW Bunsen burner. After removing the burner, the flame must self-extinguish. The zones of the cable damaged by the flame should not reach to the upper end of the cable. The flaming time is dependant on the diameter of the cable.

Comparable tests are DIN VDE 0482-332-1-2, EN 50265-2-1, NF C 32-070 C2, BS 4066-1.

**EN/IEC 60332-3**
(Tests on electric and optical fibre cables under fire conditions: test for vertical flame spread of vertically mounted bunched wires or cables)

The test for the spread of the flame with an array of several cables, i.e. a bunch of cables, is normally carried out according to IEC 332-3 (EN 50266-2, test method A, B, C or D – for use of different volumes of non-metallic materials).

The test specimens, mounted in a vertical frame, are exposed to a flame over a length of 3600 mm starting in the lower section using a special burner with a high output. During and/or after exposure to the intensive flame for 20 and/or 40 minutes, the cables may not continue to burn to their upper end.

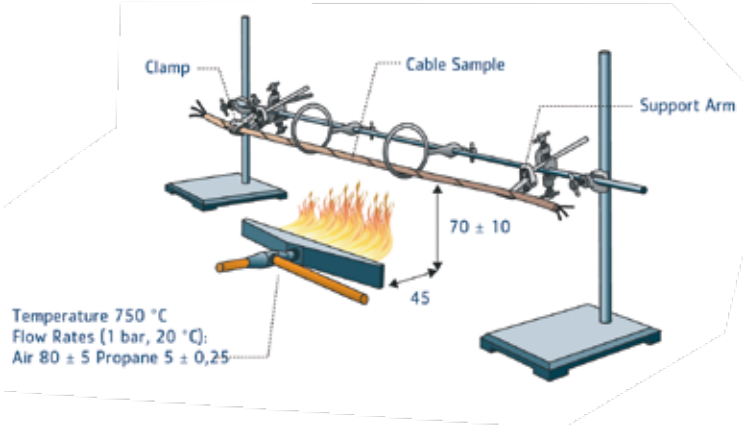
Comparable tests are DIN VDE 0482-266-2-4, EN 50266, NBN C30-004 Cat. F2, BS 4066-3.

# Railway Infrastructure Cables

**IEC 331**
(Cable with insulation integrity)

A horizontal cable sample is exposed to a flame over a width of 1200 mm with a flame temperature of at least 750 °C for a recommended duration of at least 90 minutes. The cable is connected up electrically and under tension. During flaming and a cooling down time of an additional 15 minutes, no short circuiting or interruption of the current may arise.

Comparable tests are EN 50200, EN 50263, NF C 32070 CR1, BS 6287.




**DIN 4102 part 12**
(Cable with functional integrity – system testing of cable and the cable mounting system)

This test is very extensive. As it is a test of the system which includes the cable and the cable mounting system, the product to be tested is completely walled into a closed space. The cables are connected up electrically and are kept under tension during the test. The entire room is set alight with a defined temperature unit curve. After at least 30 minutes flame exposure, neither short-circuiting or interruption of circuit may arise. It is extremely difficult to pass the test, as the cable mounting system has a considerable influence on the result. Cable clips, ducts or conductors exert mechanical loads on the cable, as the material changes during flaming: cable ducts start to bend through the load exerted by the cable and the originally smooth cable suddenly hangs down at several points. This mechanical change of position of the burned cable can lead to interruption or short-circuiting.

**IEC 61034**
(Measurement of smoke density of cables burning under defined conditions)

A plastic sample is burned under controlled conditions. In this way, the light transmission through the combustion gases which arise is measured.

Comparable tests are DIN VDE 0482-286-1 and -2, NFX 10702, BS 7622-2.

**IEC 60754-1**
(Test on halogen acid gases evolved during combustion of materials from cables)

A plastic sample is burned under controlled conditions. In this way, the smoke gases are measured for their halogen content.

Comparable tests are DIN VDE 0482-267-2-1 and EN 50267-2, NF C 20454, BS 6425-1.

**IEC 60754-2**
(Test on acidity of gases evolved during combustion of materials from cables)

A plastic sample is burned under controlled conditions. In this way, the pH-value and the conductivity of the smoke gases are measured.

A comparable test is DIN VDE 0276-604.

With the exception of the small fire test according to EN/IEC 60332-1, the cable is normally destroyed during the flame test. Although no short-circuiting or interruptions should arise, it is difficult to speak about defined electrical values such as operating capacity or characteristic impedance. In this case we are talking about either: current flowing or not. This may in reality be adequate for loudspeaker announcements or sprinkler systems. Control and safety technology using electronic interlocking is during or after a cable fire, if at all, hardly still sensible and feasible. Under these circumstances, the need to maintain fire testing standards according to EN/IEC 60331 (insulation integrity) and/or DIN 4102 part 12 (functional integrity) makes little sense for railway signalling cables for electronic interlocking.

# Construction Product Regulation

Since 01/07/2013, the "Construction Product Directive" (CPD) in the EU has been replaced by the "Construction Product Regulation" (CPR) and is thus valid law in all member states of the EU. The CPR and/or the building product directive (BPVo) affects all cables which are intended for permanent installation in a building. Products have to fulfil requirements in terms of behaviour and/or resistance in the case of fire.

CPR itself does not define any performance requirements regarding the affected products. The definition of safety requirements remains the responsibility of the national authorities.

CPR has introduced binding performance requirements (Declaration of Performance, DoP) and the corresponding CE-mark for labelling the products. The cable's fire characteristics shall be marked in the future with a combination of different classes (The index "ca" stands for "cable"):

| | | |
|---|---|---|
| CPR classes are: | $A_{ca}$, $B1_{ca}$, $B2_{ca}$, $C_{ca}$, $D_{ca}$, $E_{ca}$, $F_{ca}$ | (see table to the right) |
| Smoke classes are: | s1, s1a, s1b, s2, s3 | (EN 50399/EN 61034-2) |
| Acidity classes are: | a1, a2, a3 | (EN 60754-2) |
| Flaming droplets classes are: | d0, d1, d2 | (EN 50399) |

The CPR has no class or guideline for railway cables laid in exposed outdoor areas. These cables may continue to be designed, produced and installed as previously. For railway cables in tunnels or train stations, the relevant cable manufacturers associations recommend a classification according to the EU regulation (1303/2014), clause 4.2.2.4: "In case of fire, exposed cables shall have the characteristics of low flammability, low fire spread, low toxicity and low smoke density. These requirements are fulfilled when the cables fulfil as a minimum the requirements of classification $B2_{ca}$, s1a, a1, as per Commission Decision 2006/751/EC."

Prysmian Group will observe these obligations and, as far as they do not satisfy existing cable designs, will provide cables and products to the market with the corresponding properties.

| Class | Test method(s) | Classification criteria | Additional classification |
|---|---|---|---|
| $A_{ca}$ | EN ISO 1716 | PCS ≤ 2,0 MJ/kg and<br>PCS ≤ 2,0 MJ/kg and | |
| $B1_{ca}$ | EN 50399<br><br><br>and | FS ≤ 1.75 m and<br>THR1200s ≤ 10 MJ and<br>Peak HRR ≤ 20 kW and<br>FIGRA ≤ 120 Ws-1 | Smoke production and Flaming droplets/particles and Acidity |
| | EN 50265-2-1 | H ≤ 425 mm | |
| $B2_{ca}$ | EN 50399<br><br><br>and | FS ≤ 1.5 m; and<br>THR1200s ≤ 15 MJ; and<br>Peak HRR ≤ 30 kW; and<br>FIGRA ≤ 150 Ws-1 | Smoke production and Flaming droplets/particles and Acidity |
| | EN 50265-2-1 | H ≤ 425 mm | |
| $C_{ca}$ | EN 50399<br><br><br>and | FS ≤ 2.0 m; and<br>THR1200s ≤ 30 MJ; and<br>Peak HRR ≤ 60 kW; and<br>FIGRA ≤ 300 Ws- | Smoke production and Flaming droplets/particles and Acidity |
| | EN 50265-2-1 | H ≤ 425 mm | |
| $D_{ca}$ | EN 50399<br><br>and | THR1200s ≤ 70 MJ; and<br>Peak HRR ≤ 400 kW; and<br>FIGRA ≤ 1300 Ws-1 | |
| | EN 50265-2-1 | H ≤ 425 mm | |
| $E_{ca}$ | EN 50265-2-1 | H ≤ 425 mm | |
| $F_{ca}$ | no performance determined | | |

Table: Overview of the CPR classifications

# Transport and storage of cable drums

Even if cable and drum look very strong, there are certain rules to follow to avoid damage of the cable and an accompanying impairment of mechanical and electrical characteristics.

**Transport and storage of cable drum**
It is possible to store cable drums outdoors. When storage has occurred in heated rooms, a minimum 24-hour acclimatisation period must be observed before installation (possible condensation build-up in the cable!).

For outdoor storage the ground must be even and clean. Stones or bumps in the ground should be removed or smoothed out. Damage to the wound goods/cable should be avoided at all costs.

Cables should be secured against accidental rolling away. Under no circumstances should the drum flange of neighbouring cables touch any wound goods.

Cable drums should always be stored and transported standing on both flanges.

They should not be pushed along the ground standing on the flanges. It is possible that the strength of the cable drum would then no longer be guaranteed.

Observe the rolling direction. The arrow printed on the drum flange indicates the rolling direction so that the wound goods do not become loose.

Always uncoil the cable at a tangent, never over the flange, since the torsion thus resulting would damage the cable and laying would not be possible.

**Cable ends**
Finally it remains for us to point out the necessity of having faultless cable ends. Pressure-tight and impermeable cable ends are particularly essential for cables which are not longitudinally water-proof, as well as for cables which are insulated with paper, cellular-PE and foam-skin-PE. Carelessness in this area can lead to moisture penetration which is accompanied by a drastic deterioration in the electrical transmission rate. Power failures and expensive replacement work are the result. Pressure-tight and impermeable cable ends can be achieved, for example, through the use of synthetic sealing resin or compressed air sealing stoppers.

# Important physical characteristics

**Temperature range**
The temperature range of the cable is of great importance for both the user and fitter. After all the cable is meant to function equally well in cold and hot temperatures. It is particularly during the fitting process that powerful mechanical forces act on the cable. The plastic used serves as the limiting element for the possible temperature range. At overly warm temperatures the plastic becomes very soft and can change into a thermoplastic state (up to melting point), which causes irreversible changes in the cable.

At very cold temperatures, however, the material stiffens and becomes hard and inflexible. Here, too, irreparable damage can occur.

Tears in the sheath allow dampness and moisture in and impair the transmission rate. Details about the permissible temperature range during laying and use (following successful fitting) can be found in the information sheets of the cable manufacturer. Since the mechanical strain on the cable in its laid form is significantly less, the permissible temperature range is greater than the range valid for the installation period.

**Bending radius**
Regarding the bending radius we distinguish between multiple and single bending (shaping into the final position).

Multiple bending occurs mainly during the laying process. Cables are laid under tension around deflector rolls. The particular stress of multiple bending lies in the alternating stress on the materials, which can be stretched several times as well as compressed during the laying process.

To prevent permanent damage there are prescribed minimum bending radii of, for example, 10 x cable external diameter for multiple bending.

The stress on the material during final bending is not characterised by alternating stress. The cable is bent into form a final time and stays in this position for the duration of its use. The minimum bending radius in this case is, for example, 7.5 x cable external diameter. During final bending the cable can, therefore, be bent more tightly.

Exact minimum bending radii for specific cables can be found in the information sheets of the cable manufacturer.

**Tension**
During laying of the cable particular attention must be paid to the maximum possible tension. The cable is very quickly damaged by the use of too much force and must then be replaced. The maximum possible tension depends in the first place on the overall cross section and the tensile strength of the conducting materials used.

For cables with steel tape or copper wire spiral armouring it is the internal copper conductors alone which determine the maximum tension! The armouring has no influence on the maximum tension or can possibly reduce it through additional weight. For armouring with steel or steel profile wires, however, the tension is determined solely by the steel and steel profile wires.

**Cable weight**
The cable weight of larger cable dimensions can take weights of up to more than 10 t/km (without the reel!).

# Certifications and compliance

**Certifications of Railway and Infrastructure Authorities**

Being a very complex system with a high safety integrity level, railway products are subject to detailed requirements and strong supervision. Many railway infrastructure operators issued dedicated cable specifications which require homologation and frequent auditing. Prysmian Railway Cables are designed and produced according to a number of railway cables standards, like DB, SBB, ÖBB, SNCF, TCDD, ADIF/ RENFE, RFI, RATP and many more in Europe and around the globe. High quality manufacturing processes, many decades of experience in cable design and engineering as well as intense testing procedures guarantee state-of-the-art cable products and satisfied customers worldwide.

**REACH (Registration, Evaluation and Authorisation of Chemicals)**

Adopted on December 18th, 2006, the Regulation of the European Parliament and the European Union Council, modernized the European legislation regarding chemical substances, and set up a unique integrated system of chemical substances in the European Union. Its objective is to improve the protection of the human health and of the environment, while maintaining the European chemical industry's competitiveness and strengthening its spirit of innovation. All Prysmian railway cables are REACH compliant.

**RoHS (Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment)**

The RoHS directive aims at restricting the use of certain dangerous substances commonly used in electric and electronic equipment (EEE). Cables concerned by this directive are any cables rated below 250V, which function is the connection or the extension of an EEE to electrical outlet or the connection of two or more EEE to each other. All Prysmian railway cables are RoHS compliant.

**Management Systems**

- Quality Management System EN ISO 9001:2008
- Environmental Management System EN ISO 14001:2005
- Energy Management System EN ISO 50001:2011

# Our responsibilities

**Social Responsibility**

Within the social dimension of its business, the Prysmian Group recognises its commitment and responsibility towards the persons who work as part of the Organisation, as well as those who form the local communities in the territories in which the Group is active. Accordingly, consistent with its values, Prysmian constantly seeks to ensure the personal and professional satisfaction of its human resources, and to communicate with and involve local populations, in order to generate value for these important categories of stakeholder.

**Environmental responsibility**

The Group's commitment to safeguarding the environment and conserving natural resources is expressed not only by the intrinsic characteristics of our products, but also by how our production systems are managed. In particular, the prevention and reduction of their environmental impact is achieved, for example, by the efficient use of natural resources, the optimisation of logistics flows and the responsible management of waste.

During 2015, HSE further consolidated its activities at various levels within the Group (corporate, country or geographical area, business unit, production unit), centralising activities and coordinating the work of the local HSE functions. Group policies for Health, Safety and Environment, as well as the related Operating Procedures and Technical Standards, have been adopted and applied at operating unit level. The HSE function, with support from the Group audit team, periodically checks the effectiveness and proper application of the HSE rules at local level.

The aspects monitored by HSE using indicators include compliance with health and safety at work standards, energy consumption, waste management, water usage and greenhouse gas emissions. In particular, with reference to the greenhouse gas emissions, the Group has begun to collect energy consumption data in order to track both "direct" emissions (deriving from production processes) and "indirect" emissions (deriving from the energy purchased). This system of monitoring and reporting enabled the Group to participate in 2015, once again, in the Carbon Disclosure Project (CDP), which seeks to contribute to the pursuit of the objectives agreed in the Kyoto Protocol regarding the global reduction of greenhouse gas emissions

**Product responsibility**

Quality and innovation are the hallmarks of Prysmian's approach, both in sectors where the level of technology, the ability to innovate constantly and the commitment to offering high value-added services together establish a differentiated competitive positioning, and in those sectors where products are more standardised, such as medium and low-voltage cables. The Group applies a customer-centric approach, reflecting an ability to anticipate and satisfy the needs of customers with the maximum possible attention.

# References

Prysmian and Draka have been supplying the railway industry for many decades. We supply all renowned European railway infrastructure companies, often as part of long-term master agreements.

The following excerpt of our success records shall give you an idea about our global presence. Many more projects have been realized in the recent years, in many more countries.

There is always a Prysmian office close to you.

| | |
|---|---|
| Australia: | QueenslandRail, conversion to axle counter detection technology |
| Egypt: | Cairo – Alexandria line |
| Bulgaria: | Plovdiv-Bourgas line |
| Chile: | Rancagua project |
| Denmark: | Renewal of Danish Rail Infrastructure |
| Germany: | Framework contract and development partner of Deutsche Bahn |
| Finland: | Länsimetro project |
| Israel: | Ashkelon – Netivot line |
| Canada: | Toronto Transit Authority |
| Croatia: | Zagreb Central Station |
| Latvia: | Modernisation LZD-Infrastructure |
| Malaysia: | Thomson Line project |
| Morocco: | Casablanca – Tanger line |
| Mexico: | Metro Monterey |
| Norway: | LKAB Narvik-Kiruna project |
| Saudi Arabia: | North-South-Rail project, Mecca Metro |
| Switzerland: | Framework contract with SBB |
| Singapore: | Singapore Metro Subaqua Cable |
| Spain: | Vandellos-Tarragona line, Madrid – León – Burgos high speed Line |
| Turkey: | Ankara-Konya high speed line, Eskisehir – Balikesir line, Metro Istanbul, Metro Ankara |
| USA: | JFK Air Train, New York City Transit, Oakland Bay Area Rapid Transit |

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# Linking global expertise to the wheels of industry



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