Construction guideline

1) SUMMARY OF ABBREVIATIONS FOR CABLE CONSTRUCTION ELEMENTS

MSR - : EUPEN code for INSTRUMENTATION CABLES

JE - : cable for INDUSTRIAL ELECTRONICS

RD - : cable for CONTROL SYSTEMS

INSULATION MATERIALS:

2Y : Polyethylene (PE)

2X : Crosslinked Polyethylene (XLPE)

Y : Polyvinylchloride (PVC)

H : Halogen-free, fire-retardant compound

HX : Cross-linked, halogen-free fire-retardant compound

INDIVIDUAL SCREENS:

Pimf : **P**AIR **i**n **m**etal **f**oil

Timf : **T**RIPLE **i**n **m**etal **f**oil

Qimf : **Q**UAD **i**n **m**etal **f**oil

OVERALL SCREENS:

(St) : Aluminium laminated synthetic foil in contact with a tinned copper drain wire

(C) : Copper wire braid

(St)C : Aluminium foil + tinned copper wire braid

(CuB) : Copper tape

CABLING:

Bd : Cabling elements forming a bundle and bundles assembled together

Bd Z : Bundles identified by means of a numbered tape

Bd Si : SIMATIC ring coding of bundels

METALLIC BARRIERS:

K : Lead alloy sheath

(L) : Aluminium laminated sheath, also called composite layer sheath (Copolymer coated Alu-tape, laminated to the 2Y- or H-sheath)

METALLIC ARMOURINGS:

B : Double steel tape armour

Q : Galvanized steel wire braid

R : Galvanized round steel wire armour

OUTER SHEATH MATERIALS:

2Y : Polyethylene or High Density Polyethylene (PE or HDPE)

Y : Polyvinylchloride (PVC)

Yö : Hydrocarbon-resistant Polyvinylchloride (PVC RH)

YW : Heat-resistant PVC (max. 90°C)

H : Halogen-free, fire-retardant compound

v : Reinforced wall thickness of outer sheath

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2) APPLICABLE STANDARDS

- Cable constructions & properties can be based on the following standards:

EN	**50288-7**
NF	**M87-202**
VDE	**0815/0816**
IEC	**60502-1**

- The behaviour of the cable under fire conditions can be defined according to the following standards:

Scope	
a) Fire resistance	IEC 60331
b) Fire retardance test on cable bundles	IEC 60332-3 Cat C / Cat A
c) Flame retardance test on single cables or single insulated cores	IEC 60332-1
d) Smoke density test	IEC 601034-1+2
e) Corrosivity of combustion gases (halogen content ...)	IEC 60754-2

3) CONDUCTORS

According to **IEC 60228**:
* Solid (Class 1)
* Stranded (Class 2)
* Flexible (Class 5)

• **Selection criteria for the choice of conductor construction:**

* Flexibility * Type of Termination / Connection

• Typical constructions:

	Standard construction			Optional construction	
Conductor size	Stranded, cl.2	Diam. mm	R_{dc}@20°C (Ω/km)	Solid, cl.1	Flexible, cl.5
0,50 mm²	7x0,30 mm	0,9	36,0	1x0,8 mm	16x0,20 mm
0,75 mm²	7x0,37 mm	1,1	24,5	1x0,98 mm	23x0,20 mm
1,00 mm²	7x0,43 mm	1,3	18,1	1x1,13 mm	31x0,20 mm
1,50 mm²	7x0,52 mm	1,6	12,1	1x1,39 mm	28x0,25 mm
2,50 mm²	7x0,66 mm	2,0	7,41	1x1,76 mm	46x0,25 mm

Other cross sections and constructions on request.

4) INSULATION MATERIALS

* **2Y** : Polyethylene (PE)
* **2X** : Crosslinked Polyethylene (XLPE)
* **Y** : Polyvinylchloride (PVC)
* **H** : Halogen-free, fire-retardant compound
* **HX** : Cross-linked halogen-free, fire-retardant compound
* **m2X** : Mica tape + cross-linked Polyethylene (XLPE)

• **Selection criteria for insulation compounds:**

* Electrical Properties
* Temperature Rating
* Behaviour under Fire Conditions
* Termination Methods

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5) INSULATION WALL THICKNESS & ELECTRICAL PROPERTIES

The insulation wall thickness is selected acc. to specified parameters such as:

* Applicable standards (see pt. 2)

* Voltage rating and related test voltage

* Mutual capacitance

6) CABLING ELEMENTS AND INDIVIDUAL SCREENING

Cabling elements:

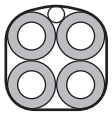
- **CORE** consisting of one insulated conductor
- **PAIR** consisting of 2 stranded cores forming a loop
- **TRIPLE** consisting of 3 stranded cores
- **STAR-QUAD** consisting of 4 stranded cores, 2 diametrically opposed cores forming a pair

INDIVIDUALLY SCREENED cabling elements are expressed as follows:

* **Pimf** : **P**AIR **i**n **m**etal **f**oil

* **Timf** : **T**RIPLE **i**n **m**etal **f**oil

* **Qimf** : **Q**UAD **i**n **m**etal **f**oil



Standard IDENTIFICATION of cabling elements (others on request):

a) Unscreened or overall screened cables:

- CORE : WHITE, each core continuously numbered
- PAIR : BLACK / WHITE, each core numbered
- TRIPLE : BLACK / WHITE / RED, each core numbered
- QUAD : BLACK / WHITE / RED / BROWN, 2 diametrically opposed cores numbered with the same number

b) Individually screened cabling elements:

- Colour code as a)
- Identification of each individually screened cabling element by means of a numbered tape

The stranding elements need to be balanced-out in order to reduce crosstalk, therefore pairs, triples and quads are twisted with a different pitch.

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7) LAYING-UP OF CABLING ELEMENTS

In most of the cases, cables are laid up in concentric LAYERS.
For certain cable types, the cabling elements are laid up in BUNDLES **(Bd)**.
The bundles can be identified for example by means of a numbered tape **(Bd Z)** or by SIMATIC ring coding **(Bd Si)**.

8) OVERALL SCREENING

Overall screenings are applied to prevent or reduce the external interferences caused by electric or electronic devices like motors, machineries, power cables ...

Standard solution:

* **(St)** : Aluminium laminated synthetic foil in contact with a tinned copper drain wire

Optional solution:

* **(C)** : Copper wire braid
* **(St)C** : Aluminium foil, metallized face in contact with a tinned copper wire braid
* **(CuB)** : Copper tape

9) METALLIC BARRIER AGAINST AGGRESSIVE LIQUIDS

When used in petrochemical installations, cables often require an additional metallic covering to make them transversally tight against aggressive liquids or polluted water.

* **K** : - Lead Alloy „E“ sheath acc. to EEMUA 133 or
  - Kb-Pb Lead Alloy sheath acc. to VDE
* **(L)** : - Aluminium laminated sheath (copolymer-coated aluminium tape laminated to PE outer sheath)

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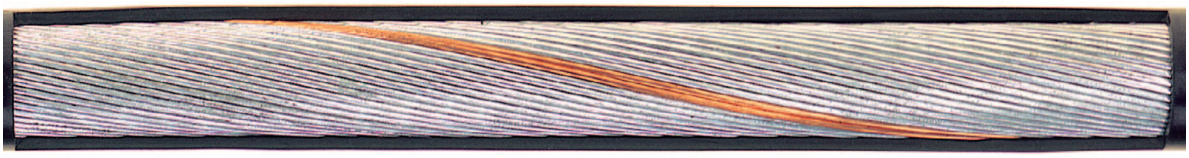
10) ARMOURINGS

Very often, the cables require an armouring as additional protection against mechanical impacts during installation and operation. Those armourings can also fulfill electrical functions as earthing interconnection, screen or interference protection.

a) GALVANIZED STEEL WIRE ARMOURING **R**

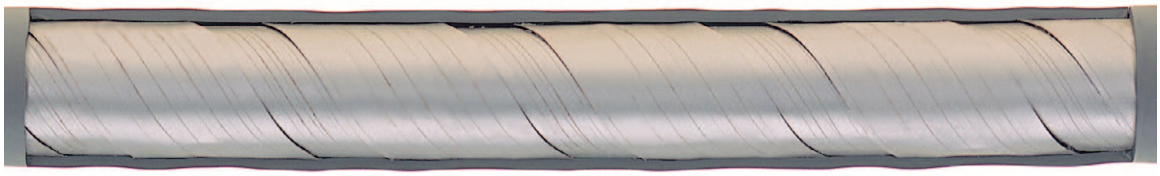
A concentric layer of galvanized round steel wires, providing over 90 % optical coverage.



* GOOD MECHANICAL PROTECTION
* GOOD TENSILE STRENGTH
* FAIR BENDING properties
* GOOD RODENT PROTECTION

b) DOUBLE STEEL TAPE ARMOURING **B**

Two layers of galvanized or bare steel tapes, providing 100 % coverage of the cable core.



* Diam. of cable core under armouring: min. 8 mm
* GOOD protection against PRESSURE & SHOCKS
* GOOD RODENT PROTECTION
* COST SAVING and light-weight
* Armouring providing BEST LOW FREQUENCY INDUCTION-PROTECTION
* Not resistant to tractive force

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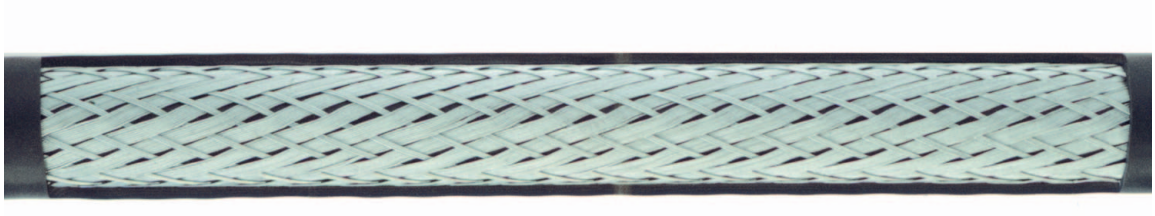
c) GALVANIZED STEEL WIRE BRAID **Q**

A galvanized steel wire braid providing min. 82 % optical coverage (min. wire diam. 0,3 mm).



* GOOD MECHANICAL PROTECTION
* FAIR TENSILE STRENGTH
* LIGHT WEIGHT
* Armouring allowing SMALLEST BENDING RADIUS of cable
* No diameter limitation for cable core to be braided

11) OUTER SHEATH MATERIALS

* **2Y**	:	Polyethylene or High Density Polyethylene (PE or HDPE)
* **Y**	:	Polyvinylchloride (PVC)
* **Yö**	:	Hydrocarbon resistant Polyvinylchloride (PVC RH)
* **H**	:	Halogen-free, fire-retardant compound
* **v**	:	Reinforced wall thickness of outer sheath

• Selection criteria:

* Behaviour under fire condition
* Temperature rating (during installation and operation)
* Site conditions (oil-resistant, termite-repellent ...)

* PREFERENTIAL COLOURS FOR OUTER SHEATHS:

BLACK	:	Best UV-resistance
BLUE	:	For intrinsically safe circuits
GREY	:	Standard
OTHERS	:	On request

• The nominal thickness of the outer sheath is in accordance with the applicable standard