Comments on selecting an OMERIN cable

For reliable long-term service, it is important to select the right electric cable or wire for the application.
The current cable market features many products whose main qualities are as much a result of the properties of insulation products available at this time, as the construction and the protection systems applied to cables.
Relying on past experience may often be useful, but can sometimes be just as dangerous.
As cable dimensions restrictions are sometimes complex, it is difficult to generally and directly assign a genuine advantage to various types of cables without deeper analysis of the intended application.

It is therefore essential to know all the environmental conditions for the application to ensure the cable is correctly dimensioned. Although non-exhaustive, the list below indicates the main restrictions to be taken into account in specifying electrical cables:

- Electrical resistance: All the electrical requirements of the application (type and voltage of power supply, current strength, etc.) are required and mandatory to define the cable. In particular, remember that the intrinsic temperature of the conductor may have a significant influence on its linear resistance. Furthermore, concerning the cable insulation, its insulation resistance varies according to its temperature.

- Thermal resistance: Exposure to excessive temperatures over a too long period may cause premature deterioration of the constituent cable materials (fissuring, combustion, flaking, etc.). The period of exposure is therefore as important as the temperature value itself, in the choice of materials which must resist both brief, high thermal shocks and prolonged exposure at lower temperatures. In this matter, note that the overall thermal resistance of the cable may not be higher than that of the constituent part with the lowest thermal resistance.

- Presence of humidity: For certain materials, the absorption of humidity may vary to certain degrees. If it exceeds a certain threshold, the level of humidity may generate faults within the electrical system itself.

- Fire and/or flame resistance: The non-spreading of vertical or horizontal flames may be a major characteristic of a cable. However, fire resistance is a completely different property to flame resistance. Indeed, for certain types of cable, applicable regulations impose a minimum duration of fire resistance, while maintaining the operational integrity of the cable.

- Resistance to mechanical forces: Certain forces of mechanical origin and external to the cable (bending, impacts, abrasion, crushing, etc.) may cause premature deterioration of certain insulation and sheathing materials (mechanical fatigue) and may cause the long-term loss of certain properties that are essential to the cable's life. For example and in general, tape insulation systems have difficulty supporting alternate bending cycles.

- Resistance to chemical products: Certain categories of chemical products (hydrocarbons, solvents, acids, etc.) may damage insulation or sheathing materials used on cables. Fluorinated materials are in general more resistant to chemical attacks than other materials used for cable insulation or sheathing.

- Resistance to cryogenic temperatures: In general, most materials used at low temperatures become brittle (flaking) or lose their natural flexibility. Only fluorinated insulation materials or polyimides retain their mechanical properties at cryogenic temperatures.

- Pouring of molten metals: This is often accidental any may cause partial or total destruction of the cable. Certain smart combinations of insulation or sheathing materials can nonetheless considerably reduce the risks of damage to the cable due to molten metal.

- Emission and toxicity of smokes In case of fire, certain safety regulations define limits on the quantity of smokes emitted, along with their nature and toxicity rating. Certain materials present interesting properties in this area (fibreglass, silicone rubber, halogen-free polymers, etc.).

- Resistance to radiation: Taking into account this factor may be restrictive to the cable dimensioning. Indeed, certain materials such as polyimide insulation resist more effectively to radiation than other materials.

The following pages provide information on the materials used to make OMERIN cables. Our technical departments are at your service to provide all further information required.

Glossary

Conducting core (or conductor)

• The conductor core of a cable carries the current.
It is generally circular, sometimes compacted.
It comprises one or more strands of the same conducting metal, which in most cases can be aluminium or copper. To improve certain properties of the conducting metal, copper strands may be coated with a metal layer. Sometimes, which resistance to high temperatures is required, a conductor core made entirely of pure nickel strands is necessary.

- **Stranded core (IEC 60228 class 2):** circular core (compacted or not) comprising a set of wires assembled together.
- **Flexible core (IEC 60228 class 5):** circular core comprising a set of wires assembled together in concentric or bunched strands.
- **Ultra-flexible core (IEC 60228 class 6):** circular core comprising a set of very fine wires assembled together in concentric or bunched strands.
- **Concentric strand:** geometrically-arranged spiral assembly of wires featuring one or more separate layers.
- **Bunched strand:** spiral assembly where the wires have no pre-defined position.
- **Composite strand:** geometrical assembly of several concentric or bunched strands featuring one or more separate layers.
- **Theoretical cross-section:** Where n is the number of strands making up the core and d is the diameter of the strands, the theoretical cross-section is given by the following formula:

$$S = n \cdot \pi d^2 / 4$$

- **Nominal cross-section:** conventional or standard value of a core cross-section.

Insulation

Single or multi-part layer, whose function is to electrically insulate the core against the outside.

- Extruded insulation: composite based on elastomer or thermoplastic technology forming a continuous, uniform and homogeneous layer.
- Composite insulation: composite featuring synthetic or mineral wires or tapes, lapped, braided, woven or wound around the core and treated, coated, lacquered or left in a natural state.

Insulated conductor

Comprises the core, its insulation and possible other components (screen, separator, etc.).

Assembly or twisted conductors

Group of insulated conductors assembled together, most commonly with a spiral layout, in one or more layers. The assembly pitch defines the length of a full rotation of the spiral along the axis of the cable, by a constituent component.

Filler

Material whose function is to fill the gaps between the constituent components of an assembly.

Separator

Film inserted between two components of a conductor or a cable to prevent interactions between them or to facilitate their separation. May also be used to facilitate the cable manufacturing.

Screen

Conductive layer comprising metal tapes, generally made of aluminium or copper, metallic braids, generally copper, whose function is to insulate the conductor or the cable against external electromagnetic fields that may disturb its operation.

Inner sheath

Continuous tubular layer of a non-metal material (elastomer or thermoplastic), usually extruded and covering the screen or the assembly of conductors and filler if any.

Bedding

Layer of under-armour material.

Armour

Layer of metal foil, round or flat metal wires, intended to protect the cable from external mechanical effects. The armour may be on the outside of the cable.

Outer sheath (jacket)

Continuous, uniform tubular layer of a non-metal material (elastomer or thermoplastic), usually extruded and applied to the external part of the cable to provide external protection. The outer sheath must be appropriate for the immediate surroundings of the cable (humidity, water, fire, oils, solvents & chemical products, aggressive weather, UV radiation, X-rays, etc.).

Lexicon of vocabulary commonly used by the cable industry and/or defined in installation standards

MECHANICAL STRESS IMPACT according to NF C 15-100

- **AG1** Low severity (Normal, e.g. household and similar equipment)
- **AG2** Medium severity (Standard industrial equipment, where applicable, or reinforced protection)
- **AG3** High severity (Reinforced protection)
- **AG4** Very high severity (mines, quarries…)

RESISTANCE TO SOLAR RADIATIONS AND WEATHER

- **Excellent** Permanent exposure
- **Very good** Frequent exposure
- **Good** Occasionnal exposure
- **Fair** Accidental exposure
- **Poor** No exposure

PRESENCE OF WATER according to NF C 15-100

- **AD1** Negligible (probability of presence of water is negligible)
- **AD2** Free falling drops (probability of presence of water is negligible)
- **AD3** Sprays (possibility of water falling as a spray at an angle up to 60° from the vertical)
- **AD4** Splashes (possibility of splashes from any direction)
- **AD5** Jets (possibility of jets of water from any direction)
- **AD6** Waves (possibility of water waves, seashore locations)
- **AD7** Immersion (possibility of intermittent partial or total covering by water)
- **AD8** Submersion (equipment is permanently and totally covered)

CHEMICAL RESISTANCE

- **Excellent** Permanent contact
- **Very good** Frequent contact
- **Good** Occasionnal contact
- **Fair** Accidental contact
- **Poor** No contact

BEHAVIOUR TO FIRE according to NF C 32-070

- **C1** Fire retardant
- **C2** Flame retardant
- **C3** No classification to fire resistance
- **CR1** Fire resistant
- **CR2** All cables which are not CR1