



**AXOSPIRAL®**

High strength spiral cords



# Summary

## AXOSPIRAL® High strength spiral cords

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SPIRAL CORD AXOSPIRAL®

# General Information

**SPIRAL CORDS HELP  
SAVE SPACE AND ARE  
VERY FLEXIBLE.  
THE DIFFERENT  
APPLICATIONS FOR  
THESE CABLES ARE  
ALMOST ENDLESS.**

Spiral cords can basically be divided into two main groups:

- > on the one hand, there are standard off the shelf spiral cord designs for microphone cables, power and control cables, appliance and tool cord sets, and power supply cords ;
- > on the other hand, there are custom-designed cords which are used for example in medical instrumentation, computer printers, robotics, earphones, test equipment, etc . . .

The spiral cord can be used for any electrical connection involving portable devices and moving equipment where flexing would quickly cause damage to conventional wire and cable constructions.

## Conception

Any standard primary wire and/or AXON' CABLE special wires can be assembled into spiral cord AXOSPIRAL®.

AXON' CABLE manufactures a complete range of wires and cables, insulated with the most advanced insulation materials such as :

- > Fluorethylene propylene (FEP),
- > Polytetrafluorethylene (PTFE),
- > Ethylenetetrafluorethylene (ETFE),
- > Perfluoralkoxy (PFA),
- > Polyimide,
- > Fluorinated elastomers (Viton®).

AXON' CABLE can assemble spiral cords with a variety of types of components including equipment wires, wire-wrap wires, coaxial cables, high voltage wire and flat cables.



RESEARCH & DESIGN

## Jacket

In general Fluoro Thermoplastics are preferred for their thermal qualities and excellent chemical resistance and include materials such as Polyurethane, Thermoplastic Polyesters.

Special taped polyimide or elastomeric jackets are also possible. For highly demanding applications AXON' offer special jacketing compounds to meet these requirements.

## Standardisation

AXON' CABLE can manufacture cords with spiral diameters of 2 mm up to 250 mm max. with retracted spiral lengths of 2 cm up to 130 cm.

Furthermore it must be noted that from the same basic cable, we can make three types of spiral cords, each with different properties:

- cord with strong memory and low extension coefficient ( $K \approx 2$ ).
- standard cord with an average extension coefficient ( $K \approx 5$ ).
- cord with a weak memory and a high extension coefficient ( $K \approx 10$ ).

The cable termination can be placed at any angle to the axis of the spiral.



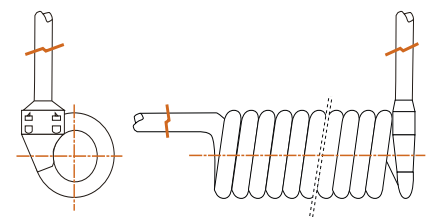
INTERCONNECT WORKSHOP

## Termination

If required, the spiral cords can be protected by heatshrink tube or moulding which ensure current conductor and the cable connector termination are waterproof.

Usually the overmoulding is made of the same or similar material as the cable jacket. This allows the fusion, of toth coating and therefore a perfect adherence between cable and overmoulding.

AXON' CABLE uses mono-elastomer or bi-component overmouldings.



GUIDING OF AXOSPIRAL CORD ALONG ITS AXIS

The volume to be overmoulded determines the moulding technique : low pressure for volumes of 350 cm<sup>3</sup> or more and high pressure (injection) moulding for volume of 30 cm<sup>3</sup> max. Hot melt technique is used the cases where fragile connectors and components must be protected from additional support.

## Marking

There are two marking possibilities :

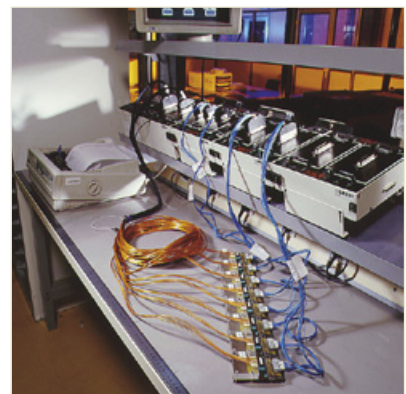
- › on cable,
- › marked heatshrink sleeve with AXON' reference or customer's reference on request.

## Packaging

Delivery by item.

## Test procedure

- › Current integrity.
- › Insulation resistance between wires, between wires and general shields and if necessary, between wires and air.
- › Conformity of lengths, winding length and output terminations.
- › Outside diameter.
- › Memory.
- › Ordered items can be accompanied by a certificate of conformity if requested.



CURRENT INTEGRITY AND INSULATION RESISTANCE  
OF THE WIRE CONTROL

## Quality assurance

AXON' CABLE is committed to quality and has obtained ISO 9001 approval, 2008 version.

All the raw materials constituting ou finished products undergo precise and stringent controls carried out in the AXON' laboratory.

The laboratory devotes its activities to checking the conformity of the finished product with respect to current standards, documents and specifications.

Regular and systematic quality test performed during and after the manufacturing process by appropriate test organisations are a result of continued adherence to quality standards achieved.



ISO 9001 : 2008 CERTIFICATION

## Criteria for spiral cord construction

The criteria listed below will form the basis of the technical information required to enable us to respond with the most appropriated designs to meet your requirements :

First stage (definition of the electrical cable) :

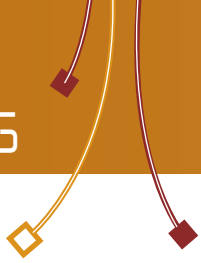
- › temperature rating,
- › description of the cable,
- › specifications,
- › number of primary wires,
- › voltage rating,
- › termination,
- › immunity,
- › bend radius.
- › intensity,
- › application,

- Second stage (design of the cord) :

- › space required,
- › length of the original spiral cord,
- › length of the spiral at its maximum extension,
- › length and geometry of output terminations (perpendicular or parallel to the axis of cord),
- › stripped terminated cable ends,
- › extension coefficient,
- › spiral cord memory,
- › spiral diameter.



SPIRAL CORD AXOSPIRAL®



## Suggestions for selection and usage of cords

When designing equipment for use with retractile cords, avoid conditions that may lead to crushing the coils.

A permanent link between spiral cords and operating equipment with a twisting motion invariably creates kinks that are difficult to remove and can destroy the memory of the jacket. To avoid this problem, use an extra-thick jacket for greater torsional stiffness, or plug-in designs where the cord is often freed and permitted to reorientate itself.

Match the retraction force of the cord to the weight and bulk of the portable product to which it will be attached. Normal use of the cord should not cause the equipment to move or shift position.

Do not use stripping equipment that operates by gripping and tearing the insulation from conductors. Most spiral cord conductors are of finer stranding than conventional straight cords (for high flexlife), and these wires are easily broken.

## Applications

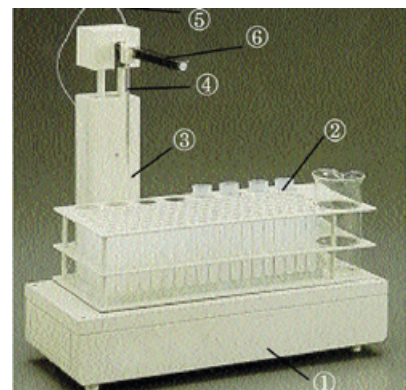
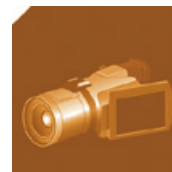
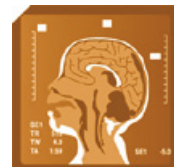
The variety of applications for these cords include:

- > radio/TV : camera and microphone cables, ...
- > industrial : measuring equipment cables for thermocouple probes, ...
- > robotics : robots for the automotive industry, ...
- > electronic data processing & computer hardware,
- > military : headphone cords for the three services, ...
- > aviation: pilot seats, landing gear, etc, ...
- > medical : scanners, radiotherapy equipment, sampling devices, surgery tables, ...
- > agricultural machinery.

### Medical applications

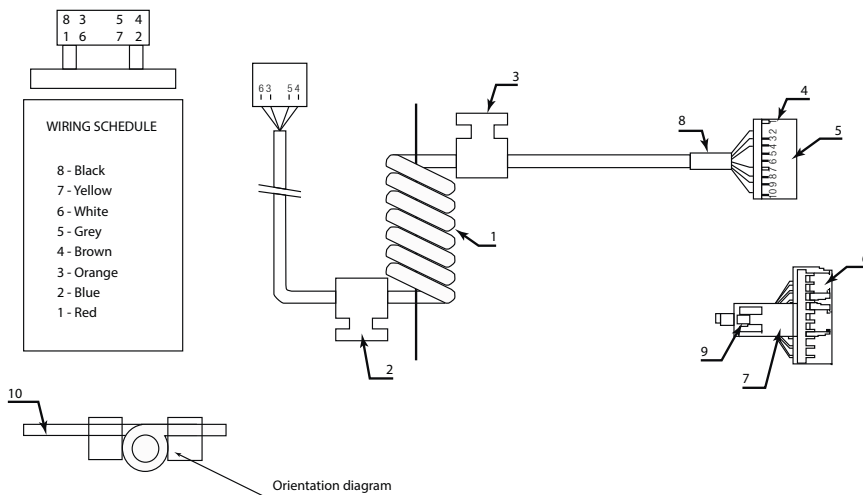
#### Construction of the sampling device

- 1 - Gearing protection house.
- 2 - Test tube holder.
- 3 - Base of the grab arm.
- 4 - Sample capillary.
- 5 - Capillary tube.
- 6 - Grab arm. Maximum movement of the grab arm : - vertical (z) : 145 mm, - horizontal (x) : 302 mm, - horizontal (y) : 110 mm. Precision degree of the movement : about : 0.1 mm ( $\pm$  4 %).





The spiral cord is integrated in a sampling device for different methods of analysis. The computer driven machine carries out an automatic capillary action of liquid samples put into test tubes. Various vertical motions require high flexibility in the cord (up to 144 samples). This particular spiral cord is situated inside the mobile base of the grab arm. Alongside this arm, a tube which transports liquid samples executes a return motion as well as upwards or downwards motions driven by this spiral cord.



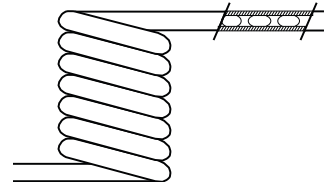
#### CONSTRUCTION

- 1 - Elastomer jacketed spiral cords.
- 2 - 3 - Rubber moulded part.
- 4 - Contact.
- 5 - Housing.
- 6 - Housing clip.
- 7 - Cable clip.
- 8 - Heatshrinkable tube.
- 9 - Cable fixing ring.
- 10 - Heatshrinkable tube.

Speed of the grab arm : roughly 3 seconds from sample to sample.

#### Spiral pipe

In laboratory, a spiral pipe allows different liquid samples to be carried from storage in test tubes to the place of analysis. The material has non-adhesive properties, the different liquids to be analysed circulate in this capillary tube without leaving any marks on the tube walls. The properties of both, liquid and tube, can therefore be maintained. The air bubbles pushed in between the different samples allow a good insulation of the liquid samples. This storage system makes the process much quicker.



## Aviation applications

#### Cockpit windows and plane wings

The spiral cord on the cockpit window has two functions : in flight it serves for the de-icing system and at ground level, it has the capacity to stretch allowing the opening of the windows for their exterior cleaning.

On the front part and on the back part of the wings, the spiral cables manage the engine system which operates the flaps, widening the wing at take off and landing.



AIRCRAFT COCKPIT

#### Pilot helmets and seats

The helmet spiral cord provides the pilot's radio link with the possibility of a microphone. On the pilot and second pilot seats, two spiral cords allow the automatic movement and reclining of the seats.

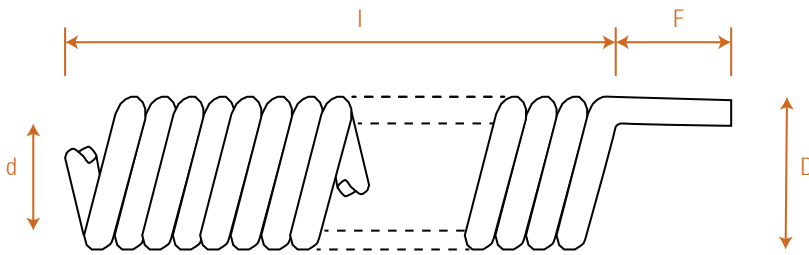


PILOT HELMET



## Technical glossary

In order to improve your knowledge on spiral cords, AXON' has compiled a short technical glossary.



### > MEMORY

Properties of a cord to enable it to revert quickly to its initial form without losing any of its original characteristics.

### > EXTENSION COEFFICIENT

Property of a cord to extend itself in relation to its original length, eg.  $K \approx 3$  means the maximum extension of the cord is three times the length of the original length.

### > MINIMUM TORQUE

Property of a cord to generate the minimum rotational effort for itself during radial or axial movements.

### > TRIAXIAL MOVEMENT

High flexibility of the cord in all directions.

### > D = SPIRAL DIAMETER

Diameter of the spiral of the cord.

### > d = MANDREL DIAMETER

Inner diameter or the diameter of the mandrel around which the original cable is wrapped.

### > l = SPIRAL LENGTH

Length of the spiral part of the cable at its initial position.

### > L = SPIRAL LENGTH

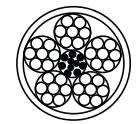
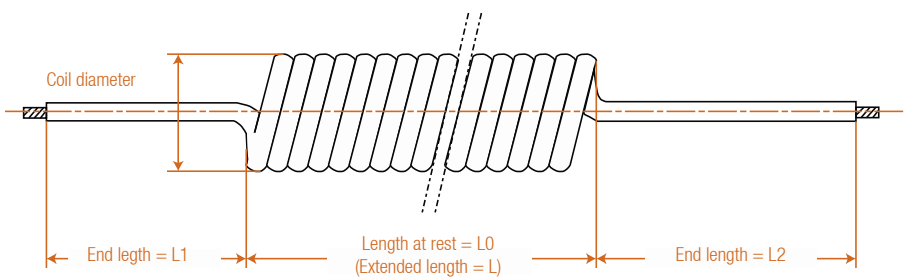
Length of the spiral part of the cable at its maximum extension.

### > F = EXITS OR TERMINATIONS

Length of the straight ends of the cable which lead off parallel, or at a certain angle, from the axis of the spire, according to the requirements of the customer.

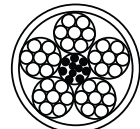
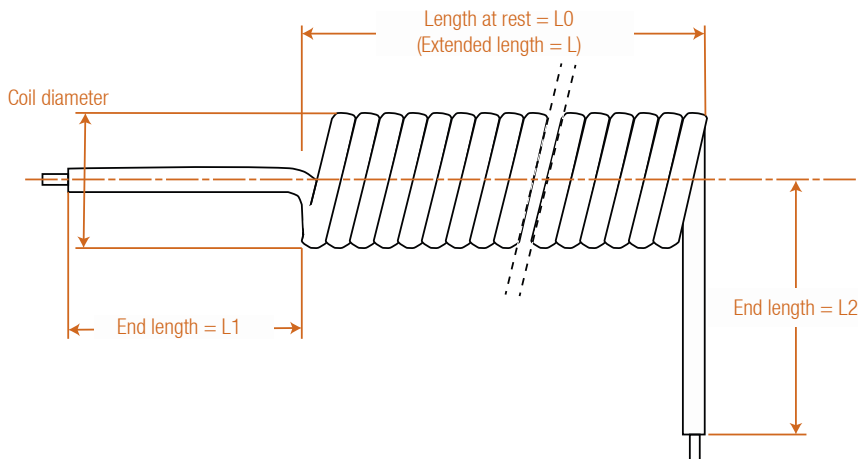
# Definition of the spiral cords geometry

## Axial exits



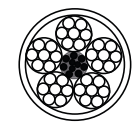
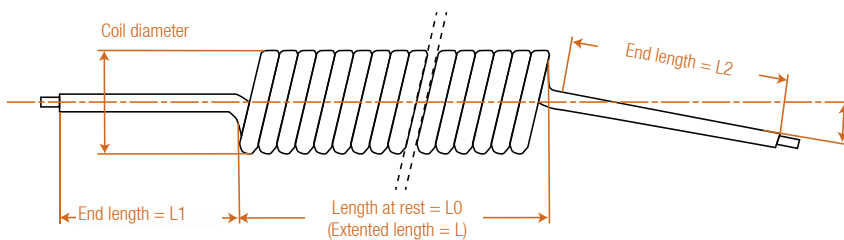
Cable cross-section

## Radial exits



Cable cross-section

## Angular exits



Cable cross-section

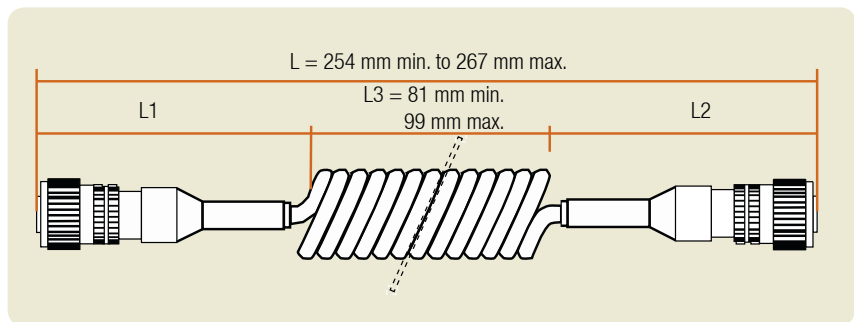
# 7 wires type K 2219

Nominal outer diameter of the cable: 6.20 mm.

Approximative nominal weight: 80 g/m.

Temperature range: -90°C à +200°C.

Operating voltage: 600 VAC.

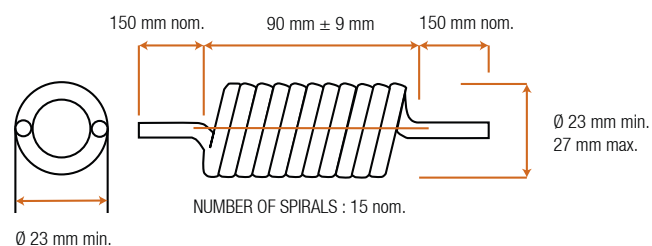


## Cord characteristics

- Two connectors, marked on the backshell.
- Overmoulding.
- Diameter: 27 mm.
- Total length: 254 mm mini.

## Construction

- 7 wires type K2219.
- Conductor
  - . Material: tin plated copper
  - . Construction: 19 x 0,160 mm
  - . Nominal diameter: 0.800 mm
  - . Nominal area: 0.38 mm<sup>2</sup>
  - . Nominal resistance: 4,7 Ω/100 m.
- Insulation
  - . Material: FEP
  - . Wire diameter: 1,30 mm
  - . Colour: green, brown, blue, orange, yellow, black, red.
- Red FEP jacket.



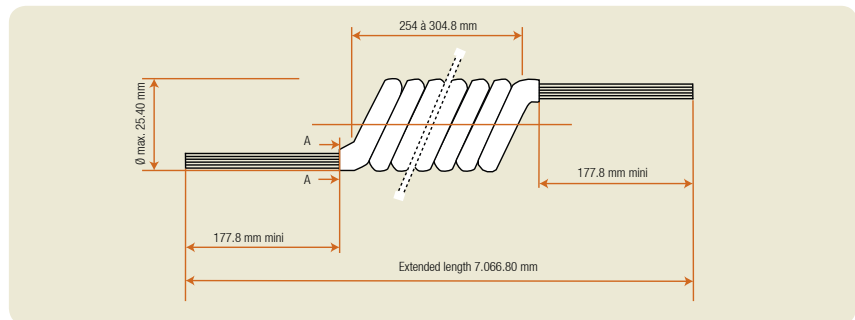
# 6 special wires

Nominal outer diameter: 5.34 mm.

Approximative nominal weight: 61.6 g/m.

Temperature rating: -90°C à +200°C.

Operating voltage: 600 VAC.



## Construction

### - 2 AWG 2019 wires with polyimide insulation

- Conductor
  - . Material: silverplated copper
  - . Construction: 19 x 0.203 mm
  - . Nominal diameter: 0.965 mm
  - . Nominal area: 0.616 mm<sup>2</sup>
  - . Resistance: 3.57 Ω/100 m maxi.

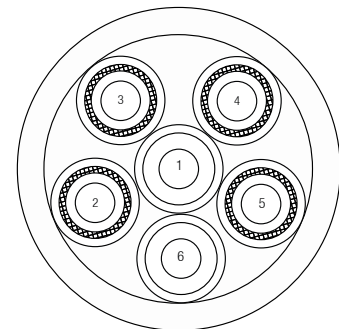
- Insulation
  - . Material: polyimide tape
  - . Diameter of the wire: 1.42 mm
  - . Colour: amber
  - . Marking: stripes

### - 4 shielded wires AWG 2419 with polyimide insulated

- Conductor
  - . Material: silverplated copper
  - . Construction: 19 x 0.127 mm
  - . Diameter: 0.597 mm
  - . Area: 0.241 mm<sup>2</sup>
  - . Resistance: 7.58 Ω/100 m maxi

- Primary insulation
  - . Material: polyimide tape
  - . Nominal wire diameter: 1.1 mm
  - . Colour: amber
  - . Marking: stripes
- Helicoidal shielding
- Jacket: polyimide tape
- Outer diameter: 1.8 mm
- Cable weight: 7.59 g/m maxi.

- Polyimide tape.



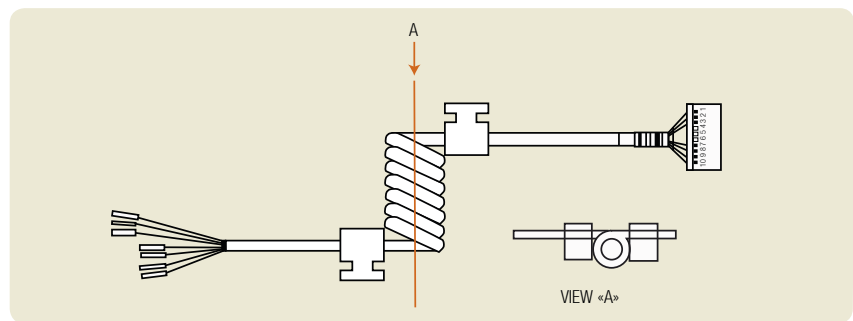
# 7 miniature wires UHT 3207 + 1 wire MT 3007

Outer diameter of the cable:  $2.6 \pm 0.1$  mm.

Approximative nominal weight: 10 g/m.

Temperature rating:  $-40^{\circ}\text{C}$  à  $+70^{\circ}\text{C}$

Operating voltage: 30 V DC.



## Connection

- 2.54 mm pitch double row rectangular connectors.

## Construction

### 1 - 1 wire MT 3007

- Conductor
  - . Material: silverplated copper
  - . Construction:  $7 \times 0.102$  mm
  - . Nominal diameter: 0.304 mm
  - . Nominal area:  $0.0572$  mm<sup>2</sup>
  - . Nominal resistance:  $36 \Omega/100$  m
- Primary insulation
  - . Material: polyester
  - . Nominal diameter: 0.52 mm

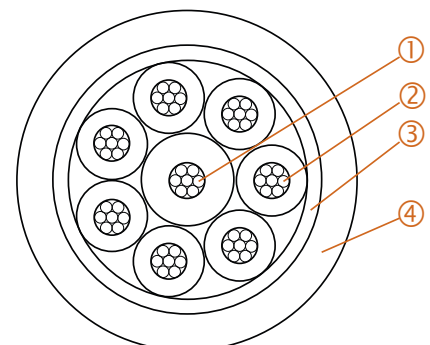
### 2 - 7 wire UHT 3207

- Conductor
  - . Material: silverplated copper
  - . Construction:  $7 \times 0.079$  mm
  - . Nominal diameter: 0.237 mm
  - . Nominal area:  $0.034$  mm<sup>2</sup>

- . Nominal resistance:  $57 \Omega/100$  m maxi.
- Insulation
  - . Material: Polyimide tape + FEP lacquer
  - . Wire diameter: 0.44 mm

### 3 - Separating PTFE tape

### 4 - Black Polyurethane jacket.

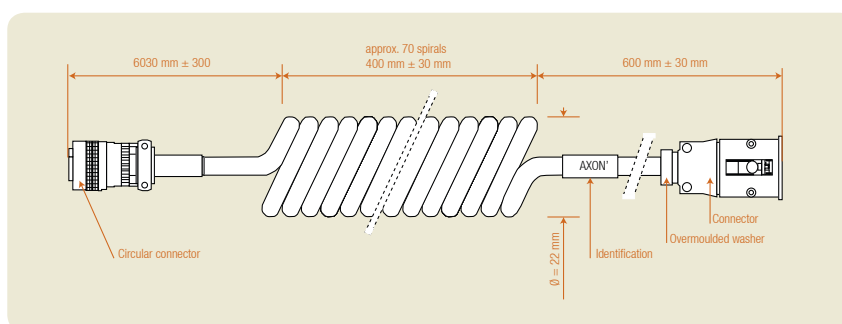


# 9 wires KT 3007 E

Outer diameter of the cable: 5.8 mm.

Approximative weight: 45 g/m.

Operating voltage: 250 V.



## Connection

- Circular connectors.

## Construction

1 - Polyester filler

2 -10 - 9 wires KT 3007 E

- Conductor
  - . Material: tin plated copper
  - . Construction: 7 x 0.102 mm
  - . Nominal diameter: 0.304 mm
  - . Nominal area: 0.057 mm<sup>2</sup>
  - . Resistance: 35  $\Omega$ /100 m maxi.
- Insulation
  - . Material: FEP
  - . Nominal wire diameter : 0.61 mm

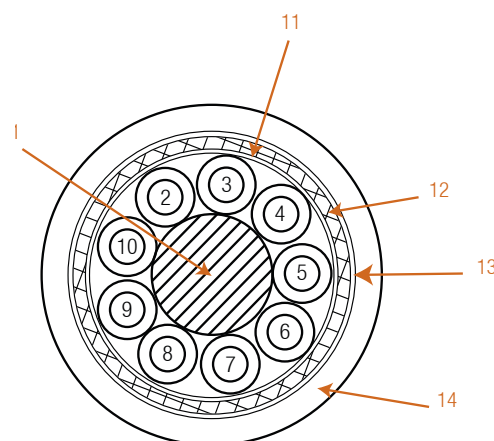
11 - PTFE tape

12 - Shielding: tin plated copper

13 - PTFE tape

14 - Hytrel jacket

. Colour: yellow.



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