



Pilot Cables



Application

Pilot cables are used for control, protection, signalling, telecommunications and data transmission purposes associated with power distribution and transmission systems. Such systems are mainly operated by the electrical supply industry and similar applications occur in many industrial systems.

Pilot cables are insulated with special materials which are designed to protect them from the danger of induced voltages coming from other cable circuits in close proximity (for example, faults in high voltage power cable circuits). An over voltage in the pilot cable cores may compromise alarm systems, prevent the proper operation of

Benefits

> High Transmission Performance

- Ensures high transmission characteristics (low capacitance, attenuation and cross-talk) over a very wide range of frequencies.
- Allows future technological upgrade of auxiliary systems (e.g., higher working frequency or higher bit rate).

> Multifunctionality

- Provides controlling, instrumentation and telecommunication services.
- Permits integration with interstitial fibre optic cables.
- Allows Utilities to grow their business to encompass further services.

> Power System Integrity

- Preserves the HV system from electrical fault “chain effects” and permanent damage.
- Reduces HV system maintenance and repair costs.

> Customised Cable Engineering

- Technical assistance and pilot cable specification based on the customer’s requirements.
- Customised lengths for specific installation requirements.
- Pilot cable testing based on proprietary facilities.

> Induced overvoltage control

- Avoids permanent damage from short-circuits on electronic equipment such as instrumentation, control and telecommunication systems, both at head-end terminals and substations.
- Reduces risk of electric shocks and injuries to people working on current maintenance and repairs.
- Fail-safe performance customised for the customer’s specific electrical protection systems.



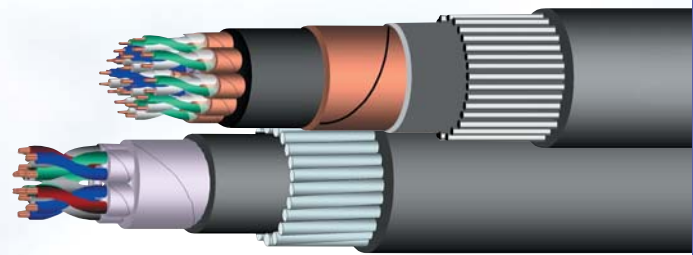
SAFE TRANSMISSION UNDER THE MOST SEVERE EMI CONDITIONS

protection equipment, resulting in severe damage to the power system.

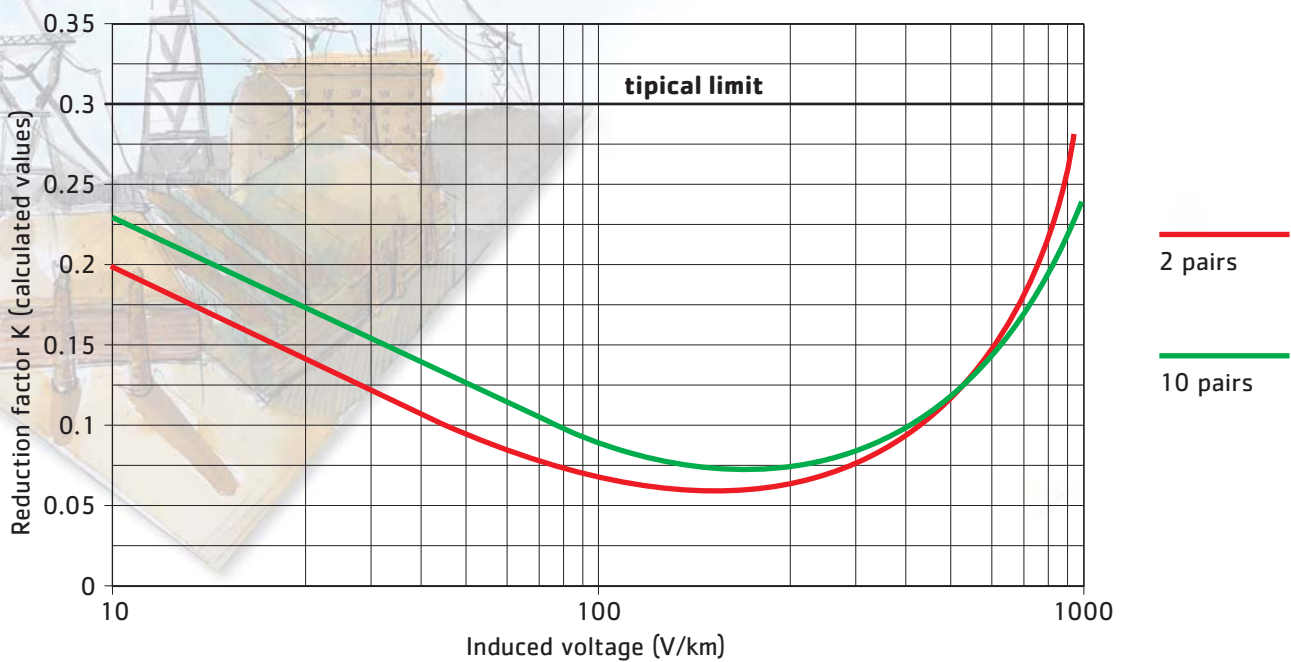
Technergy™ Pilot cables protect the system from dangerous induced voltages and EMC problems through different shielding types designed for specific operating conditions.

Screens provide a reduction factor that restricts the over voltage on the cable core up to 1/10th of the induced voltage (see the test plot, elsewhere in this brochure).

Technergy™ Pilot cables offer utilities, specifiers, contractors, system designers and installers the following benefits:



► Typical Intrinsic Reduction Factor at 50 Hz



About us

Prysmian Cables & Systems is a world-class multinational company. Founded in 1872 as "Ditta Pirelli & C.", it has achieved a leading position for more than a century of operations in its two key international markets - "Energy Cables & Systems" and "Telecom Cables & Systems".

Prysmian Cables and Systems is the world's largest manufacturer of power and telecommunications cables, with 52 manufacturing facilities in 21 countries in five continents and a market share in excess of 10%.

Prysmian Energy Cables and Systems is a global solutions provider, offering a wide range of integrated solutions, such as cable systems, system design and engineering, project management, installation and post-sale services.

Prysmian Energy Cables and Systems concentrates on continuous product innovation and on achieving a competitive edge by focusing on research and development. This is done through Prysmian's own R&D centres and by co-operating with universities, scientific institutions and above all, our customers. Prysmian's world-wide organisation makes and delivers advanced technological solutions to customers anywhere in the world.

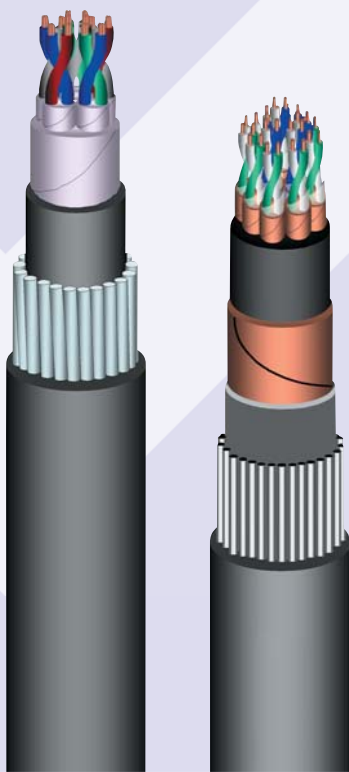


Prysmian's TECHNERGY integrated cabling solutions™ is one of the world's most comprehensive and technologically advanced answers to industry, infrastructure, contractors and OEM's specific requirements.

TECHNERGY integrated cabling solutions™ are designed and structured into twelve different product lines. Each of these offer tailored designs and added value solutions to the most diverse functional and environmental requirements in the following fields:

- > Trains
- > Marine
- > Oil & Gas
- > Plant & Petrochem
- > Mining & Tunnelling
- > Defence
- > Cranes & Mobile Equipments
- > Electro-Mechanical
- > Data & Communication
- > Transportation Infrastructures
- > Building & Civil Engineering
- > Power Plants

To find out more about the TECHNERGY integrated cabling solutions™, Prysmian Cables and Systems invites you to visit the web site: www.prysmian.com



Courtesy of Enel Distribuzione

Cable families at a glance

> PILOT CABLES 5 kV RATED: PE Insulated Al/PET or Copper Tape Collective Screen – Steel Wire Armoured or Double Steel Tape

Cable description

Conductor

Annealed plain copper solid conductor.

Insulation

Solid Polyethylene, nominal thickness $\geq 0,5$ mm.

Cabling element

Two insulated conductors uniformly twisted together to form a pair.

Pair Identification

According to BS 3573 tab. 3.

Cable Assembly

Pairs are assembled together in concentric layers.

Core wrapping

Non-hygroscopic tape applied over the cable assembly.

Collective Screen

Aluminium/polyester foil screen applied in continuous electrical contact with tinned copper drain wire (copper tape screen also available).

Inner Sheath

Black polyethylene.

Armouring

Galvanised steel wire or double steel tape.

Outer Sheath

Black flame retardant PVC sheath.

Electrical characteristics at 20 C

D.C. conductor resistance

| | | | |
|---------------------------------|------|--------------------|------|
| • 1,5 mm ² conductor | Max. | Ω/km | 12,1 |
| • 2,5 mm ² conductor | Max. | Ω/km | 7,41 |

| | | | |
|------------------------------------|------|--------|-------|
| Minimum D.C. insulation resistance | Min. | M x km | 10000 |
|------------------------------------|------|--------|-------|

Nominal

| | | |
|------------------------------|-------|----|
| mutual capacitance at 800 Hz | nF/km | 55 |
|------------------------------|-------|----|

Maximum capacitance

| | | |
|--|---------|-----|
| <i>unbalanced pair to pair at 800 Hz</i> | pF/500m | 500 |
|--|---------|-----|

D.C. voltage test for 1 minute

| | | |
|--------------------------------|----|-----|
| • conductor/conductor | kV | 7,5 |
| • conductors/screen and armour | kV | 7,5 |

Nominal attenuation at 1 kHz

| | | |
|---------------------------------|-------|------|
| • 1,5 mm ² conductor | dB/km | 0,55 |
| • 2,5 mm ² conductor | dB/km | 0,45 |

Nominal impedance at 1 kHz

| | | |
|---------------------------------|----------|-----|
| • 1,5 mm ² conductor | Ω | 260 |
| • 2,5 mm ² conductor | Ω | 210 |

Conductor Size

1.5 mm²

| Screening | Al/PET tape | | | | | | COPPER tape | | | | | |
|------------|-------------|--------|---------|-------------------|--------|---------|-------------|--------|---------|-------------------|--------|---------|
| | Steel Wires | | | Double Steel Tape | | | Steel Wires | | | Double Steel Tape | | |
| Armouring | ext. diam. | weight | lengths | ext. diam. | weight | lengths | ext. diam. | weight | lengths | ext. diam. | weight | lengths |
| | mm | kg/km | m | mm | kg/km | m | mm | kg/km | m | mm | kg/km | m |
| n of pairs | 21 | 760 | 1000 | 19 | 535 | 1000 | 21 | 810 | 1000 | 19 | 570 | 1000 |
| 5 | 27 | 1305 | 1000 | 25 | 825 | 1000 | 27 | 1365 | 1000 | 25 | 880 | 1000 |
| 10 | 30 | 1605 | 1000 | 28 | 1110 | 1000 | 30 | 1680 | 1000 | 28 | 1170 | 1000 |
| 15 | 33 | 1930 | 1000 | 30 | 1335 | 1000 | 33 | 2020 | 1000 | 30 | 1410 | 1000 |
| 20 | 39 | 2780 | 1000 | 37 | 2070 | 1000 | 39 | 2880 | 1000 | 37 | 2150 | 1000 |

Conductor Size

2.5 mm²

| Screening | Al/PET tape | | | | | | COPPER tape | | | | | |
|------------|-------------|--------|---------|-------------------|--------|---------|-------------|--------|---------|-------------------|--------|---------|
| | Steel Wires | | | Double Steel Tape | | | Steel Wires | | | Double Steel Tape | | |
| Armouring | ext. diam. | weight | lengths | ext. diam. | weight | lengths | ext. diam. | weight | lengths | ext. diam. | weight | lengths |
| | mm | kg/km | m | mm | kg/km | m | mm | kg/km | m | mm | kg/km | m |
| n of pairs | 23 | 940 | 1000 | 21 | 660 | 1000 | 23 | 995 | 1000 | 22 | 710 | 1000 |
| 5 | 31 | 1640 | 1000 | 28 | 1125 | 1000 | 31 | 1715 | 1000 | 29 | 1185 | 1000 |
| 10 | 35 | 2130 | 1000 | 32 | 1485 | 1000 | 35 | 2225 | 1000 | 33 | 1595 | 1000 |
| 15 | 38 | 2760 | 1000 | 35 | 1860 | 1000 | 38 | 2835 | 1000 | 35 | 1940 | 1000 |
| 20 | 45 | 3720 | 500 | 43 | 2875 | 500 | 45 | 3830 | 500 | 43 | 2995 | 500 |

> PILOT CABLES 15 kV RATED: PE Insulated – Copper Tape Collective Screen – Steel Wire or Double Steel Tape Armour

Cable description

Conductor

Annealed plain copper solid conductor.

Insulation

Solid Polyethylene, nominal thickness $\geq 0,8$ mm.

Cabling element

Two insulated conductors uniformly twisted together to form a pair.

Pair Identification

According to BS 3573 tab. 3.

Cable Assembly

Pairs are assembled together in concentric layers.

Core wrapping

Non-hygroscopic tape applied over the cable assembly.

Collective Screen

Copper tape screen.

Inner Sheath

Black polyethylene.

Armouring

Galvanised steel wire or double steel tape.

Outer Sheath

Black flame retardant PVC sheath.

Electrical characteristics at 20 C

D.C. conductor resistance

| | | | |
|---------------------------------|------|--------------|------|
| • 1,5 mm ² conductor | Max. | Ω /km | 12,1 |
| • 2,5 mm ² conductor | Max. | Ω /km | 7,41 |

| | | | |
|---|------|--------|-------|
| Minimum D.C. insulation resistance | Min. | M x km | 10000 |
|---|------|--------|-------|

Nominal

| | | |
|-------------------------------------|-------|----|
| mutual capacitance at 800 Hz | nF/km | 50 |
|-------------------------------------|-------|----|

Maximum capacitance

| | | |
|--|---------|-----|
| unbalanced pair to pair at 800 Hz | pF/500m | 500 |
|--|---------|-----|

D.C. voltage test for 1 minute

| | | |
|--------------------------------|----|------|
| • conductor/conductor | kV | 15 |
| • conductors/screen and armour | kV | 22,5 |

Nominal attenuation at 1 kHz

| | | |
|---------------------------------|-------|------|
| • 1,5 mm ² conductor | dB/km | 0,50 |
| • 2,5 mm ² conductor | dB/km | 0,40 |

Nominal impedance at 1 kHz

| | | |
|---------------------------------|----------|-----|
| • 1,5 mm ² conductor | Ω | 290 |
| • 2,5 mm ² conductor | Ω | 230 |

Conductor Size

| Screening | COPPER tape | | | | | |
|-------------------|-------------|--------|---------|-------------------|--------|---------|
| | Steel Wires | | | Double Steel Tape | | |
| Armouring | ext. diam. | weight | lengths | ext. diam. | weight | lengths |
| | mm | kg/km | m | mm | kg/km | m |
| n of pairs | | | | | | |
| 5 | 26 | 1180 | 1000 | 23 | 745 | 1000 |
| 10 | 33 | 1730 | 1000 | 30 | 1155 | 1000 |
| 15 | 34 | 1975 | 1000 | 31 | 1385 | 1000 |
| 20 | 38 | 2570 | 1000 | 35 | 1710 | 1000 |
| 30 | 44 | 3345 | 500 | 41 | 1535 | 500 |

1.5 mm²

Conductor Size

| Screening | COPPER tape | | | | | |
|-------------------|-------------|--------|---------|-------------------|--------|---------|
| | Steel Wires | | | Double Steel Tape | | |
| Armouring | ext. diam. | weight | lengths | ext. diam. | weight | lengths |
| | mm | kg/km | m | mm | kg/km | m |
| n of pairs | | | | | | |
| 5 | 28 | 1405 | 500 | 26 | 940 | 500 |
| 10 | 37 | 2320 | 500 | 34 | 1490 | 500 |
| 15 | 38 | 2710 | 500 | 35 | 1825 | 500 |
| 20 | 43 | 3265 | 500 | 40 | 2490 | 500 |
| 30 | 50 | 4650 | 500 | 47 | 3390 | 500 |

2.5 mm²

Cable design

Customised solutions

| Main cable design elements | Main cable main features | | | | | | | |
|---|---------------------------|----------------|-----|------------------|-------------------|-------------------|---------------------|------------------|
| Insulation | | | | | | | | |
| PE | ● | ● | ● | ○ | ○ | ○ | ● | ● |
| PVC | ● | ● | ● | ○ | ○ | ○ | ● | ● |
| Cabling | | | | | | | | |
| Pairs | ● | ● | ● | ○ | ○ | ○ | ○ | ○ |
| Water blocking | | | | | | | | |
| Water swellable tape | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● |
| Jelly | ○ | ○ | ○ | ○ | ○ | ○ | ● | ● |
| Screens | | | | | | | | |
| Aluminium tape | ○ | ● | ● | ○ | ○ | ○ | ○ | ○ |
| Copper tape | ○ | ● | ● | ○ | ○ | ○ | ○ | ○ |
| Armouring | | | | | | | | |
| Steel Wires | ○ | ○ | ● | ● | ● | ● | ○ | ● |
| Steel Tapes | ○ | ○ | ● | ● | ● | ○ | ○ | ● |
| Outer sheath | | | | | | | | |
| PE | ○ | ○ | ○ | ● | ● | ○ | ● | ● |
| PVC | ○ | ○ | ○ | ○ | ● | ○ | ● | ● |
| <p>● Strongly recommended</p> <p>● Not recommended</p> <p>● Recommended</p> <p>○ Not relevant</p> <p>● Suitable</p> | | | | | | | | |
| | Long distance connections | High Frequency | EMC | Pulling Strength | Impact Resistance | Rodent Resistance | Moisture Resistance | Flame Retardancy |

Prysmian Technergy is aware of the wide variety of customer demands; we manufacture a broad range of auxiliary cables covering both 5kV and 15kV levels of induced voltages, and providing each customer with numerous and easily customised alternatives.

The following options are available:

> **INSULATION**

Polyethylene or PVC; PE is recommended for long distance (>1km) and for High Frequency systems.

> **CABLING**

Multipair or multicore; multipair for instrumentation purposes and multicore for control purposes.

> **SCREENS**

Al/PET or copper tape screens; copper tape screens for a higher level of screening attenuation.

> **ARMOURING**

Galvanised steel wire or double steel tape; Wire for mechanical shocks and for pulling; Tape for crush and rodent resistance.

> **OUTER SHEATH**

Polyethylene (LDPE or HDPE) or PVC; PE for underground moisture resistance and PVC for flame retardance. Termite-proof additives also available.

References

| Customer | End User |
|-----------------------------------|--|
| Siemens (Germany) | Department of Electrical Services (Brunei) |
| Total Engineering (Brunei) | Department of Electrical Services (Brunei) |
| Conspel (Abu Dhabi) | Water and Electricity Department (Brunei) |
| GEC (Brunei) | Department of Electrical Services (Brunei) |
| Heliopolis Electric (Abu Dhabi) | Water and Electricity Department (Abu Dhabi) |
| Total Engineering (Brunei) | Department of Electrical Services (Brunei) |
| HSE Engineering (Brunei) | Department of Electrical Services (Brunei) |
| Prolux (Singapore) | Civil Aviation Authority (Singapore) |
| Prolux (Singapore) | Port of Singapore Authority (Singapore) |
| Prolux (Singapore) | Ministry of Defense (Singapore) |
| Mahkota Techn./GIS Group (Brunei) | Department of Electrical Services (Brunei) |
| Heliopolis Electric (Abu Dhabi) | ADWEA (Abu Dhabi) |