

THIRD CHAPTER
INSTALLATION

The aim of the present chapter is to offer a general guide for power M.I.C. installation; installation systems, materials and devices must be in conformity with applicable CEI norms.

TESTS

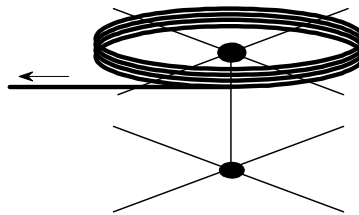
Before the installation, insulation resistance should be verified by a megger or Megaohmmeter with a forced voltage of 500 V cc between conductors and outer copper sheath; in such condition, the insulation resistance must be more than 100 MΩ; after completing the installation, each cable with its termination must be subjected again to an insulation resistance check, as above mentioned.

INSTALLATION

HOW TO UNWIND THE COILS

M.I.C. is normally supplied in self-supporting coils, with an internal diameter of 500, 1200 e 1450 mm depending on cable external diameter.

To correctly unwind the coils it's possible to build in the yard a simple unwind device using a structural metal or wooden boards like those used for common cables supporting.



CABLES CUT

When we have to cut some cable sizes from a coil, this latter lenght must approx. calculated multiplying the average internal coil diameter (lenght of a cable single coil) for 3,14 and counting the number of necessary single coils.

CABLE LAYOUT

Before fixing a cable, this must be hand-straightened or using a straightener and a bending lever; the final straightened can be made using a wooden block and a hammer, or a rubber hammer; a metal hammer must not be used directly towards the sheath, in order not to decrease mechanical and electric characteristics of sheath itself.

BENDING RADIUS

6 times the diameter of cable copper sheath represents the standard limit of the minimum bending radius, just to let the cable be straightened and bent again, if necessary.

If it's necessary to bend more, the minimum bending radius should be greater than the values reported in below table; such bends should be everlasting and every eventual

straighten, if necessary, must be made with great attention to avoid any damage of the cable copper sheath.

| External diameter of the cable (mm) | Minimum bending radius (mm) |
|-------------------------------------|-----------------------------|
| $D < 12$ | 3 D |
| $12 < D < 15$ | 4 D |
| $15 < D < 25$ | 6 D |
| $D > 25$ | 12 D |

FIXING

M.I.C. must be fixed to the surface by suitable copper clips or band supplied by **KME ITALY**; other similar fixing methods are available on the market, but they can't be coated with zinc if applied to bare cables; maximum distance between two fixings depends on cable dimension and must not be over the values included in the following table.

Fixing screws must be suitable and corrosion resistant.

| External diameter of the cable (mm) | Maximum fixing step | |
|-------------------------------------|---------------------|---------------|
| | Horizontal (mm) | Vertical (mm) |
| $D < 9$ | 600 | 800 |
| $9 < D < 15$ | 900 | 1200 |
| $16 < D < 20$ | 1500 | 2000 |
| $D > 20$ | 2000 | 3000 |

DILATIONS AND VIBRATIONS

When the cable passes through expansion joints, or when it connects devices subjected to vibrations, it's necessary to fix them inside a dilation ring, whose minimum diameter must be over 6 times the external diameter of the cable.

If vibrations are too heavy or lasting, it's advisable to make the termination of MICO cable inside a junction box near the supplying board of the user; the connection between the electric board and the junction box can be made using a flexible cable.

UNDERGROUND CABLES

MICO cables laid underground must be covered by an additional LSF sheath and must be laid as CEI 11-17 document NR.1890 chapter 2.3.11 appendix "d" states: "Class 0 and 1 cables can be laid underground without any additional mechanical protection (L way of laying) if they are covered by metal sheath, whose thickness is over 0,8 mm, suitable for protection against direct contact (3.3.01)"; if this thickness is lower than 0,8 mm they need mechanical protection (M, N, O, P and Q way of laying).

Anyway it's necessary for MIC to be laid down at least 0,5 m deep, to be covered and marked with an evidence tape laid underground, above the cable.

UNDERGROUND CONDUITS, PROTECTION TUBES OR PIPING

If cables must be laid inside underground passages, the latter ones must be controlled, in order to be sure they are smooth, dry and free from any obstruction.

For laying in concrete tubes, it's necessary to use cables with PVC or LSF outer covering; bare cables can be used when conduits are not made by concrete and when we are sure that conduits remain dry for a long time.

CONCRETE BURIED OR PLASTER EMBEDDED CABLES

If cables are buried or covered by concrete, LSF or PVC outer covered MIC must be used, to avoid copper sheath eventual corrosion; junction and termination must be made inside suitable junction boxes.

NOTE:

when PVC or LSF outer covered cables are used to prevent the corrosion, it's necessary to protect each part of the covering, taken away to make the termination, with its suitable PVC or LSF shrouds (see 4th part of this handbook) or to substitute it with insulating and self-amalgamating tape; This is necessary both for discovered copper sheath and for the gland.

CABLES ON PLATFORM

MIC can be laid directly on platform, making sure that it cannot be inadvertently cut by sharp edge of platform itself.

If platform or channel in steel coated with zinc are used, it's advisable to use MIC with additional LSF covering.

It's better to fix the cables on the platform at each direction change, following project evaluations to decide at the moment of the installation; it's not necessary to connect the platform to earth if it supports only MICO cables, provided that the copper sheath is earth connected by suitable earth bonding clip or by the earth tail seal.

OPEN AIR OR WET ENVIRONMENT INSTALLATION

When MIC termination is made in junction boxes or boards in the open air or in wet environments, it's necessary to use the gland with a suitable IP degree of protection.

INSTALLATION IN ROOMS WITH HIGH RISK OF EXPLOSION

When electric installation is made rooms with high risk of explosion, the gland locknut must be fireproof qualified (EEx d).

MIC with tubular metal, continuous and weldless sheath, as provided in chapter XIII of CEI 64-2 norm (special safety installations AD-S), can be used in C0ZR, C1Z1, C1Z2, C1ZR, C2Z, C3Z1, C3Z2 zones, where are classified as suitable or suitable in plenty.

To choose every single kind of safety electric installation (table IV, chapter VI) it's better to take care about the following indication:

- every single kind of considered installation offers safety guarantees against explosion danger only if it's used in AD zones where it's classified as "suitable" or "redundant"; it doesn't offer such guarantees where it's qualified as "not permitted".
- Therefore the expression "safety electric installation" is equivalent to "electric installation suitable in AD zone if used following the indication of the norms";
- In every AD zone with qualification and extension fixed by norms, the coexistence of different types of safety installation is allowed, provided that they are qualified, in their relative AD zone, as suitable or suitable in plenty;

- in case of overlap of AD zones belonging to rooms of 2 different classes, we must choose, according table IV, a suitable installation kind for both the classes.

HIGH TEMPERATURE ROOMS

When the temperature of a MICO cable sheath, taking care of the room temperature and of temperature increase due to the current, isn't permanently over 70°C, it's possible to choose between bare cable and PVC or LSF covered cable; we must choose bare cable if sheath temperature is over 105 °C; if the nominal temperature is permanently over 250 °C we must consider what it's stated at page 29.

LOW TEMPERATURE ROOMS

MICO cables can work even when temperature is lower than - 200 °C, without being subjected to negative effects; anyway some cracks can develop on PVC or LSF additional covering, when temperature is lower than -20 °C, without decreasing the cable functionality; that's the reason why PVC or LSF covered cables must not be laid down when temperature is lower than - 20 °C.

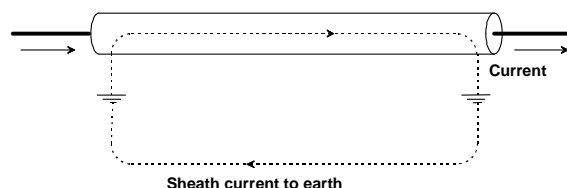
INSTALLATIONS MADE WITH LARGE SECTION SINGLE CORE CABLES

When single core cables are installed for high current carriage, it's necessary to minimize the losses due to electromagnetic fields (eddy current and hysteresis losses), which can cause an extreme warming of the ferromagnetic materials close to the cables; in dry environment and when only one cable per phase is used, it's allowed to cut a slot between the gland holes (junction box window).

in wet environment and when more than one cable per phase is used, it's necessary to use a brass or insulation material plate, in order to keep the cable unmoved.


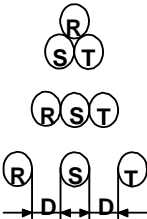
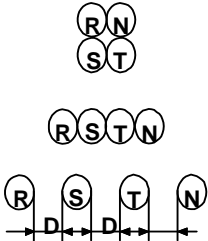
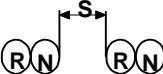
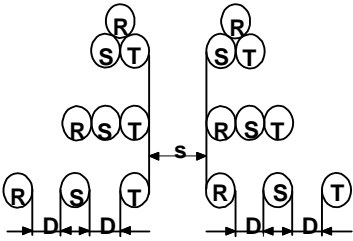
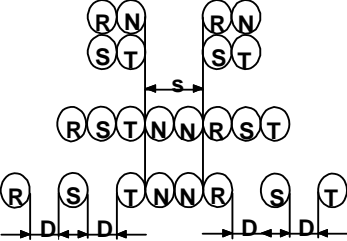
Alternate current on the conductor produces a surrounding electromagnetic field which induces a voltage on the sheath and, consequently, a current, whose direction is such as to create an opposite electromagnetic field.

Since the copper sheath is used as protection conductor and is earthed at the ends of the cable, the circuit foresees a sheath current related to the induced voltage (depending to the conductor current, to the cable length and the insulation thickness) and to the resistance of the circuit itself.



Values of induced voltage can be rather high when long cables are spaced out; this voltage, hardly dangerous for human life, produces induced current that may cross-interfere the standard working of external circuits and electric devices.

That's the reason why single core cables must be closely laid side by side or in triplet way, so to limit induced voltage on the sheath to very low values; the following picture show the single core standard layout.

| | single Phase | Three Phase - 3 conductors | Three Phase - 4 conductors |
|---|---|---|---|
| Only one cable per phase |  |  |  |
| More than one cable per phase in parallel |  |  |  |

D = overall cable diameter;

s = distance between cable groups; this should be at least two times the diameter.

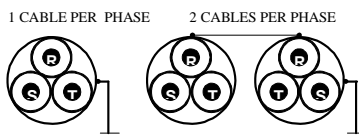
Furthermore it's necessary to short-cut and connect to earth the cable sheaths, as following way:

3 PHASE LAYOUT

The sheaths of the cables must be short-cut at the beginning and the end of the circuit, using a copper conductor with the same or greater section size than cable sheath one; it's permitted anyway that cables with 2 m of maximum lenght can be spaced at the beginning and the end of the circuit, in order to allow bonding and termination execution.

ALL THE OTHER KIND OF LAYOUT

The sheaths of the cables must be short-cut (30 m of step) using copper conductors with the same or greater section size than cable sheath one



VOLTAGE SURGES

Inductive circuits switch off can cause voltage surges and related effects to circuit devices (cables included) survivor; these voltage surges can reach values up to 5000 V, depending upon circuit characteristics.

Consultants must prevent voltage surges causes in the electrical circuit and undertake suitable actions, using voltage peaks erasers devices.

Most common reason for voltage surges is circuit switch off when voltage sinwave is at maximum value. This effect is much more possible if:

- nominal frequency of the circuit is high;
- circuit lay-out doesn't minimize reactive loads.

Circuit devices that can frequently cause voltage surges are:

- three-phase electric engines (especially the ones with small power and star connection);
- Contactor coils and single-phase inductive users up to 415 V; in this case we suggest you to use a two-phases discharger;
- Inductors for fluorescent lamp up to 280 V; in this case we suggest you to use a two-phases discharger.

INSTALLATION COSTS

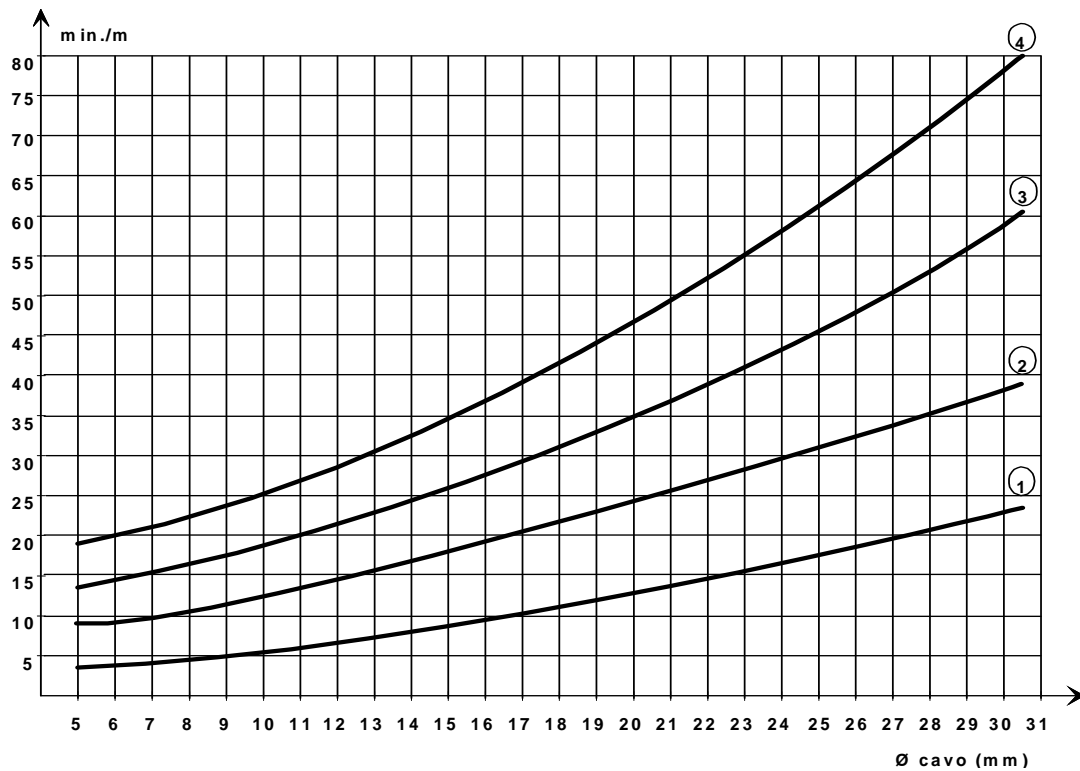
TERMINATION EXECUTION TIME

Time for single seal and gland execution can be evaluated by the following table:

| Cable type | Execution time for: | |
|---|---------------------|---------|
| | 1 seal | 1 Gland |
| Single-core up to 6 mm ² 2 conductors up to 4 mm ² 3 conductors up to 4 mm ² | 7' | 2' |
| Single-core 10 - 16 mm ² 2 conductors 6 - 25 mm ² 3 conductors 6 - 25 mm ² 4 conductors up to 2,5 mm ² | 10' | 2,5' |
| Single-core 25 - 50 mm ² 4 conductors 4 - 10 mm ² 7 conductors | 15' | 3' |
| Single-core 50 – 120 mm ² 4 conductors 16 - 25 mm ² | 20' | 3' |
| Single-core 150 - 400 mm ² 12 conductors 19 conductors | 25' | 4' |

MINERAL INSULATED CABLES INSTALLATION TIMING

Refer to following diagram where installation timing (min./m) can be derived from cable outer diameter (mm) ϕ and from installation type.



- 1 -Installation in underground passage or on platform up to 3 metres high from working level;
- 2 -Installation on platform more than 3 metres high from working level;
- 3 -Installation at sight up to 3 metres high from working level;
- 4 -Installation at sight more than 3 metres high from working level.