KME ITALY SPA

MINERAL INSULATED CABLE MICO AND THEIR TERMINATIONS

EN 60702–1:2002+A1:2015

EN 60702–2:2002+A1:2015

EN 50575:2014+A1:2016

EN IEC 60079-0:2018 and IEC 60079-0:2017

EN 60079-1:2014 and IEC 60079-1:2014

EN IEC 60079-7:2015+A1:2018 and IEC 60079-7:2015

EN 60079-31:2014 and IEC 60079-31:2013

INSTRUCTION MANUAL

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INSTRUCTION MANUAL

Instruction edition: July 2020
Instruction review: 04
Translation from the original instruction

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1.

1. Introduction

The quality of an electrical installation depends by the compliance with the regulations, by the technical capability of the designer and installer, but also by the behavior of the various electrical components in both normal situations and in critical conditions.

The task the legislator is to define the minimum conditions for which certain components have to operate; certification bodies verify that these conditions are satisfied in the actual production; to this general principle are to undergo both the components of a certain complexity that those with a simple structure which appear to be less critical.

The MICO cable (mineral insulated cable) falls within the category of electric cables, a range of standardized products of common use; security issues invest heavily electrical conduits for their characteristic of crossing different environments, so then the search for innovative solutions is very important in this field too often overlooked, but vital for the whole operation of a series of safety devices required in special situations where reliability becomes critical and essential.

1.1. Mineral insulated cable MICO

In the following parts it will be made an accurate description of the electrical and dimensional characteristics of the cable. This premise intention is to list the general principles which suggest the MICO cable installation.

MICO cable is a product that complies with the European standard EN60702-1:2002+A1:2015, and therefore constructed to pass the fire resistance tests required by the IEC 60331-1 and IEC 60331-2 standards and by the English standard BS 6387 (Protocols CWZ). Compliance with the construction standard EN 60702-1:2002+A1:2015 is certified by both IMQ and LPCB which also certifies the compliance with BS 6387. Ultimately the MICO cable is classified as "***Fire Resistant***" in accordance with both European and English regulations.

MICO is a cable classified by the Italian legislation FIRE RESISTANT, ie constructed to overcome the tests described in the standards IEC 60331-1 and IEC 60331-2, as verified by IMQ when it certifies the compliance with the construction standards EN 60702–1:2002-03 and EN 60702-1/A1:2015-02 where are providere the tests of the standards IEC 60331-1 and IEC 60331-2.

The standards IEC 60331-1 and IEC 60331-2 were issued with the intention to simulate the conditions that occur in case of fire and try such cables exceed this happens.

In this test a sample of cable is placed on a burner and brought to a temperature of 830 °C for 3 hours, at one end, the cores are removed, the other are powered at the rated voltage by 2 A fuses.

If no fuse melts the cable is classified "***Fire Resistant***".

Other countries have more stringent testing standards: England prescribes that the cable, at the rated voltage and protected with 3 A fuses, in addition to being heated by a flame at 950 ° C for 3 hours, is hit by water splashes and undergoes a mechanical stress while it is folded in S-shape.

This test simulates the action of sprinklers or pumps during the fire and fall of structures that can invest the cable if laid at sight: a cable that exceeds this test is in category CWZ (norma BS 6387).

The MICO cable without the additional sheath in plastic material (LSF) also complies with the requirement of CEI-UNEL 35500 standard and therefore has particular characteristics of "***Reaction to Fire***" and complies with the Construction

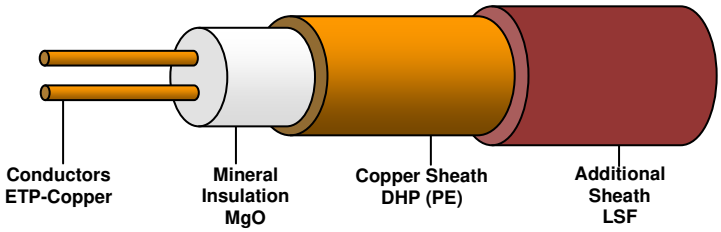
Products Regulation (CPR). In particular, the MICO cables not covered with additional plastic material belonging to the Light Duty (L), Twisted Light Duty (T)[1] and Heavy Duty Multicore (H)[2] series are certified by IMQ in accordance with EN 50575:2014+A1:2016 declaring a reaction to fire that places them in the highest performance class: $\mathbf{A_{ca}}$. Therefore, in the event of a fire, the bare MICO cable hasn't production of smoke and release of flaming droplets. This feature make MICO cable particularly suitable for use for power supply in buildings and other civil engineering works, especially those where the risk of fire is high (e.g. airport, railway and maritme stations, undergrounds road and railway tunnels).

So we have a whole series of examples of how the MICO cable has been tested in the most different and unfavorable conditions always getting brilliant results thanks to its structure, so the performance should not be questioned, but what we would like to emphasize particularly is the fact that the MICO cable offers a complete solution ready for installation in all those cases where it is necessary to apply in view: it can be said, in fact, that the cable is MICO a complete pipeline more than a simple electric cable.

At first glance this statement might seem a bit risky, because the classical concept of the pipeline: "Together consists of one or more electrical conductors and the elements that ensure their isolation, their support, their attachment and their possible mechanical protection " (standard CEI 64-8/2 par. 26.1); but to think well MICO cable laid in view with its copper staples, embodies all these characteristics in its structure and also has a fire resistance tested in many different conditions.

We have seen that the concern of regulatory bodies around the world is to achieve a test that reproduces the fire in the most reliable way possible, so as to be able to have a performance baseline, ie have some confidence that a cable that exceeds the test ensures operation even in the real conditions.

While waiting for the various regulatory changes guidelines to reach a compromise between the needs of builders and those of security, is already available with the cable MICO a concrete solution that offers truly exceptional performance and in advance to those who will be future developments.



1.2. The benefits of Mineral Insulated Cable

Thanks to the exclusive constructive approach, MICO has some properties that make this pipeline a reliable solution over time and with unique performance in the various areas where it is used:

- does not age over time (because the insulation does not oxidize);
- can carry more current for the same section (because it is not afraid of the temperature rise);
- withstands current overload and short circuit without damage (because it is not afraid of the temperature rise);
- does not propagate the flame (because it does not burn);
- does not propagate fire (because it does not burn);
- does not produce fumes, toxic and corrosive gases (because it does not burn);
- continue to operate during a fire (because it does not burn).

To these advantages of thermal nature, arising from the insulation inorganic, we must add the advantages linked to the cable geometry:

- the outer sheath is the protective earth (we are then in the presence of a cable with concentric protection wire, with all its advantages);
- The concentric protection wire wraps and surrounds the conductors preventing any manifestation of arc outside the same cable, making it inaccessible from the outside conductors and protecting it from mechanical injuries.

Any attempt to access the inside of the cable by a conductive element is transformed into a short circuit to earth, with intervention of the protection devices.

The outside sheath of the copper cable and the mineral insulation, highly compressed, constitute a resistant set to external mechanical stresses.

1 Light Duty (L) and Twisted Light Duty (T) Cables are those with a maximum rated voltage of 500 V.
2 Heavy Duty Cables (H) are those with a maximum rated voltage of 750 V.

To be convinced of it is enough to hammer the cable and see the integrity of the sheath; these mechanical properties makeMICO® cable "autonomous" in the sense that it is suitable for direct installation, without the need for protective tubes.

The coaxial configuration of the mineral insulated cable gives it an added advantage, generally little known, but no less important.

In TN systems, namely in plants supplied with its own transformation cabin, for a ground fault at any point of the system the condition $U_0/Z_s \geq I_a$ must be satisfied, where U_0 is the nominal voltage a.c. (Rms between phase and earth), I_a is the current that determines the intervention of the protections within a time of five seconds and Z_s is the impedance of failure, standard CEI 64-8 art. 413.1.3.

Z_s is composed by a resistive component and a reactive component: the latter is minimal for the coaxial configuration.

This means that with MICO is easier to meet the above condition, especially when the circuit is very extended.

Not enough: during the earth fault, the voltage on the mass is less than that in the ordinary cable, because the concentric protective conductor has a lower reactance than the phase conductor.

In conclusion, we can summarize the further advantages of the cable with mineral insulation:

- can not start a fire or cause direct contacts (because the conductors are shielded from the surrounding environment by concentric protection wire);
- does not require a protective tube (because it has a mechanical strength comparable to that of the metal tube);
- it presents the minimal impedance of the fault and the minimum contact voltage (because it is a coaxial cable).

The visual appearance gives the mineral insulated cable a further advantage, however, common to all objects in copper.

In places where you can not break the wall to make a recessed conduit, for example in the monumental buildings, the cable with copper sheathing is ideal, while a galvanized steel pipe or a metal conduit or a PVC conduit would be aesthetically unacceptable.

1.3. Productive process

It is interesting to briefly recall the construction method of MICO cable to give users the ability to more clearly appreciate the components of the material properties, which confer different characteristics compared to cables with traditional insulation.

Regarding the metal materials are used for the starting assembly of large diameter copper tubes, continuous, and without welds, and one or more of copper bars, which have between them the same relative proportions who have later in the finished cable.

The magnesium oxide powder, after a complex preliminary treatment, is compressed so as to form small cylinders, perforated longitudinally to allow insertion of the desired number of conductors.

This construction system ensures a high degree of accuracy and uniformity of the thickness of insulation between the conductors and the outer sheath and between the conductors themselves.

After the assembling of the above components, the pipe is drawn in stages with the necessary intermediate annealing to obtain the cable in the size designated by the standard construction.

After the winding of the cable in coil, the last operation is a annealing to normalize the internal stress and to ensure the most appropriate and uniform handling characteristics.

2. Safety

2.1 Intended use

Light Duty and Twisted Light Duty Mineral Insulated Cables (MICO) are suitable for:

- Energy transport up to a nominal voltage of 500 V;
- If not covered with additional plastic material, it can be used for supply of electricity, in building and other civil works with the objective of limiting the generation and spread of fire and smoke.

Heavy Duty Mineral Insulated Cables (MICO) are suitable for:

- Energy transport up to a nominal voltage of 750 V;
- Multicore cables, if not covered with additional plastic material, can be used for supply of electricity, in building and other civil works with the objective of limiting the generation and spread of fire and smoke..

MICO cables comply with the European Directive 2014/35/EU – Low Voltage Directive and therefore are supplied with the relative EU Declaration of Conformity issued by KME Italy SpA.

Light Duty, Twisted Light Duty and Multicore Heavy Duty MICO cables not coverd with additional plastic material comply with EU Regulation No. 305/2011 (CPR) and are accompanied by the relative Declaration of Performance (DoP) issued by KME Italy SpA.

Terminations for Light Duty/Heavy Duty Mineral Insulated Cables (MICO), consisting of a seal and a gland (RN or RAD series), depending on what is marked on them, are suitable for the realization of the terminations of Light Duty/Heavy Duty Mineral Insulated Cables (MICO).

The terminations for MICO cables comply with the European Directive 2014/35/EU – Low Voltage Directive and therefore are supplied with the relative EU Declaration of Conformity issued by KME Italy SpA.

If the terminations are intended for environments with potentially explosive atmospheres, they will assembly excludively RAD series glands that comply with Directive 2014/34/EU – ATEX Directive and with IECEx scheme, in this case the glands will be supplied with the relative EU Declaration of Conformity issued by KME Italy SpA pursuant to the ATEX Directive.

2.2 Residual risks

Here is a list of residual risks in the event of incorrect transport, installation, use or maintenance of Mineral Insulated Cable (MICO) and their Terminations.

- **Electrocution** due to incorrect execution of the termination, putting one of the phases on the earth sheath. 
- **Electrocution** or insulation loss due to incorrect handling or installation because of shock, crushing, perforations or excessive bending of the cable, that could damage the earth sheath. 
- **Bump** due to the cable fall in case of faulty handling or installation. 

- **Cutting** / **Shearing** / **Puncture** / **Burns** during manual operations required for the installation and the termination's execution.

- **Generic hazard** for transportation, installation, use or maintenance performed by unqualified and non trained or incorrectly equipped personnel.

- Contact with **chemicals**.

2.3 Attentions to follow

The following are the attentions to follow during transport, installation, operation and maintenance of Mineral Insulated Cable (MICO) and their Terminations.

- Always wear PPE required for transportation, installation and use (gloves, goggles, helmets, shoes).
- Designate for these operations only technical personnel trained on the correct procedures for the transport, installation, use and maintenance of Mineral Insulated Cable (MICO) and their Terminations.
- During the execution of the termination connect immediately the earth sheath to a properly marked section of cable, before performing the remaining steps.
- Pay attention to the weight to transport and handle, and certainly if more than 20 kg, do not carry it manually but use suitable lifting and transport equipment.
- During installation and execution of terminations always mark in a visible and unequivocal way the cables at both ends.
- At the end of installation and execution of terminations make a visual check on the earth sheath, to check for any discontinuities, perforations, excessive crushing or bending
- At the end of installation and execution of terminations perform a strength test and an insulation resistance test before powering up the system.
- Use only KME tools for installation and execution of terminations.
- Use only KME terminations and accessories.
- When you install at altitude, constrain the cables through the use of KME staples, using an adequate fixing distance.
- Durante il trasporto, l'installazione e lo stoccaggio prestare attenzione in ogni momento al raggio di curvatura del cable, che deve essere appropriato al Diameter del cable affinché lo stesso non venga danneggiato.
- During transport, installation and storing avoid shocks, crushing or perforations that may make the cable unusable.
- The mineral insulated cable is moisture sensitive, because the magnesium oxide, that acts as insulation, absorbs moisture if left exposed, causing the decrease of the insulation resistance value. If stored for a long time or if it's necessary to hold the cable exposed to humid environment, it is good practice to temporarily seal the ends by wrapping them with self agglomerating tape or by wrapping the ends of the cable with common insulating tape.
- In case of storage, even temporarily, use covered areas, protected from weather and far from transit zones; also the plastic cover of the coated cables may harden and deteriorate if kept to sunlight for a long time.
- In case of manipulation of chemical agents, follow the instructions of the related material safety data sheet (MSDS).
- Before uninstall the cable, ensure that there is no voltage in the system.

2.4 Installation

For the correct and complete installation procedure and execution of the terminations procedure carefully follow what quoted in this document at the specific paragraph, where are reported all KME accessories required and detailed procedures to fully execute transportation, installation and termination of Mineral Insulated Cable (MICO), accompanied by technical data, tips and detailed illustrations about.

2.5 Uninstalling and disposal

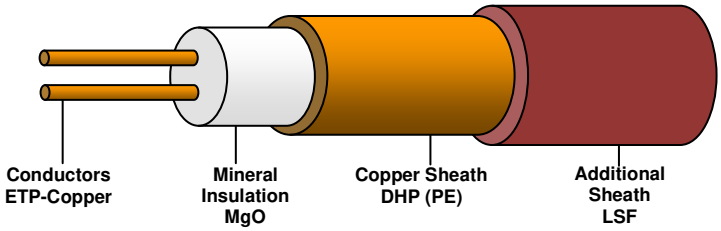
Before proceeding to final dismantling it is necessary to separate the various parts that could cause pollution, make a selection of materials in order to facilitate recycling, to earmark separate disposal.

3. Dimensional and electric features

3.1. General features

MICO is made from:

- outer sheath, continuous and without welds, made with copper tube DHP (Deoxidised High Phosphorus) with a melting point of 1083 ° C;
- Magnesium Oxide (MgO) insulation, heavily compressed, with a melting point equal to 2800 ° C;
- annealed electrolytic copper wire conductors ETP (Electrolytic Tough Pitch) 99.9 with a melting point of 1083 ° C.



Power cables with mineral insulation manufactured by KME ITALY are provided, on request, with an additional coating compliant with CEI 20-22 (EN 60332-3) in LSF (polyolefin-based) with low emission of opaque smoke and cyanhalides gas in accordance with the standards CEI 20-37/2 and CEI 20-37/4 (EN 60754-2).

This coating may be necessary in one of the following situations:

- to ensure protection of the copper sheath in corrosive environments;
- if the cable copper sheath is used as a PEN conductor;
- to facilitate the recognition of the circuit by color;
- for aesthetic reasons (in environments where there are special needs);
- when the cables must be buried or laid directly under plaster.

3.2. Regulatory Compliance

Mineral insulated cables and their terminations, manufactured by **KME Italy SpA**, comply with the following European construction standards, harmonized for Directive 2014/35/EU (Low Voltage Directive):

- EN 60702-1:2002+A1:2015, *Mineral insulated cable and their termination with a rated voltage not exceeeding 750 V – Part 1: Cables* (Conformity certified by **IMQ** e **LPCB** certifications)
- EN 60702-2:2002+A1:2015, *Mineral insulated cable and their termination with a rated voltage not exceeeding 750 V – Part 2: Terminations* (Conformity certified by **IMQ** certification);

The mineral insulated cable MICO and relative terminations complies, as regards the essential safety requirements, with as prescribed by Low Voltage Directive.

As regards the behavior of MICO cables under fire conditions, the reference standards taken into consideration in the execution of type tests periodically performed by IMQ and LPCB certification bodies are:

- BS 6387:2013, Test method for resistance to fire of cable required to maintain circuit integrity under fire conditions (MICO is certified by LPCB for the CWZ category);
- IEC 60331-1:2018, Tests for electric cables under fire conditions – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm;
- IEC 60331-2:2018, Tests for electric cables under fire conditions – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm;
- EN 50200, Method of test for resistance to fire of unprotected small cables for use in emergency circuits (this standard is equivalente for test conditions/parameter, apparatus and testing procedures to IEC 60331-2)
- IEC 60332-1-2:2002+A1:2015, Test on electric and optical fibre cables under fire conditions Part 1-2: Test for vertical flame propagation for a single insulated wire or cable- Procedure for 1kW pre-mixed flame;
- IEC 60754-2:1991, Test on gases evolved during combustion of materials from cables – Determination of degree of acidity (corrosivity) of gases by measuring pH and conductivity (only for cables with additional plastic coating);
- IEC 61034-2:1997, Measurement of smoke density of cables burning under defined conditions, Part 2: Test procedure and requirements (only for cables with additional plastic coating);
- EN 50575:2014+A1:2016, Power, control and communication cables – Cables for general applications in construction works subject to reaction to fire requirements;
- EN ISO 1716, Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value)

As regards the "***Reaction to Fire***" instead, the bare mineral insulated cables with external diameter less or equal to 20.40 mm comply with the requirements of the technical standard CEI-UNEL 35500 and therefore with the Construction Product Regulation No. 305/2011 (CPR). For bare cables belonging to Light Duty (L), Twisted Light Duty (T) and Multicore Heavy Duty (H) series, IMQ also certifies their compliance with the harmonized standard EN 50575:2015+A1:2016 by testing the reaction to fire in accordance with methods provided by EN ISO 1716. As consequence, the above listed cables have been classified $\mathbf{A_{ca}}$ and therefore in case of fire they do not give rise to smoke production and release of flaming droplets.

The quality management system adopted for the manufacture of mineral insultated cables and relative termination refers and complies with the **EN ISO 9001:2015** standard.

3.3. Dimensional features

Nominal outside diameter of the copper sheath

Voltage	section	**Nominal outside diameter of the copper sheath (mm) ± 0,05**						
nominal	mm²	1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		5,1	5,8	6,3	7,6		
	1,5		5,7	6,4	7,0	8,4		
500 V	2,5		6,6	7,3	8,1	9,7		
	4		7,7					
	1,5	4,9	7,9	8,3	9,1	10,8	14,1	16,6
	2,5	5,3	8,7	9,3	10,1	12,1	15,6	
	4	5,9	9,8	10,4	11,4			
	6	6,4	10,9	11,5	12,7			
	10	7,3	12,7	13,6	14,8			
	16	8,3	14,7	15,6	17,3			
	25	9,6	17,1	18,2	20,1			
	35	10,7						
750 V	50	12,1						
	70	13,7						
	95	15,4						
	120	16,8						
	150	18,4						
	185	20,4						
	240	23,3						
	300	26,0						
	400	30,0						

Nominal diameter of conductors

Sect. (mm²)	1	1,5	2,5	4	6	10	16	25	35
Diameter (mm)	1,13	1,38	1,78	2,26	2,76	3,57	4,51	5,64	6,68

Sect. (mm²)	50	70	95	120	150	185	240	300	400
Diameter (mm)	7,98	9,44	11,00	12,36	13,82	15,35	17,48	19,54	22,56

Average copper sheath thickness

Voltage nominal	section mm²	Average copper sheath thickness (mm) - min. - 10%						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		0,41	0,45	0,48	0,52		
	1,5		0,43	0,48	0,50	0,54		
500 V	2,5		0,49	0,50	0,54	0,61		
	4		0,54					
	1,5	0,41	0,54	0,56	0,59	0,65	0,76	0,84
	2,5	0,42	0,57	0,59	0,62	0,69	0,81	
	4	0,45	0,61	0,63	0,68			
	6	0,48	0,65	0,68	0,71			
	10	0,50	0,71	0,75	0,78			
	16	0,54	0,78	0,82	0,86			
	25	0,60	0,85	0,87	0,93			
	35	0,64						
750 V	50	0,69						
	70	0,76						
	95	0,80						
	120	0,85						
	150	0,90						
	185	0,94						
	240	0,99						
	300	1,08						
	400	1,17						

Average nominal insulation (MgO) thickness

Voltage nominal	section mm²	Average nominal insulation (MgO) thickness (mm) -0,1÷+20%						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		0,65	0,75	0,75	0,75		
	1,5		0,65	0,75	0,75	0,75		
500 V	2,5		0,65	0,75	0,75	0,75		
	4		0,65					
	1,5	1,3	1,3	1,3	1,3	1,3	1,3	1,3
	2,5	1,3	1,3	1,3	1,3	1,3	1,3	
	4	1,3	1,3	1,3	1,3			
	6	1,3	1,3	1,3	1,3			
	10	1,3	1,3	1,3	1,3			
	16	1,3	1,3	1,3	1,3			
	25	1,3	1,3	1,3	1,3			
	35	1,3						
750 V	50	1,3						
	70	1,3						
	95	1,3						
	120	1,3						
	150	1,3						
	185	1,4						
	240	1,6						
	300	1,8						
	400	2,1						

Cable weight without extra cover

Voltage nominal	section mm²	Cable weight without extra cover (kg/m)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		0,100	0,128	0,150	0,237		
	1,5		0,120	0,158	0,190	0,285		
500 V	2,5		0,176	0,210	0,265	0,395		
	4		0,240					
	1,5	0,093	0,212	0,242	0,298	0,409	0,685	0,870
	2,5	0,113	0,260	0,311	0,367	0,550	0,835	
	4	0,141	0,342	0,399	0,472			
	6	0,172	0,427	0,507	0,623			
	10	0,235	0,582	0,728	0,861			
	16	0,319	0,845	0,980	1,225			
	25	0,443	1,138	1,370	1,752			
	35	0,573						
750 V	50	0,764						
	70	1,005						
	95	1,270						
	120	1,570						
	150	1,883						
	185	2,315						
	240	3,020						
	300	3,760						
	400	5,006						

Cable weight with extra LSF cover

Voltage nominal	section mm²	Cable weight with extra LSF cover (kg/m)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		0,121	0,151	0,175	0,272		
	1,5		0,143	0,184	0,218	0,322		
500 V	2,5		0,202	0,243	0,301	0,437		
	4		0,274					
	1,5	0,110	0,243	0,274	0,333	0,455	0,746	0,968
	2,5	0,130	0,298	0,352	0,411	0,602	0,927	
	4	0,164	0,385	0,444	0,521			
	6	0,198	0,474	0,556	0,677			
	10	0,268	0,636	0,786	0,923			
	16	0,356	0,907	1,069	1,326			
	25	0,485	1,238	1,476	1,895			
	35	0,619						
750 V	50	0,816						
	70	1,063						
	95	1,358						
	120	1,668						
	150	1,990						
	185	2,460						
	240	3,186						
	300	3,936						
	400	5,199						

Theoretical manufacturing length

Voltage nominal	section mm²	Theoretical manufacturing length ± 5% (m)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
500 V	1		1800♦	1500♦	1200♦	800		
	1,5		1400♦	1100♦	900♦	600		
	2,5		1100♦	900♦	700♦	500		
	4		800♦					
750 V	1,5	1500	750	670	560	385	210	150
	2,5	1300	610	520	445	310	175	
	4	1050	480	420	350			
	6	1200	370	345	270			
	10	950	280	245	205			
	16	730	205	180	145			
	25	540	150	135	110			
	35	440						
	50	350						
	70	275						
	95	215						
	120	185						
	150	155						
	185	125						
	240	98						
	300	80						
	400	80						

♦ For immediate delivery are available in stock coils from 100 m.

Internal diameter of the coil

Voltage nominal	section mm²	Internal diameter of the coil (mm)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		1150	1150	1150	1150		
	1,5		1150	1150	1150	1150		
500 V	2,5		1150	1150	1150	1150		
	4		1150					
	1,5	1150	1150	1150	1150	1450	1450	1450
	2,5	1150	1150	1150	1450	1450	1450	
	4	1150	1150	1450	1450			
	6	1150	1450	1450	1450			
	10	1150	1450	1450	1450			
	16	1150	1450	1450	1450			
	25	1150	1450	1450	1450			
	35	1450						
750 V	50	1450						
	70	1450						
	95	1450						
	120	1450						
	150	1450						
	185	1450						
	240	1450						
	300	1450						
	400	1450						

Thickness of the extra LSF cover

Copper sheath diameter		**Cover thickness**	
from	to (included)	Minimum	Medium
mm	mm	Mm	mm
-	7	0,45	0,65
7	15	0,54	0,75
15	20	0,75	1,00
20	-	0,96	1,25

3.4. Electrical features

Conductors resistance

Section (mm²)	1	1,5	2,5	4	6	10	16	25	35
Nominal resistance at 20 °C (Ω/km)	17,241	11,494	6,896	4,31	2,835	1,724	1,077	0,690	0,492
Max. resistance at 20 °C (Ω/km)	18,10	12,10	7,410	4,610	3,080	1,830	1,150	0,727	0,524

Section (mm²)	50	70	95	120	150	185	240	300	400
Nominal resistance at 20 °C (Ω/km)	0,344	0,246	0,181	0,143	0,115	0,093	0,072	0,057	0,043
Max. resistance at 20 °C (Ω/km)	0,387	0,268	0,193	0,153	0,124	0,101	0,0775	0,0620	0,0465

If necessary, the value of the electrical resistance, measured at a temperature other than 20 ° C, can be corrected at a temperature of 20 ° C and at a length of 1 km using the following equation:

$$R_{20} = R_t \cdot \frac{254,5}{234,5 + t} \cdot \frac{1000}{L}$$

where:

t is the temperature of the cable (° C) during the measurement of the resistance;

R_{20} is the electrical resistance of the cable at 20 ° C (Ω/km);

L is the cable length (m);

R_t is the cable resistance (Ω/km) measured at the t temperature.

Copper sheath nominal resistance

Voltage nominal	section mm²	Copper sheath nominal resistance (Ω/km)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		2,855	2,279	1,964	1,491		
	1,5		2,422	1,931	1,689	1,293		
500 V	2,5		1,833	1,614	1,344	0,990		
	4		1,419					
	1,5	2,981	1,381	1,266	1,093	0,832	0,541	0,414
	2,5	2,677	1,184	1,068	0,934	0,697	0,458	
	4	2,238	0,979	0,892	0,753			
	6	1,931	0,824	0,746	0,645			
	10	1,614	0,645	0,569	0,502			
	16	1,310	0,505	0,453	0,388			
	25	1,016	0,397	0,364	0,308			
	35	0,852						
750 V	50	0,697						
	70	0,558						
	95	0,470						
	120	0,405						
	150	0,348						
	185	0,300						
	240	0,248						
	300	0,204						
	400	0,163						

Copper sheath nominal section

Voltage nominal	section mm²	Copper sheath nominal section (mm²)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		6,04	7,56	8,77	11,56		
	1,5		7,12	8,92	10,21	13,33		
500 V	2,5		9,40	10,68	12,82	17,42		
	4		12,14					
	1,5	5,78	12,49	13,62	15,77	20,73	31,85	41,59
	2,5	6,44	14,56	16,14	18,46	24,73	37,64	
	4	7,70	17,61	19,34	22,90			
	6	8,93	20,93	23,11	26,74			
	10	10,68	26,74	30,28	34,36			
	16	13,16	34,11	38,07	44,42			
	25	16,96	43,39	47,37	56,01			
	35	20,23						
750 V	50	24,73						
	70	30,89						
	95	36,69						
	120	42,59						
	150	49,48						
	185	57,47						
	240	69,39						
	300	84,55						
	400	105,97						

Copper sheath maximum resistance

Voltage nominal	section mm²	Copper sheath maximum resistance (Ω/km)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		3,950	3,150	2,710	2,060		
	1,5		3,350	2,67	2,330	1,780		
500 V	2,5		2,530	2,230	1,850	1,360		
	4		1,960					
	1,5	4,130	1,900	1,750	1,510	1,150	0,744	0,570
	2,5	3,710	1,630	1,470	1,290	0,959	0,630	
	4	3,090	1,350	1,230	1,040			
	6	2,670	1,130	1,030	0,887			
	10	2,230	0,887	0,783	0,690			
	16	1,810	0,695	0,622	0,533			
	25	1,400	0,546	0,500	0,423			
	35	1,170						
750 V	50	0,959						
	70	0,767						
	95	0,646						
	120	0,556						
	150	0,479						
	185	0,412						
	240	0,341						
	300	0,280						
	400	0,223						

Copper sheath minimum section

Voltage nominal	section mm²	Copper sheath minimum section (mm²)						
		1 cond.	2 cond.	3 cond.	4 cond.	7 cond.	12 cond.	19 cond.
	1		4,360	5,470	6,360	8,370		
	1,5		5,140	6,450	7,400	9,680		
500 V	2,5		6,810	7,730	9,320	12,670		
	4		8,790					
	1,5	4,170	9,070	9,850	11,420	14,990	23,170	30,240
	2,5	4,640	10,580	11,730	13,360	17,980	27,360	
	4	5,580	12,770	14,010	16,570			
	6	6,450	15,250	16,740	19,430			
	10	7,730	19,430	22,020	24,980			
	16	9,520	24,810	27,720	32,340			
	25	12,320	31,570	34,480	40,760			
	35	14,730						
750 V	50	17,980						
	70	22,480						
	95	26,680						
	120	31,000						
	150	35,990						
	185	41,850						
	240	50,560						
	300	61,570						
	400	77,310						

Multicore cables L series (500 V): resistance, reactance and impedance

Type cable	Resistance R (Ω/km)			Reactance X Ω/km	Impedance Z (Ω/km)		
	30 °C	70 °C	105 °C		30 °C	70 °C	105 °C
2L1	18,811	21,656	24,145	0,088	18,811	21,656	24,145
2L1,5	12,575	14,477	16,141	0,083	12,576	14,477	16,141
2L2,5	7,701	8,866	9,885	0,079	7,702	8,866	9,885
2L4	4,479	5,157	5,749	0,075	4,480	5,157	5,749
3L1	18,811	21,656	24,145	0,091	18,811	21,656	24,145
3L1,5	12,575	14,477	16,141	0,086	12,576	14,477	16,141
3L2,5	7,701	8,866	9,885	0,079	7,702	8,866	9,885

The values shown above are also valid for three-core cables, four, five and seven conductors.

Bipolar cables H series (750 V): resistance, reactance and impedance

Type cable	Resistance R (Ω/km)			Reactance X (Ω/km)	Impedance Z (Ω/km)		
	30 °C	70 °C	105 °C		30 °C	70 °C	105 °C
2H1,5	12,575	14,477	16,141	0,101	12,576	14,478	16,142
2H2,5	7,701	8,886	9,885	0,094	7,702	8,866	9,885
2H4	4,791	5,516	6,150	0,088	4,792	5,516	6,150
2H6	3,200	3,685	4,109	0,083	3,201	3,686	4,110
2H10	1,902	2,190	2,441	0,079	1,904	2,191	2,442
2H16	1,195	1,376	1,534	0,075	1,198	1,378	1,536
2H25	0,756	0,870	0,970	0,073	0,759	0,873	0,973

The values shown above are also valid for all other formations of multipolar cable (three-pole, four-pole, seven, 0:19 conductors).

single-core cables laid in trefoil shape: resistance, reactance and impedance

Type cable	Resistance R (Ω/km)			Reactance X (Ω/km)	Impedance Z (Ω/km)		
	30 °C	70 °C	105 °C		30 °C	70 °C	105 °C
1H1,5	12,576	14,478	16,142	0,139	12,577	14,478	16,142
1H2,5	7,702	8,866	9,885	0,128	7,703	8,867	9,886
1H4	4,792	5,516	6,15	0,120	4,793	5,518	8,650
1H6	3,202	3,686	4,109	0,112	3,204	3,687	4,111
1H10	1,903	2,190	2,442	0,104	1,906	2,193	2,444
1H16	1,196	1,377	1,535	0,098	1,200	1,380	1,538
1H25	0,757	0,871	0,971	0,093	0,763	0,876	0,975
1H35	0,546	0,628	0,700	0,089	0,554	0,635	0,706
1H50	0,404	0,465	0,518	0,085	0,413	0,473	0,525
1H70	0,281	0,323	0,360	0,083	0,293	0,333	0,369
1H95	0,204	0,234	0,260	0,080	0,219	0,247	0,272
1H120	0,163	0,186	0,207	0,078	0,180	0,202	0,221
1H150	0,133	0,152	0,169	0,077	0,154	0,170	0,185
1H185	0,109	0,123	0,137	0,076	0,133	0,145	0,157
1H240	0,086	0,096	0,106	0,076	0,115	0,123	0,131
1H300	0,076	0,084	0,092	0,075	0,107	0,113	0,119
1H400	0,075	0,063	0,069	0,075	0,095	0,099	0,103

Single core cables laid in floor and pushed together:

resistance and reactance

Type cable	**Resistance R** (Ω/km)									**Reactance X (Ω/km)**		
	30 °C			70 °C			105 °C					
	R	S	T	R	S	T	R	S	T	R	S	T
1H1,5	12,61	12,57	12,53	14,51	14,47	14,44	16,18	16,14	16,10	0,160	0,139	0,161
1H2,5	7,740	7,702	7,665	8,905	8,866	8,829	9,924	9,885	9,848	0,149	0,128	0,150
1H4	4,831	4,792	4,755	5,555	5,516	5,480	6,189	6,150	6,113	0,140	0,120	0,142
1H6	3,241	3,202	3,166	3,725	3,686	3,649	4,148	4,109	4,073	0,132	0,112	0,135
1H10	1,942	1,903	1,867	2,229	2,190	2,154	2,481	2,442	2,406	0,124	0,104	0,127
1H16	1,236	1,196	1,161	1,416	1,377	1,341	1,574	1,535	1,499	0,117	0,098	0,121
1H25	0,797	0,757	0,722	0,911	0,871	0,836	1,011	0,971	0,935	0,112	0,093	0,117
1H35	0,587	0,546	0,512	0,669	0,628	0,594	0,74	0,700	0,665	0,107	0,089	0,113
1H50	0,446	0,404	0,371	0,506	0,464	0,431	0,558	0,517	0,483	0,103	0,085	0,110
1H70	0,323	0,280	0,249	0,364	0,322	0,290	0,401	0,359	0,326	0,099	0,083	0,108
1H95	0,246	0,203	0,172	0,276	0,233	0,201	0,302	0,259	0,227	0,096	0,080	0,106
1H120	0,206	0,161	0,132	0,229	0,185	0,155	0,249	0,206	0,175	0,093	0,078	0,105
1H150	0,177	0,132	0,104	0,195	0,151	0,122	0,212	0,168	0,138	0,090	0,077	0,104
1H185	0,154	0,107	0,083	0,168	0,122	0,096	0,181	0,135	0,108	0,086	0,077	0,104
1H240	0,132	0,083	0,063	0,142	0,095	0,072	0,152	0,104	0,081	0,082	0,077	0,104
1H300	0,122	0,073	0,056	0,130	0,082	0,062	0,137	0,090	0,068	0,078	0,076	0,103
1H400	0,104	0,054	0,038	0,110	0,061	0,042	0,115	0,067	0,046	0,077	0,076	0,103

Single core cables laid in a floor, spaced by a diameter: resistance and reactance

Type cable	Resistance R (Ω/km)									Reactance X (Ω/km)		
	30 °C			70 °C			105 °C					
	R	S	T	R	S	T	R	S	T	R	S	T
1H1,5	12,61	12,57	12,54	14,52	14,48	14,44	16,18	16,14	16,10	0,203	0,182	0,205
1H2,5	7,743	7,703	7,767	8,907	8,867	8,831	9,925	9,886	9,850	0,192	0,171	0,194
1H4	4,833	4,793	4,728	5,557	5,518	5,482	6,191	6,151	6,115	0,183	0,163	0,186
1H6	3,244	3,203	3,169	3,727	3,687	3,652	4,150	4,111	4,075	0,175	0,156	0,179
1H10	1,946	1,905	1,870	2,232	2,192	2,157	2,484	2,443	2,408	0,167	0,148	0,171
1H16	1,24	1,199	1,165	1,420	1,379	1,345	1,578	1,537	1,502	0,160	0,141	0,165
1H25	0,803	0,760	0,728	0,916	0,874	0,841	1,015	0,973	0,940	0,154	0,136	0,161
1H35	0,593	0,550	0,519	0,674	0,632	0,600	0,745	0,703	0,671	0,150	0,132	0,157
1H50	0,453	0,409	0,379	0,512	0,469	0,438	0,564	0,521	0,490	0,145	0,129	0,154
1H70	0,332	0,287	0,259	0,372	0,328	0,299	0,408	0,364	0,334	0,140	0,126	0,152
1H95	0,257	0,210	0,185	0,285	0,239	0,212	0,310	0,265	0,237	0,136	0,123	0,150
1H120	0,217	0,170	0,147	0,239	0,193	0,168	0,259	0,213	0,186	0,133	0,121	0,149
1H150	0,190	0,142	0,121	0,207	0,160	0,137	0,222	0,176	0,151	0,129	0,120	0,147
1H185	0,169	0,120	0,105	0,182	0,134	0,116	0,194	0,146	0,126	0,123	0,199	0,147
1H240	0,148	0,100	0,141	0,158	0,110	0,097	0,167	0,118	0,103	0,116	0,117	0,145
1H300	0,139	0,093	0,085	0,147	0,099	0,088	0,154	0,105	0,092	0,112	0,115	0,143
1H400	0,120	0,075	0,069	0,126	0,079	0,071	0,131	0,83	0,073	0,108	0,115	0,142

Falls of voltage single-core cables laid in trefoil shape

Type	**Falls of voltage single-core cables laid in trefoil shape (mV/Am)**					
	cos φ = 1			cos φ = 0,8		
cable	30 °C	70 °C	105 °C	30 °C	70 °C	105 °C
1H1,5	21,780	25,080	27,960	17,570	20,210	22,510
1H2,5	13,340	15,360	17,120	10,800	12,420	13,830
1H4	8,300	9,550	10,650	6,760	7,770	8,650
1H6	5,550	6,380	7,120	4,550	5,220	5,810
1H10	3,300	3,790	4,230	2,740	3,140	3,490
1H16	2,070	2,380	2,660	1,760	2,010	2,230
1H25	1,310	1,510	1,680	1,150	1,300	1,440
1H35	0,950	1,090	1,210	0,850	0,960	1,060
1H50	0,700	0,810	0,900	0,650	0,730	0,810
1H70	0,490	0,560	0,620	0,480	0,530	0,580
1H95	0,350	0,400	0,450	0,370	0,410	0,440
1H120	0,280	0,320	0,360	0,310	0,340	0,370
1H150	0,230	0,260	0,290	0,260	0,280	0,310
1H185	0,190	0,210	0,240	0,230	0,250	0,270
1H240	0,150	0,210	0,180	0,200	0,250	0,230
1H300	0,130	0,150	0,160	0,180	0,190	0,210
1H400	0,099	0,110	0,120	0,160	0,170	0,170

Falls of voltage single-core cables laid in floor pushed together

Type	**Falls of voltage (mV/Am)**					
	cos φ = 1			cos φ = 0,8		
cable	30 °C	70 °C	105 °C	30 °C	70 °C	105 °C
1H1,5	21,780	25,080	27,960	17,570	20,210	22,510
1H2,5	13,340	15,360	17,120	10,800	12,420	13,830
1H4	8,300	9,550	10,650	6,760	7,770	8,650
1H6	5,550	6,380	7,120	4,550	5,220	5,810
1H10	3,300	3,790	4,230	2,740	3,140	3,490
1H16	2,070	2,380	2,660	1,760	2,010	2,230
1H25	1,310	1,510	1,680	1,150	1,300	1,440
1H35	0,950	1,090	1,210	0,850	0,960	1,060
1H50	0,700	0,810	0,900	0,650	0,730	0,810
1H70	0,490	0,560	0,620	0,480	0,530	0,580
1H95	0,350	0,400	0,450	0,370	0,410	0,440
1H120	0,280	0,320	0,360	0,310	0,340	0,370
1H150	0,230	0,260	0,290	0,260	0,280	0,310
1H185	0,190	0,210	0,240	0,230	0,250	0,270
1H240	0,150	0,210	0,180	0,200	0,250	0,230
1H300	0,130	0,150	0,160	0,180	0,190	0,210
1H400	0,099	0,110	0,120	0,160	0,170	0,170

Falls of voltage single-core cables laid in a floor spaced by a diameter

Type	Falls of voltage (mV/Am)					
	cos φ = 1			cos φ = 0,8		
cable	30 °C	70 °C	105 °C	30 °C	70 °C	105 °C
1H1,5	21,790	25,080	27,960	17,630	20,270	22,570
1H2,5	13,340	15,360	17,130	10,870	12,480	13,890
1H4	8,300	9,560	10,660	6,830	7,830	8,710
1H6	5,550	6,390	7,120	4,620	5,290	5,870
1H10	3,300	3,800	4,240	2,810	3,210	3,560
1H16	2,060	2,390	2,670	1,830	2,080	2,290
1H25	1,320	1,520	1,690	1,210	1,370	1,510
1H35	0,960	1,100	1,220	0,920	1,030	1,130
1H50	0,720	0,820	0,910	0,720	0,800	0,880
1H70	0,510	0,580	0,640	0,550	0,610	0,660
1H95	0,380	0,430	0,470	0,440	0,480	0,520
1H120	0,310	0,350	0,380	0,380	0,420	0,440
1H150	0,260	0,290	0,320	0,340	0,370	0,390
1H185	0,230	0,250	0,270	0,310	0,330	0,350
1H240	0,200	0,210	0,220	0,280	0,300	0,310
1H300	0,180	0,190	0,200	0,270	0,280	0,290
1H400	0,150	0,160	0,170	0,240	0,250	0,260

Falls of voltage multicore cables L series (500 V)

Type	Falls of voltage (mV/Am)					
	cos φ = 1			cos φ = 0,8		
cable	30 °C	70 °C	105 °C	30 °C	70 °C	105 °C
2L1	37,620	43,310	48,290	30,200	34,760	38,740
2L1,5	25,150	28,950	32,280	20,220	23,260	25,930
2L2,5	15,400	17,730	19,770	12,420	14,280	15,910
2L4	8,960	10,310	11,500	7,260	8,340	9,290
3L1	32,580	37,51	41,820	26,160	30,100	33,550
3L1,5	21,780	25,080	27,960	17,510	20,150	22,460
3L2,5	13,340	15,360	17,120	10,750	12,370	13,780

The values shown above are also valid for the four-pole cables and seven conductors.

Falls of voltage bipolar cables H series (750 V)

Type cable	Falls of voltage (mV/Am)					
	cos φ = 1			cos φ = 0,8		
	30 °C	70 °C	105 °C	30 °C	70 °C	105 °C
2H1,5	25,150	28,950	32,280	20,240	23,280	25,950
2H2,5	15,400	17,730	19,770	12,430	14,300	15,930
2H4	9,580	11,030	12,300	7,770	8,930	9,940
2H6	6,401	7,370	8,220	5,220	6,000	6,670
2H10	3,800	4,380	4,880	3,140	3,600	4,000
2H16	2,390	2,750	3,070	2,000	2,290	2,540
2H25	1,510	1,740	1,940	1,300	1,480	1,640

The values shown above are also valid for all other formations of multipolar cable (three-pole, four-pole, seven, 0:19 conductors).

3.5. Insulation features

Thermal conductivity

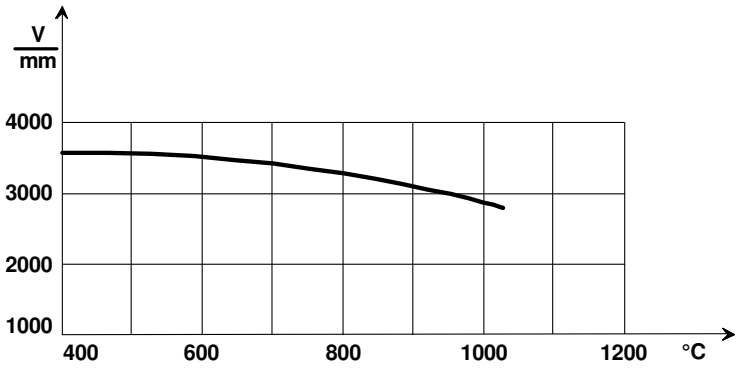
As is known, an electrical insulator is also a thermal insulator. In ordinary cables, therefore, the electric insulating hinders the diffusion of heat towards the outside and the cable then assumes, at equal current conveyed, a higher temperature against a cable with the insulating mineral.

In fact, the magnesium oxide is an exception to this general rule: it is a very good electrical insulator and a good heat conductor. These two features allow to isolate electrically the conductors and easily transmit outside the heat produced by the Joule effect.

The thermal conductivity of magnesium oxide increases with its density, resulting from the degree of compression. The construction process of KME ITALY gives rise to a density of 2.0 g / cm³ which corresponds to a thermal conductivity of 2.36 W / m ° C.

Dielectric strength

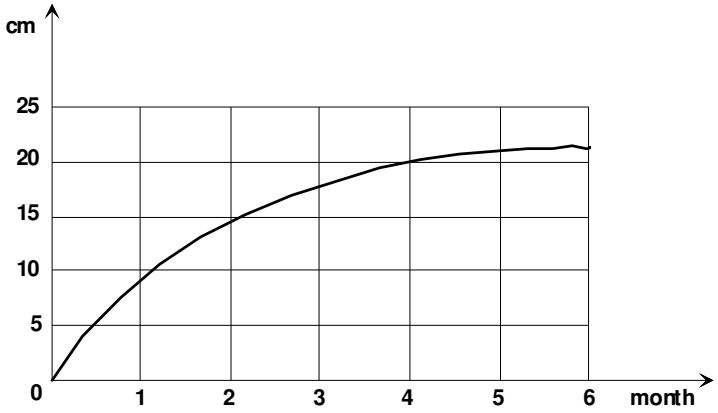
The dielectric strength of the insulation decreases with increasing temperature as shown in the following diagram.; this decrease is relatively negligible at temperatures lower than 1000 ° C.



Resistance to humidity

The magnesium oxide, used in the cable MICO as electrical insulator, is hygroscopic and the presence of moisture reduces the value of the insulation resistance.; this, measured with a megohmmeter at 500 V must be greater than 100 MΩ.

In any case, if one end of the cable is left open, the moisture penetrates into the interior only for a few centimeters. The following diagram shows the depth of penetration of moisture as a function of time of exposure to the atmosphere of a cable with ends unsealed



Moisture can therefore be easily removed or proceeding to the cut of approximately 0.1 m of cable from each end without performing any heating or by heating with an industrial drier the cable, in such a way as to push the moisture itself towards the free ends.

To obviate to moisture absorption, both the coils of cable deliver both those in stock are temporarily sealed and the ends of each cable is put in work to be protected by suitable terminals.

3.6. Temperature Limits

The magnesium oxide insulation is stable and does not suffer aging with the increase of temperature up to the melting point of 2800 ° C. Therefore, the theoretical limit temperature of the cable MICO is defined by the melting point of copper (outer sheath and conductors) of 1083 ° C.

Up to this temperature the cables are completely non-flammable and do not develop any type of gas that is toxic or corrosive or opaque. Please note that in a fire is difficult to reach temperatures over 1000 ° C.

However, it is not recommended to use the mineral insulated cables in environments where the temperature, **in continuous operation**, exceeds the value of 250 ° C.

In fact, beyond this temperature, the surface oxidation of the sheath assumes values to rapidly reduce its thickness; the following table indicates the theoretical reduction of the thickness of the sheath as a function of both the time and the temperature.

Sheath thickness decreasing (µm)	250 °C years	400 °C years	800 °C hours
25,4	2,57	0,0583	0,259
50,8	10,30	0,2330	1,040
127,0	64,30	1,4600	6,480
254,0	257,00	5,8300	25,900

In function of the above values may be obtained, in principle, the time within the thickness of the copper sheath assumes a value lower of 10% respect to its nominal value.

3.7. Behavior of the mineral insulation cable in short circuit conditions

The electrical cables in short circuit condition are subject to mechanical problems (due to the electrodynamic forces which are developed between the conductors) and thermal problems (excessive heating); the electrodynamic forces generated by a short circuit will not damage the multi-core cables which are quite robust; conversely single core cables next to each other, may be subject to violent movements and suffer or cause damage.

In this case it is advisable to secure the cables to their supporting surface with brackets placed at short intervals (of the order of a meter).

An electric conductor must also withstand the thermal problems; its dimensions (section) must be chosen in a way that the cable can be run through by a short-circuit current "I" for a time "t", within the protectins must intervene and not more than 5 s and without the temperature exceeds a certain limit (CEI 64-8 / 434.3.2); the value of this current can be determined with the following equation:

$$I = S \cdot K \cdot \frac{1}{\sqrt{t}}$$

where:

S = conductor section (mm²);

K = factor whose value depends on the material of the protective conductor, insulation and other parts and the initial and final temperatures; this factor is determined using the following equation (CEI 64-8 appendix B chapter 54):

$$K = \sqrt{\frac{Q_C \cdot (B + 20)}{\rho_{20}} \cdot \ln\left(1 + \frac{\vartheta_f - \vartheta_0}{B + \vartheta_0}\right)}$$

where:

Q_C = thermal capacity per unit volume of the conductive material (J/°C mm³);

B = inverse of the resistivity temperature coefficient at 0 ° C for the conductor (°C);

ρ_{20} = resistivity of the conductor material at 20 °C;

θ_0 = initial temperature of the conductor (°C);

θ_f = final temperature of the conductor (°C).

Obviously "ln" is the natural logarithm function.

The values of **B**, **Q_C** and **ρ_{20}** can be taken from following table:

Material	B	Q_C	ρ_{20}
Copper	235	$3{,}45 * 10^{-3}$	$17{,}241 * 10^{-6}$
Aluminium	228	$2{,}50 * 10^{-3}$	$28{,}264 * 10^{-6}$
Lead	230	$1{,}45 * 10^{-3}$	$214{,}000 * 10^{-6}$
Steel	202	$3{,}80 * 10^{-3}$	$138{,}000 * 10^{-6}$

The standard CEI 64-8 art. 434.3.2 indicates, for the copper conductors, the following values of K with the relative maximum temperature allowed during normal service and during the short circuit, depending on the nature of the insulation:

Conductors type	K	Normal service (°C)	Short circuit (°C)
Copper, PVC insulated	115	70	160
MICO with outer LSF sheath and at hand	115	70	160
Copper, common rubber insulated	135	60	200
Copper, butyl rubber insulated	135	85	220
MICO bare and at hand	135	70	200
Copper, EPR or XLPE insulated	143	90	250
MICO bare and nont at hand	200	105	500

Therefore, the the minimum value of the section of a cable, in relation to the short-circuit current and to the time of intervention of the protections is expressed by the following equation:

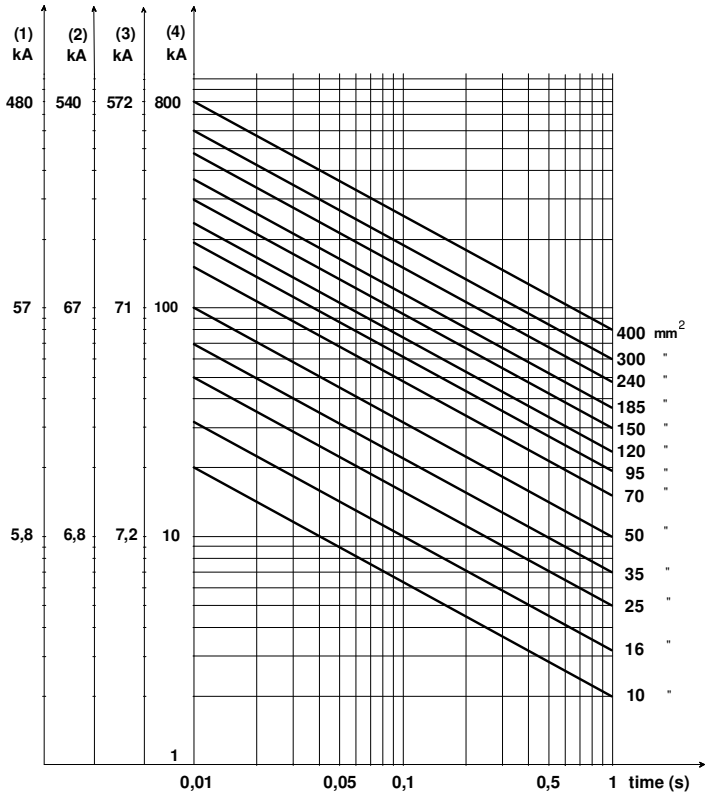
$$S = \frac{I \cdot \sqrt{t}}{K}$$

The following tables indicate the value of the minimum section to be employed by using a mineral insulation cable, bare and not at hand, and the corresponding values of the sections for other types of cable in relation to two different intervention times of the protections.

Short Circuit Duration = 0,01 s					
Insulation	Minimum Section (mm²) for a short-circuit current (kA) equal to				
	5	10	15	25	35
Mineral (k=200)	2,5	6	10	16	25
EPR (k=143)	4	10	16	25	25
Butyl rubber (k=135)	4	10	16	25	35
PVC (k=115)	6	10	16	25	35

Short Circuit Duration = 1 s					
Insulation	Minimum Section (mm²) for a short-circuit current (kA) equal to				
	5	10	15	25	35
Mineral (k=200)	25	50	95	150	185
EPR (k=143)	35	70	120	185	300
Butyl rubber (k=135)	50	95	120	185	300
PVC (k=115)	50	95	150	240	400

The tables show how the use of the cable MICO against thermal stress due to short circuit, offers the possibility of using conductors with significantly lower copper section if compared to other solutions; The following diagram allows to quickly determine the section minimum of cable allowed, based on the short-circuit current value and its duration.



(1) k = 115 for copper conductors PVC insulated and for mineral insulated cable with LSF sheath or bare not at hand;

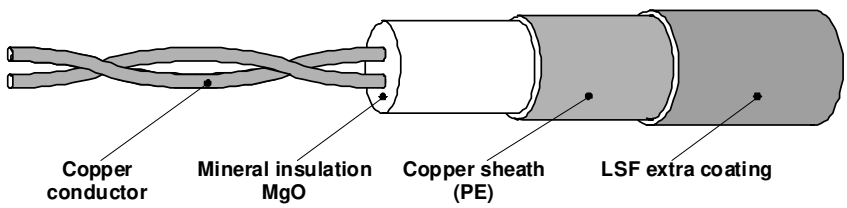
(2) k = 135 for copper conductors ordinary rubber or butyl rubber insulated and for mineral insulated cable with copper sheath bare not at hand;

(3) k = 143 for copper conductors EPR or XLPE insulated;

(4) k = 200 for mineral insulated cable with copper sheath bare not at hand.

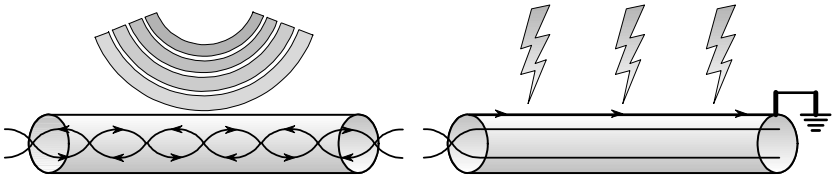
3.8. Twisted mineral insulated cable

With the same constructive technology it is possible to have a twisted version of cable MICO, Type 2T1,5 with additional red coating LSF low smoke and gas emission (CEI 20-37/2 and CEI 20-37/4).



This cable is constructed, finished and installed as all other cables with mineral insulation; in fact, its dimensional and electrical characteristics, as well as terminations and other accessories, are those indicated in the previous pages for the cable 2L1,5.

Due to this features and to the copper outer sheath, which is an excellent electrostatic shield with a low impedance, the twisted cable MICO greatly reduces electromagnetic interference and the deterioration of the signal in modern integrated safety management systems, for example, fire detection systems, phone safety systems, data transmission systems, etc.



Like the other cables with mineral insulation, the twisted cable has the peculiar feature of maintaining the signal also transported in hostile conditions as in the case of a fire and in conjunction with mechanical stresses and splashing water.

The cable 2T1,5 / LSF (red color) comes in a standard length of 100 m or multiple coils.

On request are also available the Type 2T1 / LSF and 2T2,5 / LSF.

3.9. Current carrying capacity

The current carrying capacity Iz (A) of a mineral insulated cable, in a certain installation condition, it is calculated according to the following equation:

$$I_Z = I_0 \times k_1 \times k_2$$

where:

I_0 = capacity rate in the air at 30 ° C relative to the installation method, derived from Tables I and II;

k_1 = correction factor for ambient temperatures different from 30 ° C (Table III);

k_2 = correction factor for multiple circuits installed in a bundle or in layer (Table IV - V or VI).

The definitions of bundle and layer are the following ones.

Layer: set of more circuits made with cables installed side by side, spaced apart or not, arranged horizontally or vertically; cables on the layer are installed on wall, walkway, ceiling, floor or on cable ladder.

NOTE

- several superimposed layers on a single support (eg. duct) are to be considered a bundle;
- two unipolar cables, belonging to different circuits, are spaced apart when the distance between them exceeds twice the outer diameter of the upper cable section;
- two multipolar cables are spaced apart when the distance between them exceeds the outer diameter.

Bundle: set of more circuits made with non-spaced cables and not installed in a layer.

NOTE

- It is specified that the maximum temperature mentioned in the respective tables is referred to the metal sheath and not to the conductors. In the case of a particular installation, the thermal inspection of the cables can be performed using the calculation method described in standard CEI 20-21, assuming that the conductors are at the same temperature of the metal sheath.

The number of loaded conductors to be taken into consideration are the conductors really run by current actually. For the calculation of the capacity, the three-phase system is supposed balanced.

The capacities shown in Tables I and II are determined for the maximum permissible operating temperature, indicated at the bottom of each table.

Capacities are based on an ambient temperature of 30 ° C.

For other ambient temperature, capacities values must be multiplied by the appropriate correction factors deduced from Table III.

When two or more conductors are connected in parallel in the same phase or pole of the system, it is necessary to take into account special precautions in order to ensure that the current is equally divided between them; these measures shall be fulfilled if:

a - the conductors have equal section;
b - the conductors have approximately the same length and have no intermediate derivations of other circuits;
c - the wires in parallel all belong to multipolar or unipolar cables transposed along the route.

For single-core cables not transposed, arranged in a clover shape or in plan, having conductors with section> 50 mm², you must take special precautions in relation to the installation, the spacing of the phases and the optimum sequence of the same.

Table I/1

Mineral insulated cables ***unipolar H (750 V)*** bare at hand or covered with thermoplastic material (T max of metal sheath 70 °C). For bare cables must be multiplied by 0.9. The sheaths of the cables are connected at the ends.										
Type cable	Cables in free air in clover shape	Cables in free air in plan in contact		Cables in free air spaced on a horizontal plane		Cables in free air spaced on a vertical plane		Cables in plan in free air, fixed on the wall or ceiling		Cables in clover shape, in free air fixed on the wall / ceiling
	13-14 15-16 *	13-14 15-16 *		14 15-16 *		14 15-16 *		11 11A *		11 11A *
	3 cables	2 cables	3 cables	2 cables	3 cables	2 cables	3 cables	2 cables	3 cables	3 cables
	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
1H1,5	22	26	26	26	32	26	28	25	23	21
1H2,5	30	36	34	36	43	36	37	34	31	28
1H4	40	47	45	47	56	47	49	45	41	37
1H6	51	60	57	60	71	60	62	57	52	48
1H10	69	82	77	82	95	82	84	77	70	65
1H16	92	109	102	109	125	109	110	102	92	86
1H25	120	142	132	142	162	142	142	133	120	112
1H35	147	174	161	174	197	174	173	163	147	137
1H50	182	215	198	215	242	215	213	202	181	169
1H70	223	264	241	264	294	264	259	247	221	207
1H95	267	317	289	317	351	317	309	296	264	249
1H120	308	364	331	364	402	364	353	340	303	286
1H150	352	416	377	416	454	416	400	388	346	327
1H185	399	472	426	472	507	472	446	440	392	371
1H240	466	552	496	552	565	552	497	514	457	434

Table II/1

Mineral insulated cables ***multipolar H (750 V) e L (500 V)*** bare exposed at hand or covered with thermoplastic material (T max of the metal sheath 70 ° C). For bare cables multiply by 0.9.				
section nomin. condutt. mm²	Cable in free air, spaced from the wall or ceiling or on duct		Cable in free air, fixed on the wall or ceiling	
	13-14-15-16 *		11-11A *	
	2 cables	3 cables	2 cables	3 cables
serie	(A)	(A)	(A)	(A)
500 V				
1,5	25	21	23	19
2,5	33	28	31	26
4	44	37	40	35
750 V				
1,5	26	22	25	21
2,5	37	30	34	28
4	47	40	45	37
6	60	51	57	48
10	82	69	77	65
16	109	92	102	86
25	142	120	133	112

* Installation Methods taken from the 3rd edition of the standard CEI 64-8/5 tab. 52 C

Table I/2

Mineral insulated cables **unipolar H (450/750 V)** bare not exposed at hand (T max of the metal sheath 105 ° C).

You do not need the correction factor for groups.

Type cable	Cables in free air in clover shape	Cables in free air in plan in contact		Cables in free air spaced on a horizontal plane		Cables in free air spaced on a vertical plane		Cables in plan in free air, fixed on the wall or ceiling		Cables in clover shape, in free air fixed on the wall / ceiling
	13-14 15-16 *	13-14 15-16 *		14 15-16 *		14 15-16 *		11 11A *		11 11A *
	3 cables	2 cables	3 cables	2 cables	3 cables	2 cables	3 cables	2 cables	3 cables	3 cables
	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
1H1,5	28	33	32	33	40	33	35	31	30	26
1H2,5	38	45	43	45	54	45	47	42	41	35
1H4	50	60	56	60	70	60	61	55	53	47
1H6	64	76	71	76	89	76	78	70	67	59
1H10	87	104	96	104	120	104	105	96	91	81
1H16	115	137	127	137	157	137	137	127	119	107
1H25	150	179	164	179	204	179	178	166	154	140
1H35	184	220	200	220	248	220	216	203	187	171
1H50	228	272	247	272	304	272	266	251	230	212
1H70	279	333	300	333	370	333	323	307	280	260
1H95	335	400	359	400	441	400	385	369	334	312
1H120	385	460	411	460	505	460	441	424	383	359
1H150	441	526	469	526	565	526	498	485	435	410
1H185	500	596	530	596	629	596	557	550	492	465
1H240	584	697	617	697	704	697	624	643	572	544

Table II/2

Mineral insulated cables ***multipolar H (750 V) e L (500 V)*** bare not exposed at hand (T max of the metal sheath 105 ° C). You do not need the correction factor for groups				
Sect. nomin. condutt. mm²	Cable in free air, spaced from the wall or ceiling or on duct		Cable in free air, fixed on the wall or ceiling	
	13-14-15-16 *		11-11A *	
	2 cables	3 cables	2 cables	3 cables
serie	(A)	(A)	(A)	(A)
500 V				
1,5	31	26	28	24
2,5	41	35	38	33
4	54	46	51	44
750 V				
1,5	33	26	32	26
2,5	45	35	42	35
4	60	47	55	47
6	76	59	70	59
10	104	81	96	81
16	137	107	127	107
25	179	140	166	140

* Installation Methods taken from the 3rd edition of the standard CEI 64-8/5 tab. 52 C

Table III

Correction factor k_1 for ambient temperatures different from 30 °C

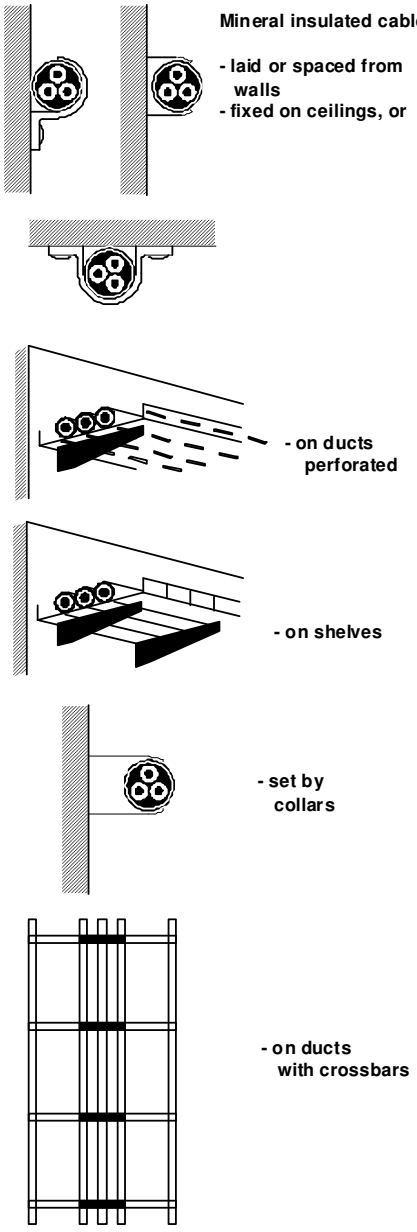
Ambient temperature	Cable bare or covered with thermoplastic material exposed at hand	Cable bare not exposed at hand
°C	70 °C	105 °C
10	1,26	1,14
15	1,20	1,11
20	1,14	1,07
25	1,07	1,04
35	0,93	0,96
40	0,85	0,92
45	0,76	0,88
50	0,67	0,84
55	0,57	0,80
60	0,45	0,75
65	-	0,70
70	-	0,65
75	-	0,60
80	-	0,54
85	-	0,47
90	-	0,40
95	-	0,32

Table IV

Correction factors **k2** for circuits made with cables installed in a bundle or layer

Appendix A			N° of circuits or multipolar cables											
	Art.	Shape (cables in contact)	1	2	3	4	5	6	7	8	9	12	16	20
Installation conditions not 2-3-4-5- provided in the following articles and in tables V and VI	1	Grouped in bundle, sunken	1,00	0,80	0,70	0,65	0,60	0,57	0,54	0,52	0,50	0,45	0,41	0,38
11-12-25	2	Single layer on wall, floor or non-perforated ducts	1,00	0,85	0,79	0,75	0,73	0,72	0,72	0,71	0,70			
11A	3	Layer On ceiling	0,95	0,81	0,72	0,68	0,66	0,64	0,63	0,62	0,61			
13	4	Layer on horizontal or vertical perforated ducts (perforated or non-perforated)	1,00	0,88	0,82	0,77	0,75	0,73	0,73	0,72	0,72			
14-15 16-17	5	Layer upon laying cables scale or stapled to a support	1,00	0,87	0,82	0,80	0,80	0,79	0,79	0,78	0,78			

APPENDICE A


Mineral insulated cables:
- laid or spaced from walls
- fixed on ceilings, or
- on ducts perforated
- on shelves
- set by collars
- on ducts with crossbars

4. Installation

The purpose of this section is to provide a general guide to the installation of electrical energy cables with mineral insulation. As regards the use of mineral insulated cables and their terminations, the following regulatory guide is also available:

- EN 60702-3:2016, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V, Part 3: Guide for use*.

Installation systems, materials and plant components must comply with the applicable rules.

4.1. Tests

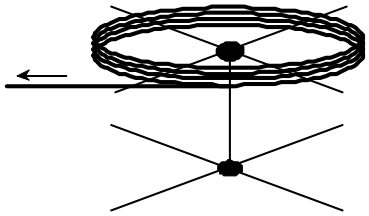
It is necessary, before installation, to check the insulation resistance, using a megohmmeter or megger with a set voltage of 500 V dc between the conductors and the outer copper sheath; in such conditions the insulation resistance must not be less than 100 MΩ; when the installation is complete, every cable terminations must be again subjected to the insulation resistance test as described above.

4.2. Installation

4.2.1 How unwind the coils

The mineral insulated cable is normally supplied in self-supporting coils having an internal diameter of 500, 1200 and 1450 mm depending on the outer diameter of the cable.

To unwind properly the coils is possible to construct a simple unwinder, using a metal profile or wooden boards such as that used for the support of common cables.



4.2.2 Cut the sections of cable

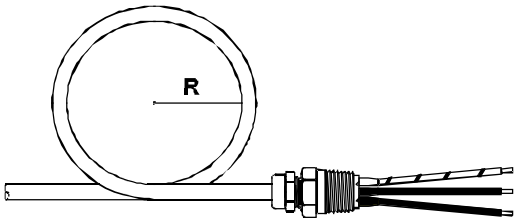
When you have to cut the sections of cable from coil, the length of the sections can be roughly determined by multiplying the average internal diameter (length of a cable loop) of the coil for π and counting the number of turns necessary.

4.2.3 Installation of cable

Before fixing the cable this must be straightened by hand or using a straightener or a bender; the final straightening can be performed using a block of wood and a hammer, or with a rubber hammer; a metal hammer directly on the cable sheath must never be used for not compromising the mechanical and electrical characteristics of the sheath.

4.2.4 Bending radius

The curves should generally be limited to a minimum radius of no less than six times the Diameter of the copper sheath of the cable, so as to allow to straighten the cable and perform any subsequent curves.



R => 6 x external cable diameter

If it is necessary to perform more tight curves, the minimum radius of curvature must not be less than that indicated in the following Table; these curves should be permanent and any straightening, if unavoidable, must be carried out carefully to avoid damage to the copper sheath of the cable.

Cable external diameter (mm)	Minimum bending radius (mm)
D < 12	3 D
12 < D < 15	4 D
15< D < 25	6 D
D > 25	12 D

4.2.5 Bracket units

The mineral insulated cables must be fixed to surfaces with staples provided by KME Italy SpA; other similar fastening methods are commercially available, but for the bare cable, these must not be galvanized; the maximum distance between a fastener and the other depends on the size of the cable and must not exceed the values indicated in the following Table. The screws used for fastening must be of a suitable type and corrosion resistant.

External cable diameter (mm)	Maximum fastening spacing	
	Horizontal (mm)	Vertical (mm)
D < 9	600	800
9 < D < 15	900	1200
15 < D < 20	1500	2000
D > 20	2000	3000

4.2.6 Dilations and vibration

When the cable passes through expansion joints of structures, or when connects equipment subjected to vibrations, is required the realization of expansion rings whose minimum radius must not be less than six times the outer Diameter of the cable.

In the case of excessive and prolonged vibration it is advisable to carry out the termination of the cable MICO in a junction box adjacent to the user's power supply terminal; the connection between the terminal and the junction box can be performed with a flexible cable.

4.2.7 Buried cables

The buried cables MICO must be equipped with the additional LSF sheath and must be routed as required by CEI 11-17, par. 2.3.11 cap. d: "The cables intended to zero and 1 category systems can be buried without additional mechanical protection (shutter mode L) when equipped with metallic coating with a thickness exceeding 0.8 mm suitable as protection against direct contacts (3.3. 01) "; in the case of thicknesses of less than 0.8 mm metallic coating must be mechanically protected (shutter mode M, N, O, P and Q).

It is however necessary that the mineral insulated cables are placed to a depth of not less than 0.5 m, have a cover or are marked with a highlighter tape buried above the compartment.

4.2.8 Underground ducts, protective pipes or pipes

When the cables must be placed in underground tunnels, you must inspect the tunnels to ensure they are smooth, dry and free of obstructions.

For the laying of concrete pipes, cables must be laid with the external coating in PVC or LSF; you can use naked cables when the ducts are not of concrete, and you have the confidence that the ducts are kept dry in time.

4.2.9 Cables sunk in concrete or embedded in the plaster

When the cables are embedded or covered by concrete, it must use mineral insulated cables with PVC or LSF outer coating to avoid possible corrosion of the copper sheath; the joints and terminations should be carried out within the appropriate junction boxes.

NOTE: when using cables with PVC or LSF coating for protection against corrosion, it is essential that every part of the coating that is removed by the termination of the execution is protected with the appropriate PVC or LSF cone or be replaced with insulating or aself-vulcanizing tape; this for both the copper sheath that has been discovered and the gland.

4.2.10 Cables mounted on the ducts

The mineral insulated cable can be laid directly on the duct, making sure that it is not be inadvertently impacted by the sharp edges of the duct itself.

Using ducts in galvanized steel is good practice to employ cables MICO with additional coating in LSF.

It is preferable to provide the clamping of the cables on the ducts at each change of direction and; it is not necessary to ground the duct if only contains mineral insulated cables, if the copper sheath is connected to ground via the terminal with ground wire or the appropriate staple.

4.2.11 Installation outdoors or in wet areas

When the termination of mineral insulated cables is carried out in boxes, outdoors cabinets or in humid environments, it is necessary to use connection with an appropriate degree of protection IP.

4.2.12 High temperature environments

When the temperature of the sheath of a cable MICO, taking into account the ambient temperature and the increase in temperature due to the current, does not exceed 70 ° C in working conditions, you can choose between the bare cable and the cable coated in LSF; for temperatures of the sheath upper to 105 ° C you should choose the bare cable; for continuous operating temperatures above 250 ° C it must be taken into account as indicated about the GF sealant.

4.2.13 Low temperature environments

The cables MICO can also be operated at temperatures above -200 ° C, without suffering adverse effects; on the other hand, cracks can occur in the extra PVC or LSF coating at temperatures lower than -20 ° C without that the functionality of the cable is seriously affected; for this reason it must not perform the laying of the cable with extra LSF coating in the presence of temperatures below - 20 ° C.

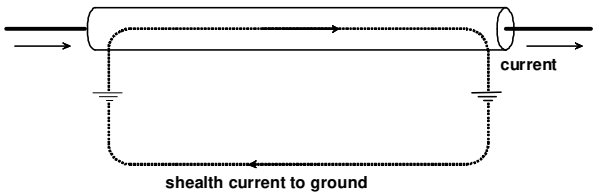
4.3. Installations made with unipolar cables of large section

When unipolar cables are installed for the transport of high currents it is necessary to minimize losses due to the electromagnetic field (eddy current and hysteresis losses) which can produce an excessive heating of the ferromagnetic structures placed in proximity to the cables themselves; in a dry environment, and where it is employed only one cable for each phase, we can affect cracks between the holes of the fittings (cassette) window.

In humid environments, or when they are employed more cables per phase, it is necessary to use, as an anchor of the cables, a brass plate or an insulating material.

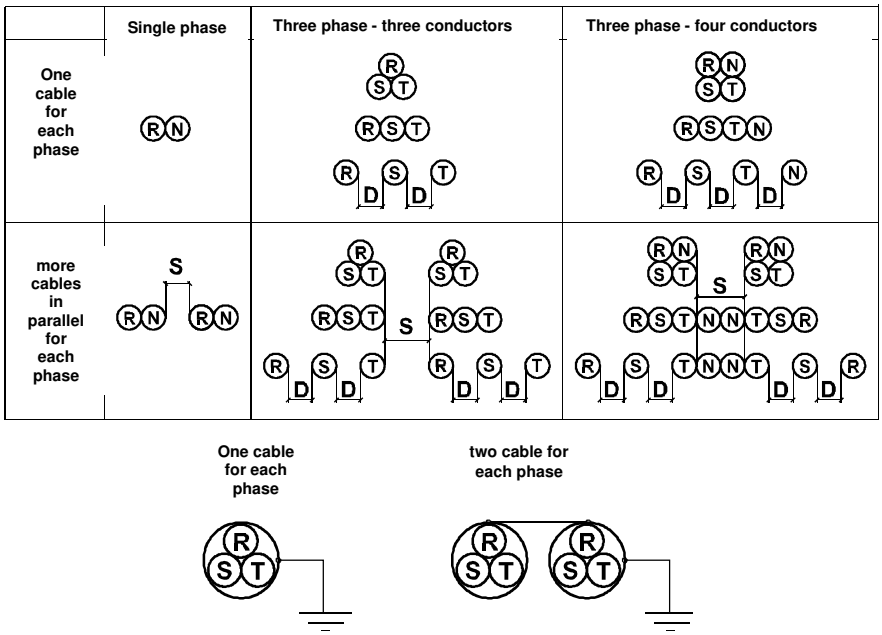
The alternating current flowing through the conductor generates a magnetic field around it on the sheath which induces an e.m.f. and consequently a current such as to produce, in turn, a magnetic field which is opposed to the original one.

Because the sheath is used as a protective conductor, suitably being connected to ground at each end of the cable, there is provided a circuit which is traversed by a sheath current, the voltage function induced (depending itself from the conductor current, from the cable length and the thickness of insulation) and the electric resistance of the thus formed circuit.



The induced voltages can reach quite high values for cables laying spaced and of considerable length; these tensions, improbably dangerous for human life, create the possibility of induced currents that may cross the external circuits and electrical equipment and determine malfunctions.

For these reasons it is essential that unipolar cables are routed plain very close or in trefoil shape, in order to limit the voltages induced on the sheath to negligible values; the following figure shows some typical arrangement of unipolar cables.



D = external cable diameter;

s = spacing between groups of cables; this should be equal to at least twice their Diameter.

Furthermore it is essential to short-circuit each other and connect to the ground of the cables sheaths as shown below:

Pose in clover shape: the sheaths of the cables will be short-circuited at the beginning and end of the line with a copper conductor of section equal to or greater than the section of the cable sheath; It is allowed, for a maximum length of 2 m, which at the beginning and at the end of the line cables are spaced apart to allow the execution of the terminations and connections.

All other types of laying: The sheaths of the cables will be short-circuited every 30 m with a copper conductor of section greater than or equal to that of the cable sheath

4.4. Overvoltage

It is known that the interruption of inductive circuits causes overvoltage which may cause inconveniences to the circuit components including cables; these overvoltages can assume values up to 5000 V as a function of the intrinsic characteristics of the circuit; it is the task of the designer to identify possible sources of sovravoltage within the circuits and take appropriate countermeasures using suppressors of voltage spikes devices.

The most common cause that generates the overvoltage is the opening of the circuit to the maximum value of the sine wave voltage; this effect is likely if:

• the switching frequency of the circuit is high;

• the circuit layout is such that it does not minimize reactive loads.

The circuit components that may be more frequently due to overvoltages are:

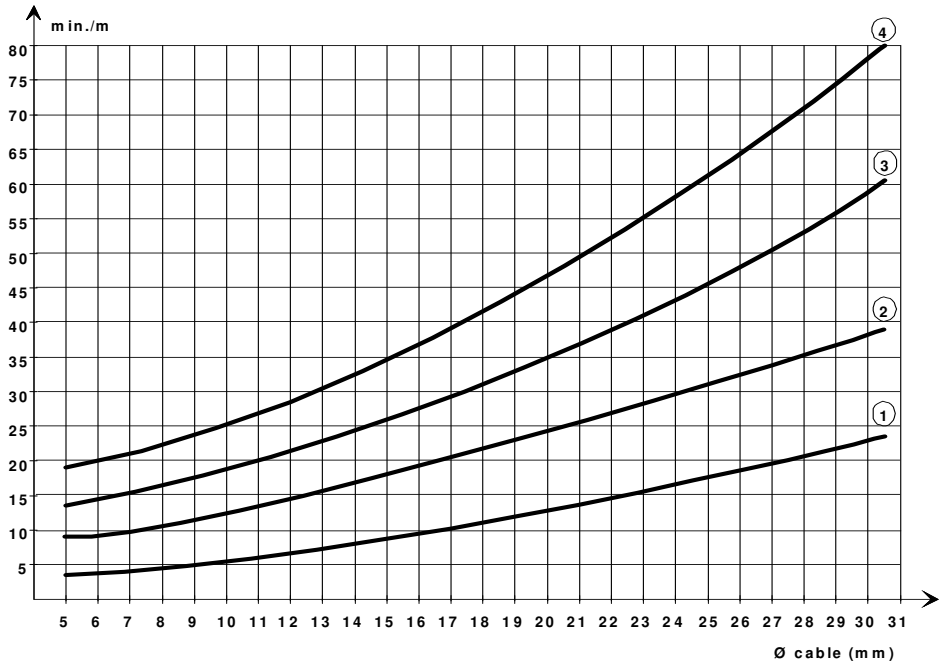
- • three-phase electric motors (in particular those of small power and with star connection); in this situation you should use:
- - for motors rated up to 1 HP with supply voltage up to 415 V three-pole arresters;
- - for 1÷6 HP motors with power supply voltage up to 250 V using 3 bipolar arresters;
- • inductive coils of contactors and single-phase users up to 415 V; In this case, we recommend using a bipolar discharger;
- • ballasts for fluorescent lamps up to 280 V; In this case, we recommend using a bipolar discharger.

4.5. Installation costs

4.5.1 Positioning times of mineral insulated cable

Refer to the following diagram where you can determine the shutter speed (min./m) as a function of the outside of the cables Diameter (mm) and the Type of pose.

1. Pose in open tunnel or walkway at a height up to 3 m from the working surface;
2. Laying on the catwalk at a height greater than 3 m from the working surface;
3. Pose a view at a height up to 3 m from the working surface,
4. Pose a view at a height greater than 3 m from the working surface.



5
Execution of terminations and joints

This section, which is connected with earlier known techniques, has the objective of integrating previously disclosed information with news and suggestions that we consider useful for technicians and installers of cable MICO.

The instructions contained in this section can not be considered substitutional elements of operational experience that every installer of mineral insulated cable must have.

For this purpose, KME Italy SpA provides, in its own branches, equipment and personnel for education and qualification on the use of cable MICO.

5.1 Testing

At the end of the production cycle, 100% of the coils of mineral insulation cable, in accordance with the requirements of construction standards and the internal manufacturing and control procedures, are subjected to the following acceptance tests, specified by the Standard EN 60702 – 1: 2002-03:

- Electrical resistance of conductors;
- Dielectric strenght 2500 V x 30” for H series cables;
  2000 V x 30” for L series cables;
- Insulation resistance (≥1000 MΩ/km).

5.2 Temporary sealing of the ends of the cables

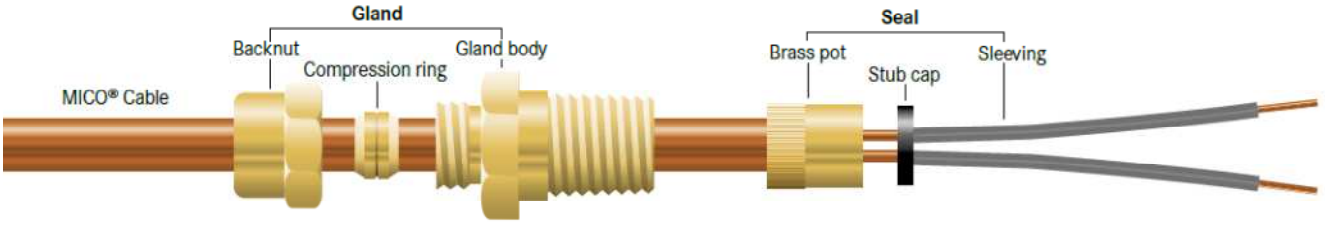
In order to retain as long as possible the level of insulation resistance, at the end of the production line each coil of cable is temporarily sealed, at the ends, to prevent the infiltration of moisture until its installation.
Such sealing is made with waterproof plastic materials, resistant to mechanical stress.
In the case where it is intended to store for a long period of time the cable is a good practice to seal the ends not terminated of the cable using one of the following methods:

- wrapping the ends of the cable with self-agglomerating tape;
- wrapping the ends of the cable with common insulating tape.

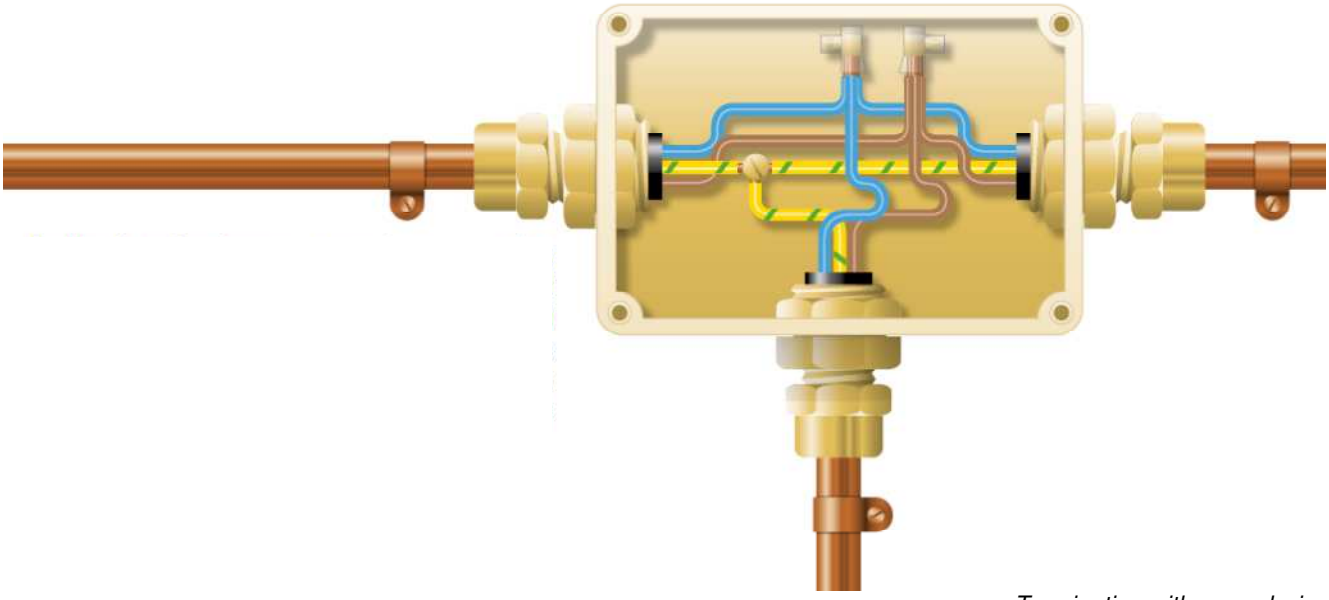
5.3 Termination

The method of the MICO cable laying is clearly distinguished from that of traditional cables with organic insulation, because the ends must be closed with appropriate terminations.
The terminations built by KME Italy SpA, in accordance with EN 60702–2:2002+A1:2015, consist of:

- GLAND;
- SEAL.



Standard termination



Termination with ground wire

5.3.1 Gland

The gland connect the mineral insulation cable with the distribution box. Use only KME glands for carrying out terminations. KME cable glands are made from brass alloy CW614N (CuZn39Pb3) according to UNI CEN/TS 1388 and EN 12164 standards, such as to guarantee the absence of corrosion arising from electrolytic action. Upon customer request, the cable glands can be supplied with galvanic coating of nickel with a thickness between 2 and 5 µm. With reference to the previous figure, the use of the locknut is not intended for ATEX/IECEx applications. The following types of gland are provided, depending on type of system to be realized.

"RN" TYPE GLANDS FOR ELECTRICAL HERMETIC INSTALLATIONS

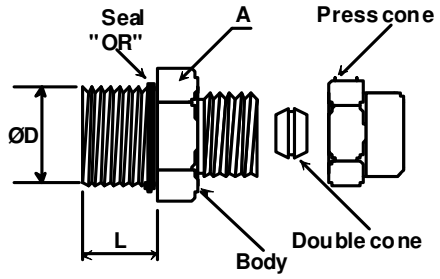
The fittings of this type allow easy anchoring of the cable to sealed distribution boxes; the body, the double cone and the press cone are made of brass and the external thread is of type cylindrical gas UNI ISO 228 (ex UNI 338); with the aid of a synthetic rubber seal type "OR" the fitting ensures a degree of protection IP 67 (CESI GR 015 certificate).

In the following table are indicated the maximum value of Diameter, in case you need to drill a hole crossing the wall of an enclosure, to maintain the degree of protection IP 67.

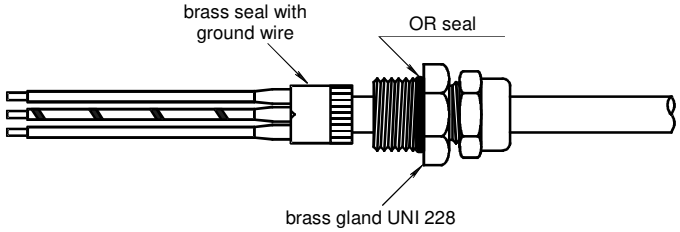
The type of connection corresponding to each cable type is indicated in the table “RN cable glands and seals used with MICO Cables” (see pg. 49-50).

The minimum tightening torques to be applied to the press-cone in order to ensure the tightening of the cables are shown in the table “Minimum tightening torques for the press-cone” (see pg. 48).

Ø D *Cylindrical gas threads UNI ISO 228*	Max. **Ø** of through hole (mm)	Length **L** (mm)	**A** (mm)
½”	21,50	10,50	24
¾”	27,00	11,00	30
1”	34,00	11,00	38
1-¼”	41,50	19,00	46



TERMINATION FOR HERMETIC INSTALLATIONS (IP 67)



"RAD" TYPE GLANDS FOR INSTALLATIONS IN ATEX & IECEX ZONES

The glands for mineral insulated cables, complying with the directive 2014/34/EU-ATEX and to the IECEx certification scheme, they are also built according to the harmonized European standards and the corresponding IEC standards below listed:

- EN IEC 60079-0:2018 Explosive atmospheres – Part 0: Equipment – General requirements
- IEC 60079-0:2017, Explosive atmospheres – Part 0: Equipment – General requirements;
- EN 60079-1:2014 Explosive atmospheres – Part 1: Equipment protection by flameproof enclosure “d”
- IEC 60079-1:2014, Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures “d”
- EN IEC 60079-7:2015+A1:2018 Explosive atmospheres – Part 7: Equipment protection by increased safety “e”
- IEC 60079-7:2015, Explosive atmospheres – Part 7: Equipment protection by increased safety “e”
- EN 60079-31:2014 Explosive atmospheres – Part 31: Equipment dust ingnition protection by enclosure “t”
- IEC 60079-31:2013, Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”

The quality management system adopted by KME Italy S.p.A. for the manufacture of RAD type cable glands referes and is compliant with standard ISO/IEC 80079-34:2018 ed. 2.0 (Product quality assurance notification: IMQ 18 ATEX 004 Q).

Having the glands successfully passed the tests described in the above standards (Certificates: IMQ 17 ATEX 027 X and IECEx IMQ 19.0001X) the glands are marked as follows and are suitable for fixed installations in potentially explosive areas (zone 1 and 21):

Ⓔx II 2G Ex eb IIC Gb Ex db IIC Gb

Ⓔx II 2D Ex tb IIIC Db IP65

Ambient Temperature -20°C ÷ + 70°C

Service Temperature -20°C ÷ +250 °C

Also this gland is constituted by a press cone, a double cone and a brass body; the external thread of the body, for coupling with the junction box, can be:

• Conical gas EN 10226-1 (ex UNI ISO 7-1);

• Isometric ISO 262 (or UNI 4535 with coupling tolerances according to ISO 965-1 e ISO 965-3);

the dimensions of the glands bodies are shown in the table on page 47.

The gland corresponding to each type of cable is shown in the tables “RAD ISO and RAD GAS cable glands and seals used with MICO Cables” on pages 51-54.

The glands are suitable to be inserted inside Ex d and Ex e enclosures and through threaded holes of the suitable size (the use with enclosures with not-threaded holes and the use of counter-nuts is not guaranteed). In case of ATEX/IECEx applications for the cable gland/enclosure jointing the following conditions must be guaranteed:

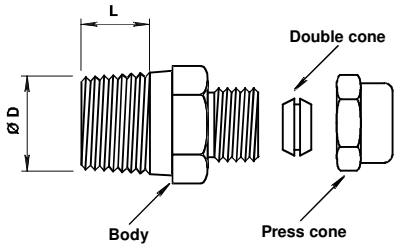
- Enclosure with threaded entries Ex d: jointing with both RAD ISO and RAD GAS cable glands must guarantee that at least 5 complete threads are engaged, and the minimum thickness of the enclosure must be greater than or equal to 8 mm.
- Enclosure with threaded entries Ex t: jointing with RAD ISO cable glands must guarantee that at least 5 complete threads are engaged, while coupling with RAD GAS cable glands must guarantee that at least 3,5 threads are engaged.

To prevent the loosening of the body with the enclosure, use Loctite on at least one thread.

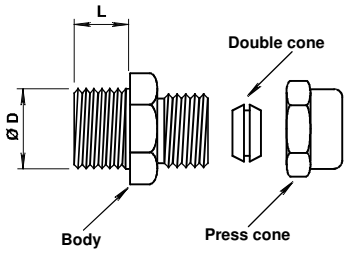
The minimum tightening torques to be applied to the press-cone in order to ensure the tightening of the cables are shown in the table “Minimum tightening torques for the press-cone” (see pg. 48).

Conical (RAD GAS) *EN10226 (ex UNI ISO 7-1)*		**Isometric cylindrical (RAD ISO)** *ISO 262 (UNI 4535)*	
Ø **D**	Length **L**	Ø **D**	Length **L**
½"	15,40	M 20x1,5	11
¾"	15,40	M 25x1,5	12
1"	19,70	M 32x1,5	12
1-¼"	19,70	M 40x1,5	12

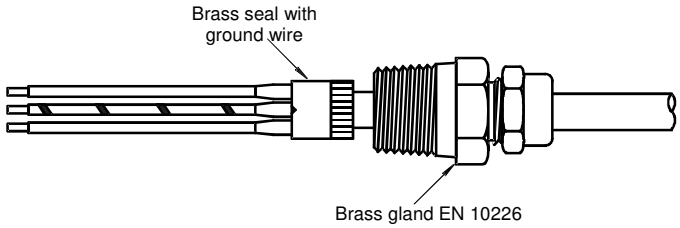
Conical Gas Thread

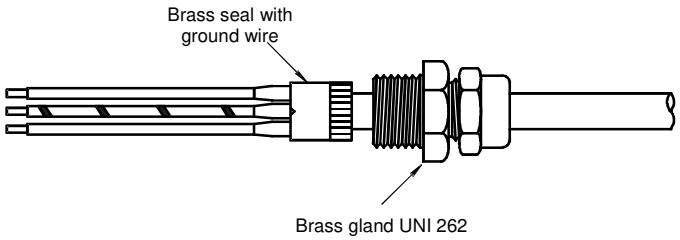


Isometric Thread



TERMINATIONS FOR ELECTRICAL INSTALLATION IN ATEX AND IECEx ZONES (IP65)





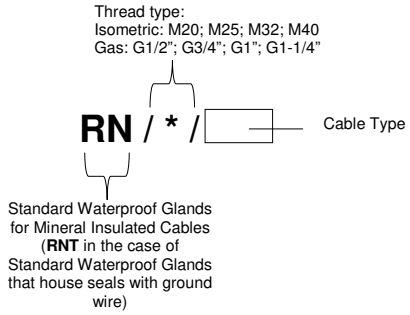
MINIMUM TIGHTENING TORQUE FOR THE PRESS-CONE			
GLANDS			Minimum tightening torque [Nm]
Gland Types	*Seal Type*	*Dimensions*	
RN	ST – 500 V	1/2" o ISO 20	18
		3/4" o ISO 25	
	ST – 750 V	1/2" o ISO 20	18
		3/4" o ISO 25	
		1"o ISO 32	36
		1-1/4" o ISO 40	
	GW – 750 V	3/4" o ISO 20	18
		1"o ISO 32	36
		1-1/4" o ISO 40	
RAD ISO	ST – 500 V	ISO 20	18
		ISO 25	
	ST – 750 V	ISO 20	18
		ISO 25	
		ISO 32-12H	40
		ISO 32 -1, -2,-4H	45
		ISO 40 *(except 1H400)*	110
		ISO 40-1H400	150
	GW - 750 V	ISO 25	18
		ISO 32	40
		ISO 40	45
RAD GAS	ST – 500 V	1/2"	18
		3/4"	
	ST - 750 V	1/2"	18
		3/4"	
		1"	36
		1-1/4"	
	GW - 750 V	3/4"	18
		1"	36
		1-1/4"	

ST – Standard seal (without ground wire)
GW – Seals with ground wire

RN CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code(*)**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
2 L 1	2 x 1	G 2L1	1/2" o ISO 20	RN/ * /2 L 1	GFT 2L1		
2 L 1.5	2 x 1.5	G 2L1.5	1/2" o ISO 20	RN/ * /2 L 1.5	GFT 2L1.5		
2 L 2.5	2 x 2.5	G 2L2.5	1/2" o ISO 20	RN/ * /2 L 2.5	GFT 2L2.5		
2 L 4	2 x 4	G 2L4	1/2" o ISO 20	RN/ * /2 L 4	GFT 2L4		
3 L 1	3 x 1	G 3L1	1/2" o ISO 20	RN/ * /3 L 1	GFT 3L1		
3 L 1.5	3 x 1.5	G 3L1.5	1/2" o ISO 20	RN/ * /3 L 1.5	GFT 3L1.5		
3 L 2.5	3 x 2.5	G 3L2.5	1/2" o ISO 20	RN/ * /3 L 2.5	GFT 3L2.5		
4 L 1	4 x 1	G 4L1	1/2" o ISO 20	RN/ * /4 L 1	GFT 4L1		
4 L 1.5	4 x 1.5	G 4L1.5	1/2" o ISO 20	RN/ * /4 L 1.5	GFT 4L1.5		
4 L 2.5	4 x 2.5	G 4L2.5	1/2" o ISO 20	RN/ * /4 L 2.5	GFT 4L2.5		
7 L 1	7 x 1	J 7L1	3/4" o ISO 25	RN/ * /7 L 1	JFT 7L1		
7 L 1.5	7 x 1.5	J 7L1.5	3/4" o ISO 25	RN/ * /7 L 1.5	JFT 7L1.5		
7 L 2.5	7 x 2.5	J 7L2.5	3/4" o ISO 25	RN/ * /7 L 2.5	JFT 7L2.5		
1 H 1.5	1 x 1.5	G 1H1.5	1/2" o ISO 20	RN/ * /1 H 1.5	GFT 1H1,5		
1 H 2.5	1 x 2.5	G 1H2.5	1/2" o ISO 20	RN/ * /1 H 2.5	GFT 1H2.5		
1 H 4	1 x 4	G 1H4	1/2" o ISO 20	RN/ * /1 H 4	GFT 1H4		
1 H 6	1 x 6	G 1H6	1/2" o ISO 20	RN/ * /1 H 6	GFT 1H6		
1 H 10	1 x 10	G 1H10	1/2" o ISO 20	RN/ * /1 H 10	JFT 1H10	ISO 25 o 3/4"	RNT/ * /1 H 10
1 H 16	1 x 16	G 1H16	1/2" o ISO 20	RN/ * /1 H 16	JFT 1H16	ISO 25 o 3/4"	RNT/ * /1 H 16
1 H 25	1 x 25	G 1H25	1/2" o ISO 20	RN/ * /1 H 25	KFT 1H25	ISO32 o 1"	RNT/ * /1 H 25
1 H 35	1 x 35	G 1H35	1/2" o ISO 20	RN/ * /1 H 35	KFT 1H35	ISO32 o 1"	RNT/ * /1 H 35
1 H 50	1 x 50	J 1H50	ISO 25 o 3/4"	RN/ * /1 H 50	MFT 1H50	ISO 40 o 1-1/4"	RNT/ * /1 H 50
1 H 70	1 x 70	J 1H70	ISO 25 o 3/4"	RN/ * /1 H 70			
1 H 95	1 x 95	J 1H95	ISO 25 o 3/4"	RN/ * /1 H 95			
1 H 120	1 x 120	K 1H120	ISO32 o 1"	RN/ * /1 H 120			
1 H 150	1 x 150	K 1H150	ISO32 o 1"	RN/ * /1 H 150			
1 H 185	1 x 185	K 1H185	ISO32 o 1"	RN/ * /1 H 185			
1 H 240	1 x 240	M 1H240	ISO 40 o 1-1/4"	RN/ * /1 H 240			
2 H 1.5	2 x 1.5	G 2H1.5	1/2" o ISO 20	RN/ * /2 H 1.5	GFT 2H1.5		
2 H 2.5	2 x 2.5	G 2H2.5	1/2" o ISO 20	RN/ * /2 H 2.5	GFT 2H2.5		
2 H 4	2 x 4	G 2H4	1/2" o ISO 20	RN/ * /2 H 4	JFT 2H4	ISO 25 o 3/4"	RNT/ * /2 H 4
2 H 6	2 x 6	G 2H6	1/2" o ISO 20	RN/ * /2 H 6	JFT 2H6	ISO 25 o 3/4"	RNT/ * /2 H 6
2 H 10	2 x 10	J 2H10	ISO 25 o 3/4"	RN/ * /2 H 10	KFT 2H10	ISO32 o 1"	RNT/ * /2 H 10
2 H 16	2 x 16	J 2H16	ISO 25 o 3/4"	RN/ * /2 H 16	MFT 2H16	ISO 40 o 1-1/4"	RNT/ * /2 H 16
2 H 25	2 x 25	K 2H25	ISO32 o 1"	RN/ * /2 H 25	MFT 2H25	ISO 40 o 1-1/4"	RNT/ * /2 H 25
3 H 1.5	3 x 1.5	G 3H1.5	1/2" o ISO 20	RN/ * /3 H 1.5	GFT 3H1.5		
3 H 2.5	3 x 2.5	G 3H2.5	1/2" o ISO 20	RN/ * /3 H 2.5	JFT 3H2.5	ISO 25 o 3/4"	RNT/ * /3 H 2.5
3 H 4	3 x 4	G 3H4	1/2" o ISO 20	RN/ * /3 H 4	JFT 3H4	ISO 25 o 3/4"	RNT/ * /3 H 4
3 H 6	3 x 6	J 3H6	ISO 25 o 3/4"	RN/ * /3 H 6	JFT 3H6		
3 H 10	3 x 10	J 3H10	ISO 25 o 3/4"	RN/ * /3 H 10	KFT 3H10	ISO32 o 1"	RNT/ * /3 H 10
3 H 16	3 x 16	J 3H16	ISO 25 o 3/4"	RN/ * /3 H 16	MFT 3H16	ISO 40 o 1-1/4"	RNT/ * /3 H 16
3 H 25	3 x 25	M 3H25	ISO 40 o 1-1/4"	RN/ * /3 H 25	MFT 3H25		
4 H 1.5	4 x 1.5	G 4H1.5	1/2" o ISO 20	RN/ * /4 H 1.5	GFT 4H1.5		
4 H 2.5	4 x 2.5	G 4H2.5	1/2" o ISO 20	RN/ * /4 H 2.5	JFT 4H2.5	ISO 25 o 3/4"	RNT/ * /4 H 2.5
4 H 4	4 x 4	J 4H4	ISO 25 o 3/4"	RN/ * /4 H 4	JFT 4H4		
4 H 6	4 x 6	J 4H6	ISO 25 o 3/4"	RN/ * /4 H 6	KFT 4H6	ISO32 o 1"	RNT/ * /4 H 6

RN CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code(*)**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
4 H 10	4 x 10	J 4H10	ISO 25 o 3/4"	RN/ * /4 H 10	KFT 4H10	ISO32 o 1"	RNT/ * /4 H 10
4 H 16	4 x 16	K 4H16	ISO32 o 1"	RN/ * /4 H 16	MFT 4H16	ISO 40 o 1-1/4"	RNT/ * /4 H 16
4 H 25	4 x 25	M 4H25	ISO 40 o 1-1/4"	RN/ * /4 H 25	MFT 4H25		
7 H 1.5	7 x 1.5	J 7H1.5	ISO 25 o 3/4"	RN/ * /7 H 1.5	JFT 7H1.5		
7 H 2.5	7 x 2.5	J 7H2.5	ISO 25 o 3/4"	RN/ * /7 H 2.5	JFT 7H2.5		
12 H 1.5	12 x 1.5	J 12H1.5	ISO 25 o 3/4"	RN/ * /12 H 1.5			
12 H 2.5	12 x 2.5	K 12H2.5	ISO32 o 1"	RN/ * /12 H 2.5			
19 H 1.5	19 x 1.5	M 19H1.5	ISO 40 o 1-1/4"	RN/ * /19 H 1.5			

(*) Gland code:



"RAD ISO" CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
2 L 1	2 x 1	G 2L1	ISO 20	ISO 20 - 2 L 1	GFT 2L1	ISO 20	ISO 20 - 2 L 1
2 L 1.5	2 x 1.5	G 2L1.5	ISO 20	ISO 20 - 2 L 1.5	GFT 2L1.5	ISO 20	ISO 20 - 2 L 1.5
2 L 2.5	2 x 2.5	G 2L2.5	ISO 20	ISO 20 - 2 L 2.5	GFT 2L2.5	ISO 20	ISO 20 - 2 L 2.5
2 L 4	2 x 4	G 2L4	ISO 20	ISO 20 - 2 L 4	GFT 2L4	ISO 20	ISO 20 - 2 L 4
3 L 1	3 x 1	G 3L1	ISO 20	ISO 20 - 3 L 1	GFT 3L1	ISO 20	ISO 20 - 3 L 1
3 L 1.5	3 x 1.5	G 3L1.5	ISO 20	ISO 20 - 3 L 1.5	GFT 3L1.5	ISO 20	ISO 20 - 3 L 1.5
3 L 2.5	3 x 2.5	G 3L2.5	ISO 20	ISO 20 - 3 L 2.5	GFT 3L2.5	ISO 20	ISO 20 - 3 L 2.5
4 L 1	4 x 1	G 4L1	ISO 20	ISO 20 - 4 L 1	GFT 4L1	ISO 20	ISO 20 - 4 L 1
4 L 1.5	4 x 1.5	G 4L1.5	ISO 20	ISO 20 - 4 L 1.5	GFT 4L1.5	ISO 20	ISO 20 - 4 L 1.5
4 L 2.5	4 x 2.5	G 4L2.5	ISO 20	ISO 20 - 4 L 2.5	GFT 4L2.5	ISO 20	ISO 20 - 4 L 2.5
7 L 1	7 x 1	J 7L1	ISO 25	ISO 25 - 7 L 1	JFT 7L1	ISO 25	ISO 25 - 7 L 1
7 L 1.5	7 x 1.5	J 7L1.5	ISO 25	ISO 25 - 7 L 1.5	JFT 7L1.5	ISO 25	ISO 25 - 7 L 1.5
7 L 2.5	7 x 2.5	J 7L2.5	ISO 25	ISO 25 - 7 L 2.5	JFT 7L2.5	ISO 25	ISO 25 - 7 L 2.5
1 H 1.5	1 x 1.5	G 1H1.5	ISO 20	ISO 20 - 1 H 1.5	GFT 1H1,5	ISO 20	ISO 20 - 1 H 1.5
1 H 2.5	1 x 2.5	G 1H2.5	ISO 20	ISO 20 - 1 H 2.5	GFT 1H2.5	ISO 20	ISO 20 - 1 H 2.5
1 H 4	1 x 4	G 1H4	ISO 20	ISO 20 - 1 H 4	GFT 1H4	ISO 20	ISO 20 - 1 H 4
1 H 6	1 x 6	G 1H6	ISO 20	ISO 20 - 1 H 6	GFT 1H6	ISO 20	ISO 20 - 1 H 6
1 H 10	1 x 10	G 1H10	ISO 20	ISO 20 - 1 H 10	JFT 1H10	ISO 25	ISO 25T - 1 H 10
1 H 16	1 x 16	G 1H16	ISO 20	ISO 20 - 1 H 16	JFT 1H16	ISO 25	ISO 25T - 1 H 16
1 H 25	1 x 25	G 1H25	ISO 20	ISO 20 - 1 H 25	KFT 1H25	ISO 32	ISO 32T - 1 H 25
1 H 35	1 x 35	G 1H35	ISO 20	ISO 20 - 1 H 35	KFT 1H35	ISO 32	ISO 32T - 1 H 35
1 H 50	1 x 50	J 1H50	ISO 25	ISO 25 - 1 H 50	MFT 1H50	ISO 40	ISO 40T - 1 H 50
1 H 70	1 x 70	J 1H70	ISO 25	ISO 25 - 1 H 70			
1 H 95	1 x 95	J 1H95	ISO 25	ISO 25 - 1 H 95			
1 H 120	1 x 120	K 1H120	ISO 32	ISO 32 - 1 H 120			
1 H 150	1 x 150	K 1H150	ISO 32	ISO 32 - 1 H 150			
1 H 185	1 x 185	K 1H185	ISO 32	ISO 32 - 1 H 185			
1 H 240	1 x 240	M 1H240	ISO 40	ISO 40 - 1 H 240			
1 H 300	1 x 300		ISO 40	ISO 40 - 1 H 300			
1 H 400	1 x 400		ISO 40	ISO 40 - 1 H 400			
2 H 1.5	2 x 1.5	G 2H1.5	ISO 20	ISO 20 - 2 H 1.5	GFT 2H1.5	ISO 20	ISO 20 - 2 H 1.5
2 H 2.5	2 x 2.5	G 2H2.5	ISO 20	ISO 20 - 2 H 2.5	GFT 2H2.5	ISO 20	ISO 20 - 2 H 2.5
2 H 4	2 x 4	G 2H4	ISO 20	ISO 20 - 2 H 4	JFT 2H4	ISO 25	ISO 25T - 2 H 4
2 H 6	2 x 6	G 2H6	ISO 20	ISO 20 - 2 H 6	JFT 2H6	ISO 25	ISO 25T - 2 H 6
2 H 10	2 x 10	J 2H10	ISO 25	ISO 25 - 2 H 10	KFT 2H10	ISO 32	ISO 32T - 2 H 10
2 H 16	2 x 16	J 2H16	ISO 25	ISO 25 - 2 H 16	MFT 2H16	ISO 40	ISO 40T - 2 H 16
2 H 25	2 x 25	K 2H25	ISO 32	ISO 32 - 2 H 25	MFT 2H25	ISO 40	ISO 40T - 2 H 25
3 H 1.5	3 x 1.5	G 3H1.5	ISO 20	ISO 20 - 3 H 1.5	GFT 3H1.5	ISO 20	ISO 20 - 3 H 1.5
3 H 2.5	3 x 2.5	G 3H2.5	ISO 20	ISO 20 - 3 H 2.5	JFT 3H2.5	ISO 25	ISO 25T - 3 H 2.5
3 H 4	3 x 4	G 3H4	ISO 20	ISO 20 - 3 H 4	JFT 3H4	ISO 25	ISO 25T - 3 H 4
3 H 6	3 x 6	J 3H6	ISO 25	ISO 25 - 3 H 6	JFT 3H6	ISO 25	ISO 25 - 3 H 6
3 H 10	3 x 10	J 3H10	ISO 25	ISO 25 - 3 H 10	KFT 3H10	ISO 32	ISO 32T - 3 H 10
3 H 16	3 x 16	J 3H16	ISO 25	ISO 25 - 3 H 16	MFT 3H16	ISO 40	ISO 40T - 3 H 16
3 H 25	3 x 25	M 3H25	ISO 40	ISO 40 - 3 H 25	MFT 3H25	ISO 40	ISO 40 - 3 H 25
4 H 1.5	4 x 1.5	G 4H1.5	ISO 20	ISO 20 - 4 H 1.5	GFT 4H1.5	ISO 20	ISO 20 - 4 H 1.5
4 H 2.5	4 x 2.5	G 4H2.5	ISO 20	ISO 20 - 4 H 2.5	JFT 4H2.5	ISO 25	ISO 25T - 4 H 2.5
4 H 4	4 x 4	J 4H4	ISO 25	ISO 25 - 4 H 4	JFT 4H4	ISO 25	ISO 25 - 4 H 4
4 H 6	4 x 6	J 4H6	ISO 25	ISO 25 - 4 H 6	KFT 4H6	ISO 32	ISO 32T - 4 H 6

"RAD ISO" CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
4 H 10	4 x 10	J 4H10	ISO 25	ISO 25 - 4 H 10	KFT 4H10	ISO 32	ISO 32T - 4 H 10
4 H 16	4 x 16	K 4H16	ISO 32	ISO 32 - 4 H 16	MFT 4H16	ISO 40	ISO 40T - 4 H 16
4 H 25	4 x 25	M 4H25	ISO 40	ISO 40 - 4 H 25	MFT 4H25	ISO 40	ISO 40 - 4 H 25
7 H 1.5	7 x 1.5	J 7H1.5	ISO 25	ISO 25 - 7 H 1.5	JFT 7H1.5	ISO 25	ISO 25 - 7 H 1.5
7 H 2.5	7 x 2.5	J 7H2.5	ISO 25	ISO 25 - 7 H 2.5	JFT 7H2.5	ISO 25	ISO 25 - 7 H 2.5
12 H 1.5	12 x 1.5	J 12H1.5	ISO 32	ISO 32 - 12 H 1.5			
12 H 2.5	12 x 2.5	K 12H2.5	ISO 32	ISO 32 - 12 H 2.5			
19 H 1.5	19 x 1.5	M 19H1.5	ISO 40	ISO 40 - 19 H 1.5			

xxx Cable Glands that for housing seals with ground wire are supplied with increased dimensions.

"RAD GAS" CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
2 L 1	2 x 1	G 2L1	RAD G 1/2"	RAD G 1/2" - 2 L 1	GFT 2L1	RAD G 1/2"	RAD G 1/2" - 2 L 1
2 L 1.5	2 x 1.5	G 2L1.5	RAD G 1/2"	RAD G 1/2" - 2 L 1.5	GFT 2L1.5	RAD G 1/2"	RAD G 1/2" - 2 L 1.5
2 L 2.5	2 x 2.5	G 2L2.5	RAD G 1/2"	RAD G 1/2" - 2 L 2.5	GFT 2L2.5	RAD G 1/2"	RAD G 1/2" - 2 L 2.5
2 L 4	2 x 4	G 2L4	RAD G 1/2"	RAD G 1/2" - 2 L 4	GFT 2L4	RAD G 1/2"	RAD G 1/2" - 2 L 4
3 L 1	3 x 1	G 3L1	RAD G 1/2"	RAD G 1/2" - 3 L 1	GFT 3L1	RAD G 1/2"	RAD G 1/2" - 3 L 1
3 L 1.5	3 x 1.5	G 3L1.5	RAD G 1/2"	RAD G 1/2" - 3 L 1.5	GFT 3L1.5	RAD G 1/2"	RAD G 1/2" - 3 L 1.5
3 L 2.5	3 x 2.5	G 3L2.5	RAD G 1/2"	RAD G 1/2" - 3 L 2.5	GFT 3L2.5	RAD G 1/2"	RAD G 1/2" - 3 L 2.5
4 L 1	4 x 1	G 4L1	RAD G 1/2"	RAD G 1/2" - 4 L 1	GFT 4L1	RAD G 1/2"	RAD G 1/2" - 4 L 1
4 L 1.5	4 x 1.5	G 4L1.5	RAD G 1/2"	RAD G 1/2" - 4 L 1.5	GFT 4L1.5	RAD G 1/2"	RAD G 1/2" - 4 L 1.5
4 L 2.5	4 x 2.5	G 4L2.5	RAD G 1/2"	RAD G 1/2" - 4 L 2.5	GFT 4L2.5	RAD G 1/2"	RAD G 1/2" - 4 L 2.5
7 L 1	7 x 1	J 7L1	RAD G 3/4"	RAD G 3/4" - 7 L 1	JFT 7L1	RAD G 3/4"	RAD G 3/4" - 7 L 1
7 L 1.5	7 x 1.5	J 7L1.5	RAD G 3/4"	RAD G 3/4" - 7 L 1.5	JFT 7L1.5	RAD G 3/4"	RAD G 3/4" - 7 L 1.5
7 L 2.5	7 x 2.5	J 7L2.5	RAD G 3/4"	RAD G 3/4" - 7 L 2.5	JFT 7L2.5	RAD G 3/4"	RAD G 3/4" - 7 L 2.5
1 H 1.5	1 x 1.5	G 1H1.5	RAD G 1/2"	RAD G 1/2" - 1 H 1.5	GFT 1H1,5		
1 H 2.5	1 x 2.5	G 1H2.5	RAD G 1/2"	RAD G 1/2" - 1 H 2.5	GFT 1H2.5		
1 H 4	1 x 4	G 1H4	RAD G 1/2"	RAD G 1/2" - 1 H 4	GFT 1H4		
1 H 6	1 x 6	G 1H6	RAD G 1/2"	RAD G 1/2" - 1 H 6	GFT 1H6		
1 H 10	1 x 10	G 1H10	RAD G 1/2"	RAD G 1/2" - 1 H 10	JFT 1H10	RAD G 3/4"	RAD G 3/4" T- 1 H 10
1 H 16	1 x 16	G 1H16	RAD G 1/2"	RAD G 1/2" - 1 H 16	JFT 1H16	RAD G 3/4"	RAD G 3/4" T- 1 H 16
1 H 25	1 x 25	G 1H25	RAD G 1/2"	RAD G 1/2" - 1 H 25	KFT 1H25	RAD G 1"	RAD G 1" T- 1 H 25
1 H 35	1 x 35	G 1H35	RAD G 3/4"	RAD G 3/4" - 1 H 35	KFT 1H35	RAD G 1"	RAD G 1" T- 1 H 35
1 H 50	1 x 50	J 1H50	RAD G 3/4"	RAD G 3/4" - 1 H 50	MFT 1H50	RAD G 1-1/4"	RAD G 1-1/4" T- 1 H 50
1 H 70	1 x 70	J 1H70	RAD G 3/4"	RAD G 3/4" - 1 H 70			
1 H 95	1 x 95	J 1H95	RAD G 1"	RAD G 1" - 1 H 95			
1 H 120	1 x 120	K 1H120	RAD G 1"	RAD G 1" - 1 H 120			
1 H 150	1 x 150	K 1H150	RAD G 1-1/4"	RAD G 1-1/4" - 1 H 150			
1 H 185	1 x 185	K 1H185	RAD G 1-1/4"	RAD G 1-1/4" - 1 H 185			
1 H 240	1 x 240	M 1H240	RAD G 1-1/4"	RAD G 1-1/4" - 1 H 240			
1 H 300	1 x 300		RAD G 1-1/4"	RAD G 1-1/4" - 1 H 300			
1 H 400	1 x 400		RAD G 1-1/4"	RAD G 1-1/4" - 1 H 400			
2 H 1.5	2 x 1.5	G 2H1.5	RAD G 1/2"	RAD G 1/2" - 2 H 1.5	GFT 2H1.5		
2 H 2.5	2 x 2.5	G 2H2.5	RAD G 1/2"	RAD G 1/2" - 2 H 2.5	GFT 2H2.5		
2 H 4	2 x 4	G 2H4	RAD G 1/2"	RAD G 1/2" - 2 H 4	JFT 2H4	RAD G 3/4"	RAD G 3/4" T- 2 H 4
2 H 6	2 x 6	G 2H6	RAD G 3/4"	RAD G 3/4" - 2 H 6	JFT 2H6		
2 H 10	2 x 10	J 2H10	RAD G 3/4"	RAD G 3/4" - 2 H 10	KFT 2H10	RAD G 1"	RAD G 1" T- 2 H 10
2 H 16	2 x 16	J 2H16	RAD G 3/4"	RAD G 3/4" - 2 H 16	MFT 2H16	RAD G 1-1/4"	RAD G 1-1/4" T- 2 H 16
2 H 25	2 x 25	K 2H25	RAD G 1"	RAD G 1" - 2 H 25	MFT 2H25	RAD G 1-1/4"	RAD G 1-1/4" T- 2 H 25
3 H 1.5	3 x 1.5	G 3H1.5	RAD G 1/2"	RAD G 1/2" - 3 H 1.5	GFT 3H1.5		
3 H 2.5	3 x 2.5	G 3H2.5	RAD G 1/2"	RAD G 1/2" - 3 H 2.5	JFT 3H2.5		
3 H 4	3 x 4	G 3H4	RAD G 3/4"	RAD G 3/4" - 3 H 4	JFT 3H4		
3 H 6	3 x 6	J 3H6	RAD G 3/4"	RAD G 3/4" - 3 H 6	JFT 3H6		
3 H 10	3 x 10	J 3H10	RAD G 3/4"	RAD G 3/4" - 3 H 10	KFT 3H10		
3 H 16	3 x 16	J 3H16	RAD G 1"	RAD G 1" - 3 H 16	MFT 3H16	RAD G 1-1/4"	RAD G 1-1/4" T- 3 H 16
3 H 25	3 x 25	M 3H25	RAD G 1-1/4"	RAD G 1-1/4" - 3 H 25	MFT 3H25		
4 H 1.5	4 x 1.5	G 4H1.5	RAD G 1/2"	RAD G 1/2" - 4 H 1.5	GFT 4H1.5		
4 H 2.5	4 x 2.5	G 4H2.5	RAD G 3/4"	RAD G 3/4" - 4 H 2.5	JFT 4H2.5		
4 H 4	4 x 4	J 4H4	RAD G 3/4"	RAD G 3/4" - 4 H 4	JFT 4H4		
4 H 6	4 x 6	J 4H6	RAD G 3/4"	RAD G 3/4" - 4 H 6	KFT 4H6	RAD G 1"	RAD G 1" T- 4 H 6

"RAD GAS" CABLE GLANDS AND SEALS USED WITH MICO CABLES							
Cable Code	**Nr. of Conductors x Section (mm^2)**	**Plain Seal**	**Gland Type**	**Gland Code**	**Seal with Ground wire**	**Gland Type** (ground wire)	**Gland Code** (ground wire)
4 H 10	4 x 10	J 4H10	RAD G 1"	RAD G 1" - 4 H 10	KFT 4H10		
4 H 16	4 x 16	K 4H16	RAD G 1"	RAD G 1" - 4 H 16	MFT 4H16	RAD G 1-1/4"	RAD G 1-1/4" T- 4 H 16
4 H 25	4 x 25	M 4H25	RAD G 1-1/4"	RAD G 1-1/4" - 4 H 25	MFT 4H25		
7 H 1.5	7 x 1.5	J 7H1.5	RAD G 3/4"	RAD G 3/4" - 7 H 1.5	JFT 7H1.5		
7 H 2.5	7 x 2.5	J 7H2.5	RAD G 3/4"	RAD G 3/4" - 7 H 2.5	JFT 7H2.5		
12 H 1.5	12 x 1.5	J 12H1.5	RAD G 3/4"	RAD G 3/4" - 12 H 1.5			
12 H 2.5	12 x 2.5	K 12H2.5	RAD G 1-1/4"	RAD G 1-1/4" - 12 H 2.5			
19 H 1.5	19 x 1.5	M 19H1.5	RAD G 1-1/4"	RAD G 1-1/4" - 19 H 1.5			

xxx Cable Glands that for housing seals with ground wire are supplied with increased dimensions.

5.3.2 Seal kits

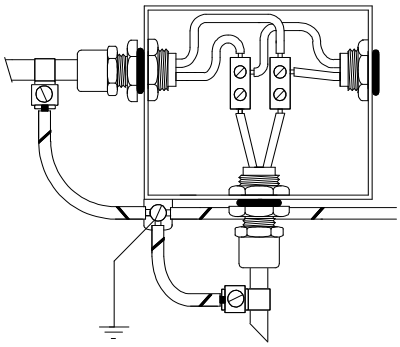
The seal is used to permanently inhibit the absorption of moisture by the insulation of the cable (magnesium oxide); the components of the seal are:

- brass cup;
- spacers of conductors;
- sealant;
- insulating sheaths.

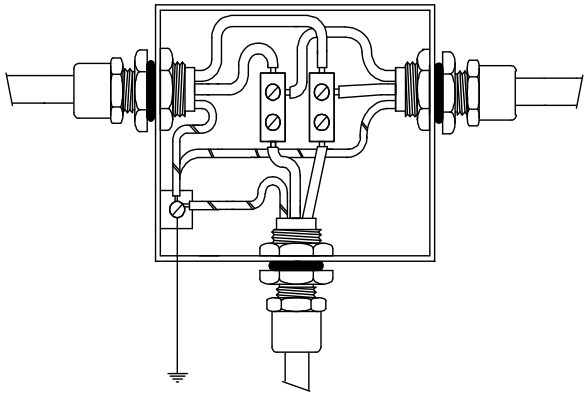
BRASS CUP

The cup body is constituted by a cable body made of brass with self-tapping base of variable diameter depending on the diameter of the cable, for screwing on the outer sheath of the cable in copper; there are the three types of cup available.

- **Standard**: with this kind of cup is necessary to use a suitable copper staple for connecting the outer sheath of the cable, which performs the the protective ground conductor, with the ground terminal of the distribution box; they are not available for cables 1H300 and 1H400.



- **With ground wire**: this kind of glass is provided with a copper wire of an appropriate section (as per standard CEI 64-8 / 5 par. 543.1.2) welded on the bottom that allows you to bring directly inside the box the earth conductor (outer sheath); they are not available for unipolar cables from 70 mm² up to 400 mm² and for cables to 24:19 conductors. Such seal type is particularly suitable in electrical plants where the aesthetic factor is of particular importance.



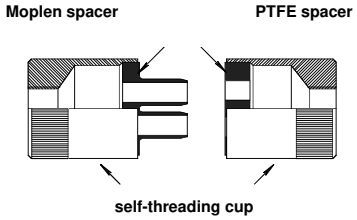
Both types are supplied complete with everything needed (spacers, insulation and sealant sheath) and four different sizes are provided (which, for the correct supply, must follow the cable type); in the following table are the codes are indicated, the size and the number of parts contained in a package.

Cup type		Dimensions (mm)		Packs
Standard	With groung wire	Ø	hight	(N° pieces)
XG	XGFT	14,9	16,7	10
XJ	XJFT	21,2	25,4	2
XK	XKFT	26,8	31,7	2
XM	XMFT	33,0	34,0	2

- **Heat shrinking**: this kind of cup is used, normally, only for unipolar cables; is constituted by a sleeve of heat-shrinking tube with double wall, with length of approximately 70 mm; during the closing operation of the cable the inner sheath under the action of heat melts, sealing consequently the cable.

SPACER

The spacer is supplied together with the cup and is made of a printed disc in plastic polymer; its function is to space the conductors and at the same time to prevent the leakage of the sealant; as a function of operating temperature of cables are provided two types of spacers: one in Moplen, of black color for operating temperatures up to 105 ° C; the other one in natural color PTFE for operating temperatures up to 250 ° C.



SEALANT

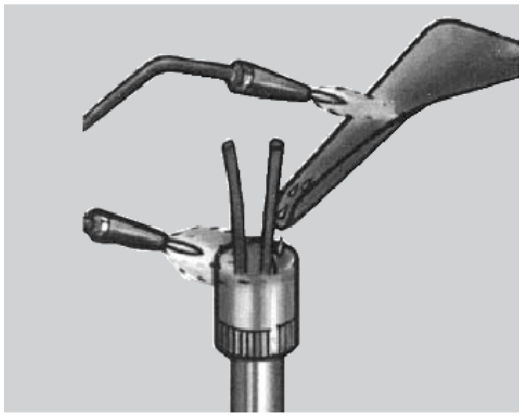
Four types of sealant are provided as a function of the system operating temperature:

- **CS**: is an insulating paste in packs of 100 g and is suitable for operating temperatures up to 135 ° C;
- **HT**: is a two component sealant (binder + hardener) contained in tubes of 100 g and is suitable for operating temperatures up to 185 ° C;
- **HT/W**: is a silicone dielectric grease contained in tubes of 100 g and is suitable for continuous operating temperatures of up to 185 ° C;
- **GF**: is a granulated glass fiber-based packed in metal pipes of 100 g and is suitable for operating temperatures up to 250 ° C.

The table below shows the number of terminations that can be performed with a pack of 100 g of the sealants described above.

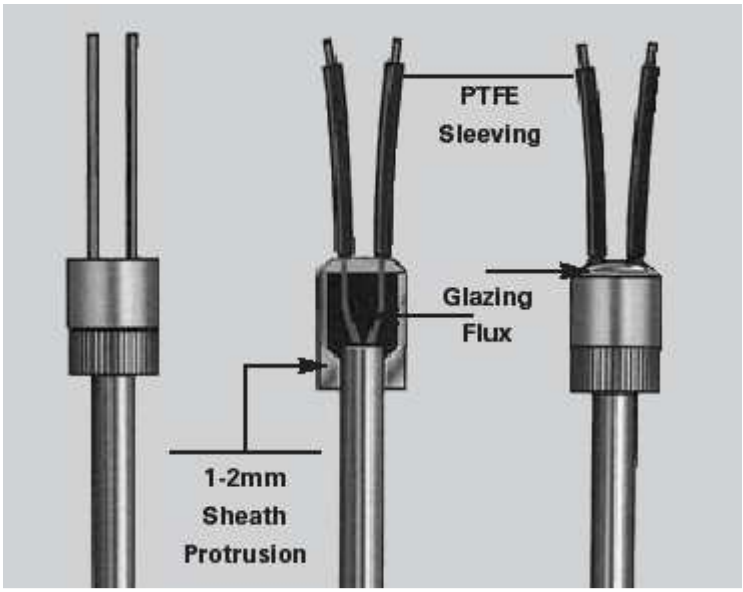
Seal Type	N° of terminations that can be performed with a sealant pack of 100 g
G-GFT	36
J-JFT	12
K-KFT	6
M-MFT	2

- **Positioning Glanzing Flux (GF) sealant**
  - Using a torch, heat the cable up to a pale red color, approximately 150 mm from the cup, making the heat flow through the seal.
  - Pour the Glazing Flux in the center of a metal blade (see figure below) and juxtapose to the conductor , just above the cup.
  - Heat the cup, the conductors and the tip of the blade simultaneously. As soon as the Glazing Flux begins to melt, slightly tilt the blade to direct the molten liquid inside the cup (see figure below).
  - The cup should be filled slowly, allowing the sealant to cool and solidify progressively from the bottom, ensuring excellent adhesion to the seal and to the conductors and reducing the volume near the surface.
  - For the G seal, fill up to the top of the cup. For all other measures of seals, fill up to form a dome. Bring to melt the sealant to the surface if there is a reduction in volume.
  - The formation of bubbles through the sealant indicates that the cable has been insufficiently heated before the filling described above. If this should occur, the final stretch of the cable adjacent to the cup must be heated while the sealant is maintained in a fluid state until the bubbles cease.



- - For the G terminal, insert the ceramic spacer on the conductors. Heat the spacer and the surface of Glazing Flux and, at the same time, caulk with a screw tool until the spacer flange is at level with the rim of the cup. The sealant should escape from the holes above the surface thanks to the heat of the spacer. If necessary, it is possible to encourage this phenomenon by applying more sealant on the surface, but avoiding excesses.
- - Wrap the insulating PTFE tape around the conductors exposed to the ceramic spacer or in contact with the dome of Glazing Flux. The sheath must be secured in position with a wire weave around the end of the conductor.
- - One of the constituents of the sealant is lead oxide that can be reduced and thus form free of lead globules, in the case of excessive heat is applied with a reducing flame. For this reason, with greater than 50 mm2 unipolar cables they should be taken further precautions, always using oxidizing flames (characterized by short internal cones)
- - With this sealant you should always avoid the application of harmful mechanical stress, such as those originating from incorrect manipulation of the ends of conductors. This could give rise to breakage (cracking) of the relatively fragile glass poured between the conductors.

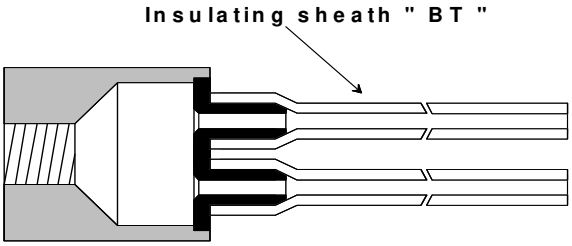
The Glazing Flux powder that is melted and poured into the seals to realize the insulation to 250 ° C contains lead compounds. It must be kept in a dry environment and avoidhigh temperatures. Adequate ventilation should be provided so that the vapors can not be inhaled.



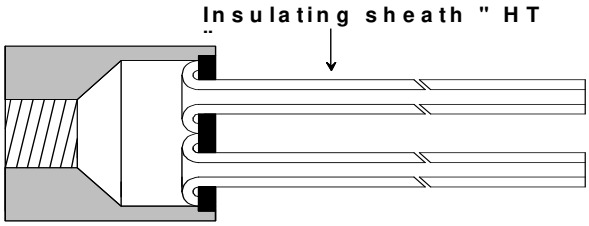
INSULATING SHEATHS

Insulating sheaths have the purpose to isolate the conductors of the cable coming out from the spacer; as a function of the operating temperature three types of sheath are provided.

- **BT**: PVC jackets are fire retardant (black BT / section cable code) for all sections of active conductors except of conductors 300 and 400 mm² and up to 25 mm² section for yellow / green terminals ground wire; they are supplied in coils of 3 m and are suitable for maximum operating temperatures of 105 ° C; the sheath clips are threaded onto the conductors and then forced slightly on the spacer.



- **HT**: They are made of PTFE (HT / section cable code) and are indicated when the system operating temperature is higher than 105 ° C; they are supplied in lengths of 30 or 120 cm; this type of sheath must be introduced through the holes of the spacer, and then beaded (as shown in the following figure) to prevent it from shifting as indicated below.



- **Heatshrinkable**: is necessary for the conductors of cables 1H300 and 1H400; their implementation is described later. This sheath type is also used as a terminal for all unipolar cables; is constituted by a sleeve of double wall heat-shrink tubing, with length of approximately 70 mm; during the closing operation of the cable the inner sheath under the action of heat melts sealing consequently the cable.

Here are described the procedures for the proper execution of the terminations; these are simple operations, but require attention from operators.

5.4 Termination execution

5.4.1 Preliminary test of the insulation resistance

As previously indicated each coil of cable is controlled and sealed to maintain unchanged over time the insulation resistance; however, before starting the instalation operation of the seal is good rule to cut approximately 10 cm of cable from both ends; thereafter it must be controlled, via a megohmmeter with a voltage imposed between the sheath and the conductors of 500 V DC, the insulation resistance whose value must be greater than 100 MΩ.

It may happen that some cable present a resistance of less than 100 MΩ isolation (also about MΩ 5); in this case you can still proceed with the execution of the termination because, as subsequently shown, the value of the insulation resistance will assume the value required after 5÷10 minutes.

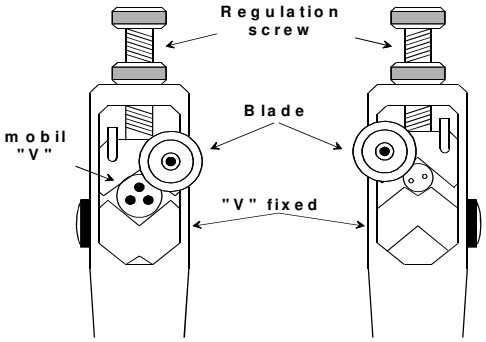
5.4.2 Specific tools

Use only KME accessories for installation and terminations execution.

The operation takes place in three phases during which only two specific tools are needed in addition to those forming part of the operator's normal kit, visible in the figure below.

STRIPPER

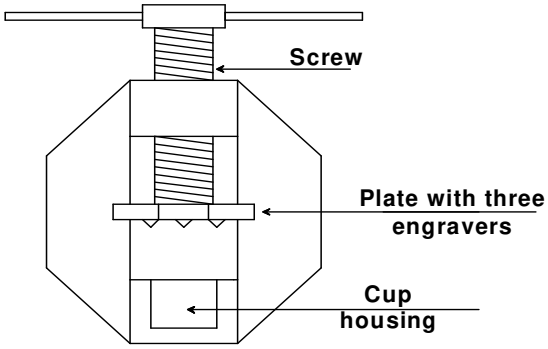
It is a tool necessary to remove the cable sheath to make the conductors available for subsequent operations and is usable on mineral insulated cables up to the section of 185 mm²; is composed of two opposing "V" blocks, one of which is fixed (positioned in two different orientations depending on the Diameter of the cable) and the other is movable, adjustable in height with of a screw, carrying the blade to cut the sheath in the copper cable.



CRIMPING TOOL FOR CUP/SPACER

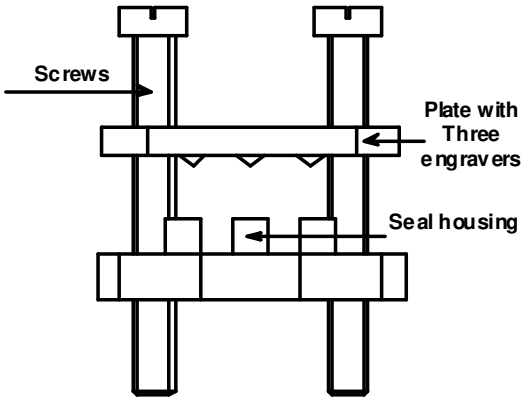
To make integral the spacer with the brass cup is necessary to use this tool which, with a plate equipped with three engravers arranged at 120 ° from each other and adjustable in height, allows to drill three incisions on the edge of the cup preventing the escape of the spacer; three types of tool are available, as a function of the size of the terminal.

- **Type G and J/K**



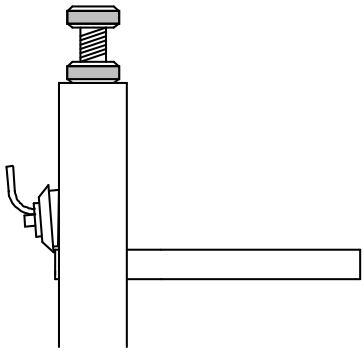
The screw J / K tool is accompanied by a reduction sleeve (for the terminal housing) and a engraving plate for Type J terminals.

- **Type M** for type M seals

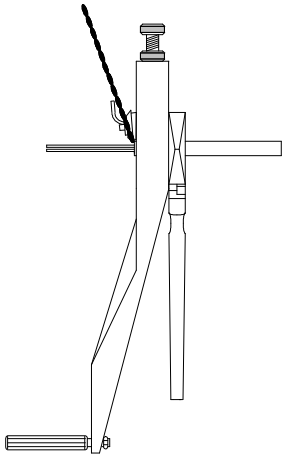


5.4.3 Preparation of the ends of the cables

- Cut the end of the cable to terminate by a small saw (approx 1 cm);
- place the stripper on the cable and tighten it: the blade must be in contact with the copper outer sheath and the V shaped clamp must be tightened on the cable by its screw, so to let the tool spin round with the cable without stopping it.;



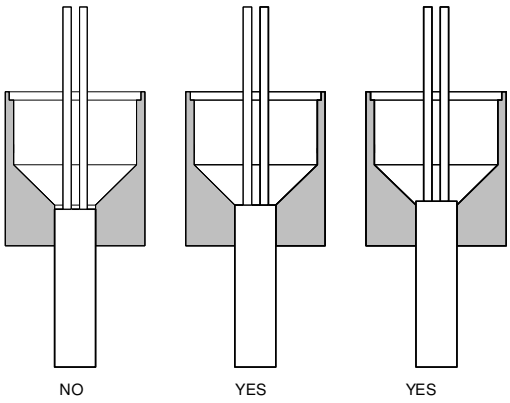
- start rotating the tool pushing it towards the inner part of the cable;
- avoid the rolling up of the copper shaving on the conductors, fixing it on the suitable hook.
- when you have stripped enough copper sheath, you can insert the pliers to cause the drop of the copper shaving.



5.4.4 Seal mounting

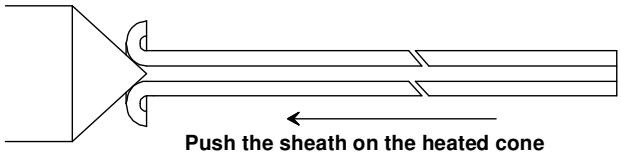
Only if installed in zones with potentially explosive atmospheres the cable glands, shall bemarked ATEX or IECEx.

- Remove from the conductors the Magnesium Oxide shattered during previous operation.
- Insert the gland on the cable.
- Revive the edge of the sheath and remove any burrs.
- Screw with pliers or with a special tool (wrench pot) the brass cup on the cable, taking care that is axis; the cup must be screwed up to match or as or slightly exceed the cable edge with the inner edge of the hole.

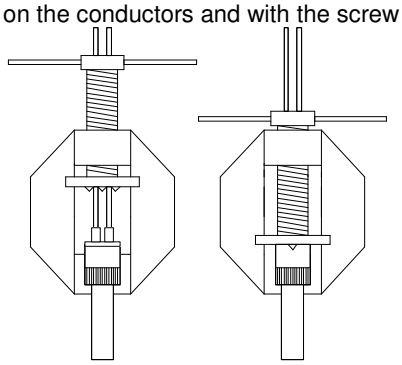


- Remove from the brass cup the Magnesium Oxide shattered during previous operation;
- Slightly stretch conductors with a pair of pliers;
- Fill the cup with the sealant; this must always be introduced on the same side thus avoiding the formation of air bubbles; it is considered essential to fill the cup with an excessive amount of sealant.

- As described above applies to the sealant CS, HT and HT / W; with regard to the GF sealant operate as reported on p. 56 regarding the installation of the sealant Glanzing Flux (GF).
- Insert the spacer on the conductors, in the case of using the sealant CS and BT sheaths with the spacer in Moplen, and pressing it with the appropriate tool on the cup up to practice the three fixing incisions.
  When using other types of sealant (HT, HT / W and GF) together with the spacer in PTFE, the corresponding sheaths must be bordered as already shown, and then threaded through the holes in the spacer; the PTFE sheaths can be edged using a cone suitably heated with a torch or electrically as shown in the following figure;

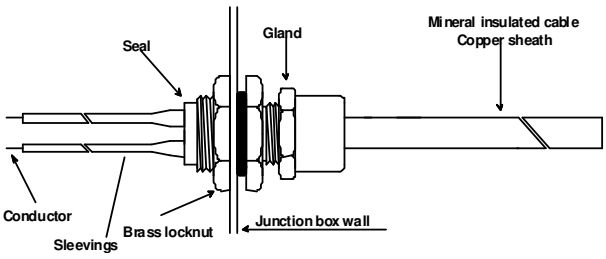


- Then insert the spacer with the sheaths on the conductors and with the screw tool press it on the cup.

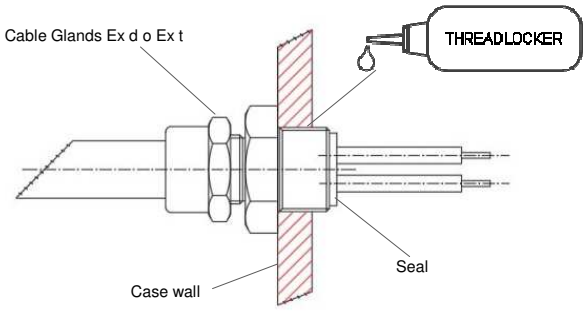


- Pull the cable with the glass from the tool and eliminate the sealant spilled during compression;
- Insert the insulating sheaths on the conductors up to overcome the spacer.

EXAMPLE OF "RN" CABLE GLANDS/ENCLOSURE JOINTING



EXAMPLE OF "RAD" CABLE GLANDS/ENCLOSURE JOINTING



5.4.5 Test of the insulation resistance before installation

After the terminal mounting operation on the two ends of the cable, it must be made of the insulation resistance control; are two possible scenarios:

1) the terminal has been performed on the cable that had an insulation resistance >100 MΩ; if the termination has been well performed the megohmmeter will indicate a value of resistance of >100 MΩ isolation.

2) the terminal has been performed on the cable that had a resistance of <100 MΩ insulation; in this case you might encounter an insulation resistance value <100 MΩ (also 1÷5 MΩ), but if the termination has been well performed after 5÷10 minutes the value of the insulation resistance will assume a much higher value 100 MΩ.

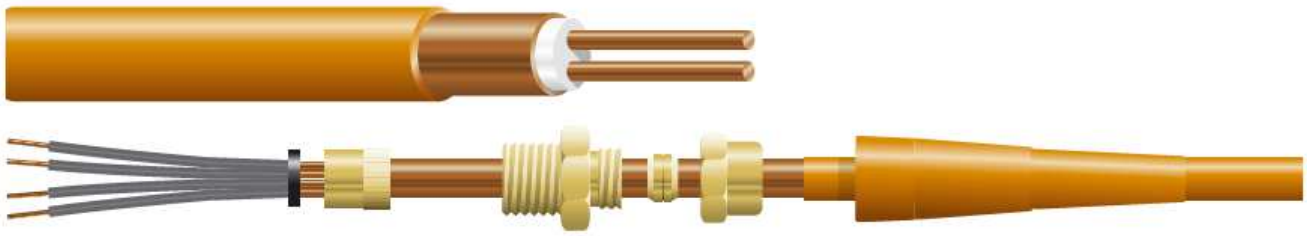
5.4.6 Test of the insulation resistance after installation

Rarely can occur, during the final testing of the system, to find a low insulation of the system due to a not well executed termination; in this case proceed as follows:

- identify the defective termination;
- Remove the termination;
- eliminate the residual sealant removing 2÷3 mm sheath with the appropriate tool;
- restore the insulation resistance as previously indicated;
- again proceed to the assembly of the termination as described above.

5.4.7 Positioning the seal on cable MICO with LSF sheath

The operations described in the previous paragraph refer to the assembly of a terminal on mineral insulated cable with bare copper sheath, but in particular environments, where it is advisable to put into practice the cable MICO with additional LSF sheath, it is essential to use a PVC cone.

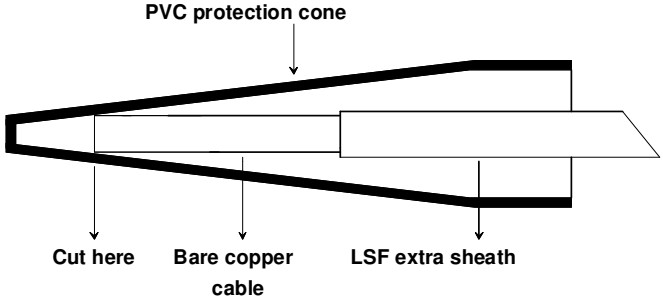


Cable with LSF sheath

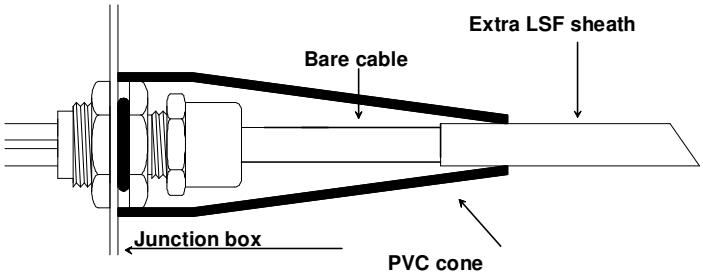
The cone is used to restore the additional protection (up to the connection box) on that part of the cable which is released from the coating to perform the seal assembly operations.

In this case the assembly operations of the terminal are the following:

- remove the extra LSF cover for a suitable length "L" for the execution of the operation; below we indicate the approximate value of the length "L" (including a length of conductors to be stripped of about 150 mm) for the various sizes of the termination:
  - ½" gland : mm 250;
  - ¾" gland : mm 250;
  - 1" gland : mm 260;
  - 1-¼" gland: mm 300;
- cut the end of the protective cone as shown in the following figure;



- insert the cut cone and insert it on the cable and repeat the operations described in the previous paragraph.



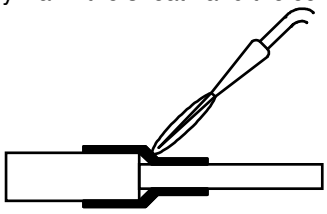
- There are four sizes of PVC cones according to the sizes of the terminations:
  - code CO1: for gland ½" (packs of 10 pieces);
  - code CO2: for gland ¾" (packs of 2 pieces);
  - code CO3 for gland 1" (packs of 2 pieces);
  - code CO4 for gland 1-¼" (packs of 2 pieces).

5.4.8 Shrinkable seal execution

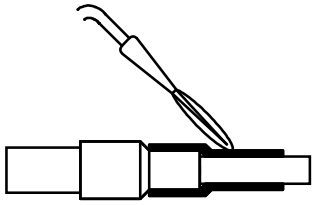
As already mentioned this type of seal is used for cables 1H300 and 1H400 (but can also be used for all other unipolar cables); for its assembly do not need nor the stripper nor the screw tool, but cutters and nippers.

The steps are as follows:

- incising the cable sheath to allow easy detachment of the chip; it is important that the sheath is engraved for about half of its thickness.
- remove, with a nippers, the cable sheath with a helical motion;
- check the cable insulation resistance as already described;
- clean with emery cloth the stripped conductor;
- eliminate any residue with a tip, which could compromise the functionality of the seal, deposited insulator uncovered;
- position the sleeve, having a variable length in function of the cable type, double-wall heat-shrink tubing on the cable and with a torch make it stick on the cable, taking care that the inner wall of the terminal is melted; to have the security that this happens is necessary to previously warm the sheath and the conductor;



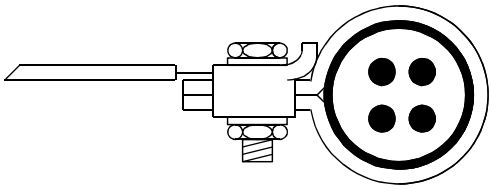
- insert the heat-shrink tubing double wall on the conductor and, with a torch, it adheres on the conductor itself and on the previously positioned seal.



5.5 Other accessories

5.5.1 Staples for the grounding of the sheath

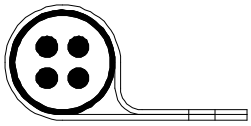
When not using the seal with the ground wire embedded it is necessary to use a suitable copper staple to perform the connection of the copper sheath, which has the function of protective conductor, with the ground terminal of the junction box.



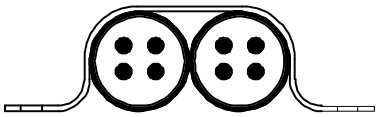
The general catalog is given for each type of cable the code of the corresponding grounding staple; each set of staples contains 10 pieces.

5.5.2 Staples and fixing tape

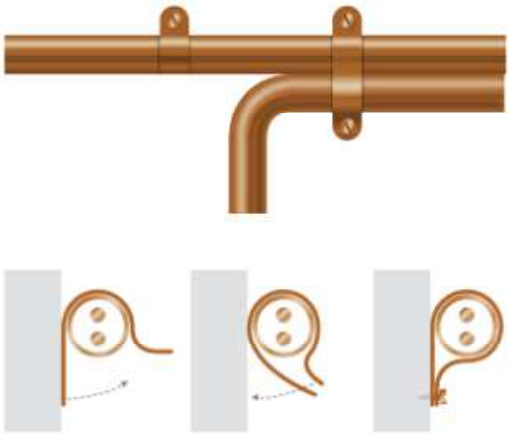
For each type of cable are available copper staples for fixing to the wall one or two cables of equal Diameter; both types of staples can be supplied in bare copper or copper LSF coated in packs of 50 pieces.



Staple for fixing one cable



Staple for fixing two cables



When it is necessary to fix cables of different diameter or more than two cables are available rolls of soft copper tape 12x0,8 mm in length 3 meters; such tape is provided with pre-drilled holes having the diameter of 4 mm and a pitch of 10 mm (code **CUM3**).

5.5.3 Locknuts

If you have a junction box with smooth holes, it is necessary, for the anchoring of the connector, a brass nut inside the box itself; the following table shows the codes for GAS and ISO thread locknuts, and the number of pieces for each package.

Locknut code	Ø thread.	Pieces for any package	Locknut code	Ø thread.	Pieces for any package
C1	½”	10	C1-20	M20x1,5	10
C2	¾”	2	C2-25	M25x1,5	2
C3	1”	2	C3-32	M32x1,5	2
C4	1-¼”	2	C4-40	M40x2	2

5.5.4 Sealed joints

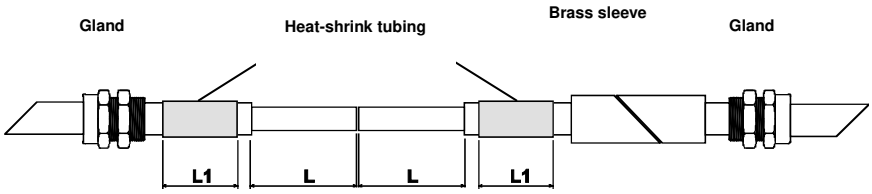
When it is necessary to join two sections of the same cable and can not be used for reasons of space a watertight box, it can be put into operation a sealed joint; the sealed joints kit are made in a different way if the cables are unipolar or multipolar.

SEALED JOINTS FOR UNIPOLAR CABLES

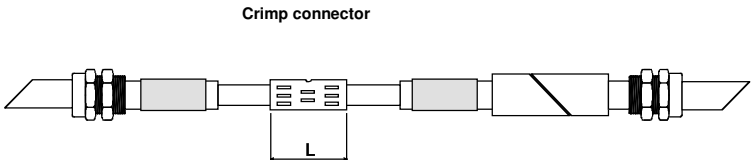
The sealed joints for unipolar cables are made up:

- n ° 1 brass sleeve;
- n ° 2 glands;
- n ° 1 crimp connector;
- n ° 3 pieces of heat-shrink tubing.

Prepare the ends of the cables to be joined in accordance with the previously described mode (shrinkable seal execution) taking into account the dimensions indicated below.

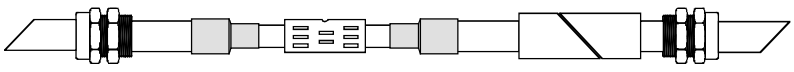


Cable type	L	L1	Cable type	L	L1
1H10	30	20	1H120	50	40
1H16	30	20	1H150	60	40
1H25	30	20	1H185	65	70
1H35	35	30	1H240	75	70
1H50	35	30	1H300	75	80
1H70	45	35	1H400	85	80
1H95	45	35			



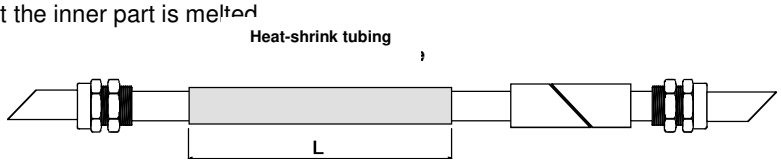
Place the connector and proceed with relative crimp.

Cable type	L	Cable type	L
1H10	30	1H120	50
1H16	30	1H150	60
1H25	30	1H185	65
1H35	35	1H240	75
1H50	35	1H300	75
1H70	45	1H400	85
1H95	45		



Perform the terminations of cables with the previously described mode.

Place the shrinkable sheath in such a way as to fully cover the terminals and the connector, and through a heater make it stick, paying attention that the inner part is melted



Cable type	L	Cable type	L
1H10	95	1H120	160
1H16	95	1H150	160
1H25	95	1H185	160
1H35	95	1H240	200
1H50	140	1H300	200
1H70	140	1H400	200
1H95	140		

Slide the protective sleeve so as to affect the ends of the cables together and tighten the glands.

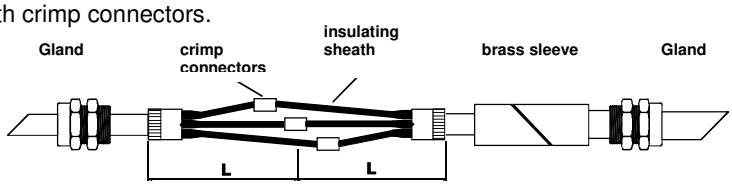
SEALED JOINTS FOR MULTIPOLAR CABLES

Sealed joints for multipolar cables ar made of:

- n° 1 brass sleeve;
- n° 2 glands;
- n° 2 seals
- crimp connectors.

Prepare and terminate the ends of the cables to be joined as previously described (Termination execution) taking into account the dimensions indicated below.

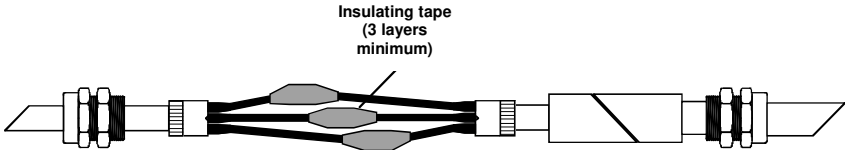
Connect the conductors with crimp connectors.



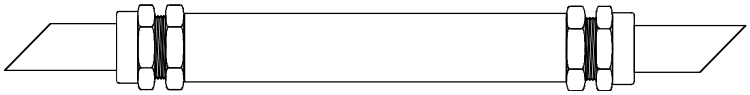
Cable type	L	Cable type	L	Cable type	L
2L1	50	2H1,5	50	3H25	100
2L1,5	50	2H2,5	50	4H1,5	50
2L2,5	50	2H4	50	4H2,5	50
2L4	50	2H6	50	4H4	70
3L1	50	2H10	70	4H6	70
3L1,5	50	2H16	70	4H10	70
3L2,5	50	2H25	80	4H16	80
4L1	50	3H1,5	50	4H25	100
4L1,5	50	3H2,5	50	7H1,5	70

Cable type	L	Cable type	L	Cable type	L
4L2,5	50	3H4	50	7H2,5	70
7L1	70	3H6	70	12H1,5	70
7L1,5	70	3H10	70	12H2,5	80
7L2,5	70	3H16	70	19H1,5	100

Insulate the connectors with 3 layers (minimum) of insulating tape.



Slide the protective sleeve in order to cover the ends of the cables together and tight the fittings.



JOINTS SEALED WITH EPOXY RESIN

When it is necessary to join two sections of the same cable and can not be used for reasons of space a junction box, it must be put in place a sealed jointn; the watertight joints provided with the mineral insulated cable are identified as follows:

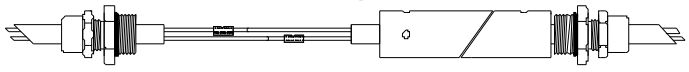
- GS1/(cable type) for gland ½" gas;
- GS2/(cable type) for gland ¾" gas;
- GS3/(cable type) for gland 1" gas;
- GS4 (cable type) for gland 1-¼" gas.

This type of connection, available for all types of cable, is composed of:

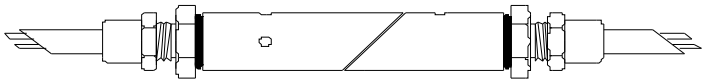
- an external brass sleeve, with a hole at one end and two other holes, which acts as a mechanical protection;
- two watertight glands;
- solder or crimp connectors for the head / head joining of conductors;
- n° 2 of bicomponent resin packs for GS1 joints;
- n° 2 of bicomponent resin packs for GS1 joints GS2;
- n° 4 of bicomponent resin packs for GS1 joints GS3;
- n° 5 of bicomponent resin packs for GS1 joints GS4;
- n ° 2 cones and n ° 2 plastic curves for the casting of the epoxy resin inside the sleeve.

Execution Mode:

- cut perpendicularly to the ends of the cables to be spliced
- unsheath the conductors for the following lengths:
    - approximately 30 mm for section conductors up to 25 mm²;
    - approximately 60 mm for section conductors up to 150 mm²;
    - approximately 80 mm for section conductors up to 400 mm²;
- clean the ends of conductors previously unsheathed;
- check that the resistance of the cable insulation is higher than 100 MΩ;
- insert on one end of a cable a gland, and on the end of the other cable the other gland and the brass sleeve;
- place the connectors on the conductors (these should be staggered between them) and perform the corresponding crimping or welding; in the latter case, clean the welds of any residue;



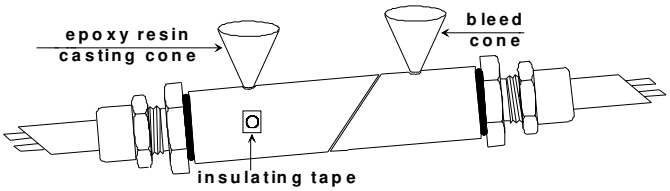
- clean and brighten the outer surfaces of copper sheaths of the cables that will be contained by the brass sleeve;
- put in position the brass sleeve, in such a way that the connectors of conductors are at the center of the same sleeve, and tighten the glands at the ends, taking care not to cause the rotation of the cable;



- again check the resistance of insulation, and heat the cables and the sleeve so as to facilitate the pouring of the resin; it is clear that if the insulation resistance is less than 100 Ω, the cable must be heated sufficiently and in this case, obtained the correct value of the insulation resistance; wait until the temperature of the coupling is lowered to the value of 50 ÷ 60 ° C before pouring the resin.

Execution in a horizontal position

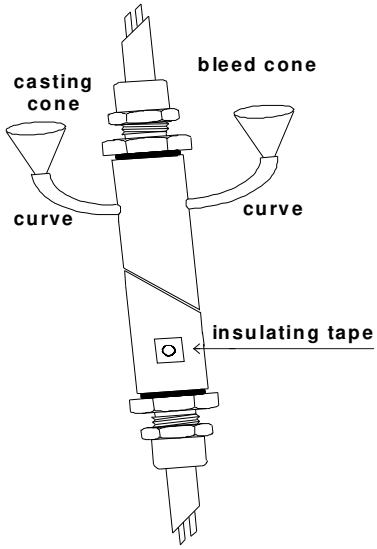
- slightly tilt the coupling (1 ÷ 5 °) and insert the plastic cones in the upper holes of the sleeve and close with insulating tape the transverse hole;



- mix the two components of the epoxy resin, by executing carefully the instructions on the packages, and then pour the resin through the casting cone (lowest); the filling of the tube will be executed when the resin will purge the other cone (highest);
- let the epoxy resin to solidify (about 4 hours at an ambient temperature of 20 ° C);
- cut the plastic cones above the sleeve.

Execution in a vertical position

- posizionare il giunto in verticale con una leggera inclinazione (1÷5°); deve essere fatta attenzione che il canotto sia infilato sui cables in modo che durante l'assemblaggio risulti avere l'estremità con i due fori in alto;
- posizionare le curve e i coni di plastica sui due fori in alto e chiudere con del nastro adesivo il foro in basso;
- colare la resina attraverso il cono più basso e riempire fino a che la resina non spurga dall'altro cono;



BRASS JOINTS FOR UNIPOLAR CABLES WITH SEAL

When it is necessary to join two sections of the same cable and can not be used for reasons of space a junction box can be put in place a joint; the brass joints kit cable with mineral insulation are identified as follows:

- GS20/(cable type) for glands ISO 20;
- GS25/(cable type) for glands ISO 25;
- GS32/(cable type) for glands ISO 32;
- GS40/(cable type) for glands ISO 40.

This junction type, available for all types of cable, is normally composed of:

- an external brass sleeve;

- two brass glands;
- crimp connectors to the head / head joining of conductors;
- n ° 2 seal;
- sealant for seal and insulating sheaths in sufficient quantity.

For this type of joints, to be implemented on sections already finished in the production plant, the available accessories are as follows:

- an external brass sleeve;
- a crimp connector for the head / head joining of conductors;
- a heat shrink tubing for the insulation of the connector from the sleeve body.

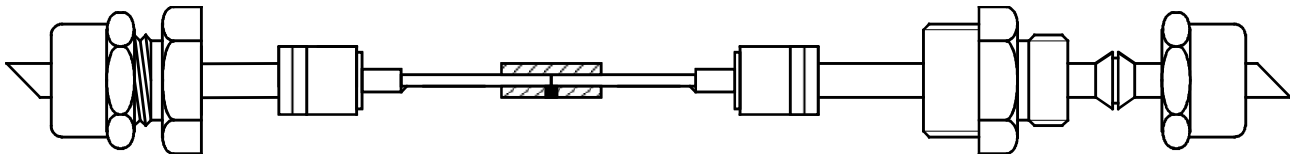
The dimensions of the sleeve and its connector are shown in the Table:

Joint and thread type	Sleev lenght	Connector lenght	Heat shrinkable tube
G 20 / M20 x 1,5	125 mm	30 mm	20/6
J 25 / M25 x 1,5	180 mm	35 – 45 mm	20/6
K 32 / M32 x 1,5	200 mm	45 – 60 mm	34/10
M 40 / M40 x 1,5	250 mm	65 – 75 mm	34/10

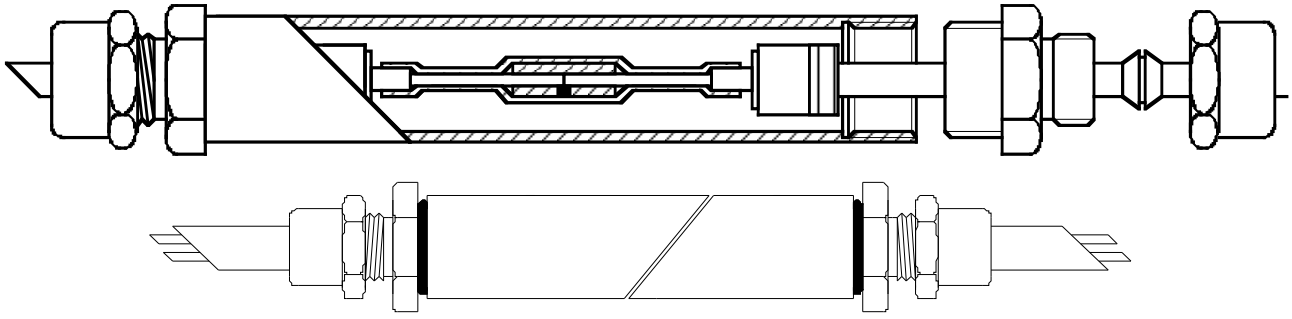
Implementing rules - general procedure *

* For pre-assembled sections in the production plant start from point 6.

- cut perpendicularly to the ends of the cables to be spliced and unsheathing the conductor for the following lengths:
  a) approximately 50 mm for section conductors up to 25 mm²;
  b) approximately 80 mm for section conductors up to 150 mm²;
  c) approximately 100 mm for the section of conductors up to 400 mm²;
- clean the ends of conductors previously unsheathed;
- insert on one end of a cable a connector on the end of the other cable the other connector;
- check that the resistance of the cable insulation is higher than 100 M Ω;
- make the two terminations;
- check that the resistance of the cable insulation is higher than 100 M Ω;
- place on one end of the cable the brass sleeve and the heat shrink tube;
- place the connector on the conductors, taking care to keep them aligned, and perform the corresponding crimping; if possible perform the crimping operation with a hexagonal array, in order to increase the contact surface between the connector and conductors: this recommendation more important as the larger the size of conductors.



- isolate the previously crimped connector, with self-amalgamating tape provided inside the package; in particular, be sure to place the tube of thermoplastic material centrally in relation to the connector and possibly cut off the excess length
- put in position the brass sleeve, in such a way that the connector of conductors is at the center of the sleeve, and tighten the glands at the ends, taking care not to cause the rotation of the cables. It is good practice to use silicon grease or loctite threadlocking material on the threads, in order to facilitate the grip and increase its ability to seal.



- Check the continuity of electrical contact even with a simple tester.

Junction boxes

When the electrical system must be carried out in places of artistic, historical or monumental it is necessary to mitigate the unpleasant aesthetic impact of the common junction boxes; for this purpose, upon completion of the mineral insulated cable, two types of junction box are available whose main characteristics are the followi:

- molten body of copper alloy (brass);
- lid molten copper alloy (brass);
- sandblasted surface finish;
- neoprene gasket;
- degree of protection against entry of liquids or dusts IP 67 as certificate CESI GR-93/0226610; currently this certification is valid for the CA Type 1;
- solid construction;
- pleasant appearance;
- the possibility, by means of two slits on the lid of the CA1 Type of housing supports for switches or sockets of the series 502.

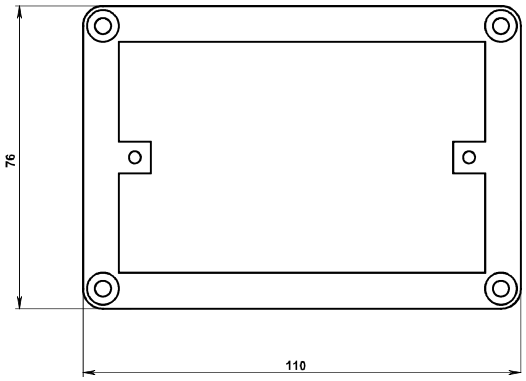
These boxes are made in three types:

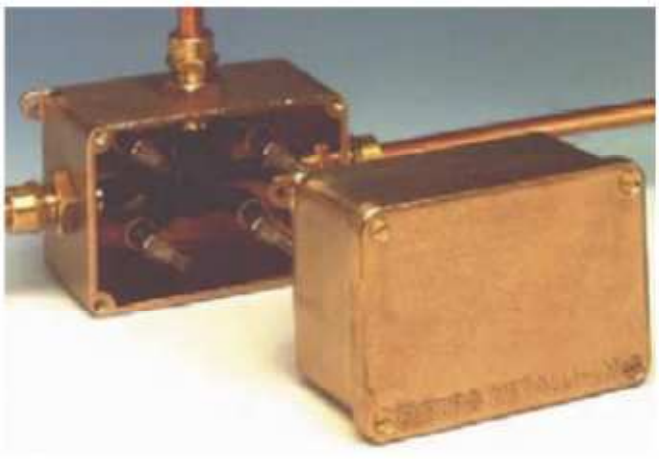
- CA1
- CA1/2F (when there are two slits on the lid of the Type CA1)
- CA2

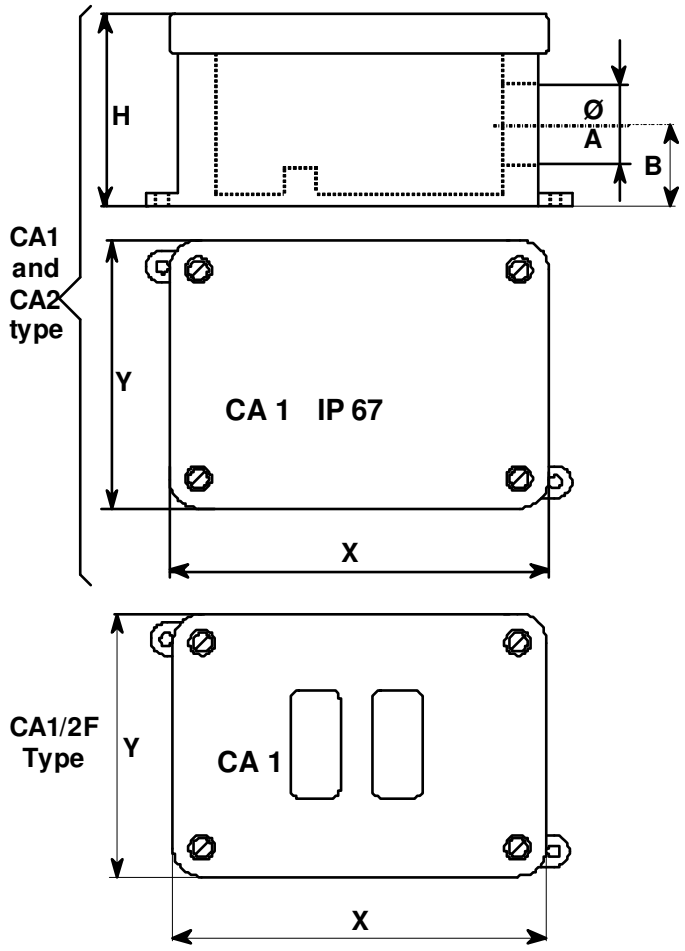
These boxes are provided in a package comprising the screws for fixing the cover on the body and the screw for the ground terminal that is located within the body of the box.

Please note that the boxes CA1 and CA1 / 2F are suitable for cable MICO terminations that provide glands up to ¾" gas or ISO 25 and a top section of the cable conductors of 4 mm².

It is also possible to use a plate of the series 503 (with only two active fruits) using the copper adapter below, mounted on the body of a cassette CA1.







Box type	X mm	Y mm	H mm
CA1- CA1/2F	117	83	63
CA2	191	132	72

Gland type IP 67	Ø A max. mm	B mm
½" gas UNI ISO 228	22	33
¾" gas UNI ISO 228	27	41

6
Annexes – Facsimile CE Declaration of Conformity and DoP

CE

EU DECLARATION OF CONFORMITY
D*ichiarazione di conformità UE*

The manufacturer:
Il fabbricante:

KME ITALY SPA, Via della Repubblica 257, 55051 Fornaci di Barga (LU)**,** Italia

Declare that the product:
Dichiara che il prodotto:

MINERAL INSULATED CABLE (MICO) - BARE
CAVO AD ISOLAMENTO MINERALE (MICO) - NUDO

type:
modello:

HEAVY DUTY – 750 V
SERVIZIO PESANTE – 750 V

is in conformity with the relevant Union harmonization legislation:
è conforme alla pertinente normativa di armonizzazione dell'Unione:

2014/35/EU Directive - LOW VOLTAGE DIRECTIVE (LDV)
Direttiva 2014/35/UE – DIRETTIVA *BASSA TENSIONE*

References to the relevant harmonised standards used:
Riferimento alle pertinenti Norme utilizzate:
EN 60702–1: 2002+A1:2015 - Mineral insulated cables and their termination with a rated voltage not exceeding 750 V – Part 1: Cables / *Cavi per energia ad isolamento minerale e loro terminazioni con tensione nominale non superiore a 750 V – Parte 1: Cavi*

This declaration of conformity is issued under the sole responsibility of the manufacturer
La presente dichiarazione di conformità è rilasciata sotto la responsabilità esclusiva del fabbricante

Name/*Nome*:
Position/*Funzione*: Plant Manager
Place and date of Issue/ *Luogo e data di emissione*: Fornaci di Barga, dd/mm/yyyy

CE

DECLARATION OF PERFORMANCE (DOP)

No. *nnnn-aa*

1. Mineral Insulated Cables MICO without additional plastic sheath:

   Light Duty Series (L) 500V

   Compositions:

2L1	**2L1.5**	**2L2.5**	**2L4**
3L1	**3L1.5**	**3L2.5**	
4L1	**4L1.5**	**4L2.5**	
7L1	**7L1.5**	**7L2.5**	

2. Intended use of the construction product, in accordance with the harmonized standard EN 50575:2014-09+A1:2016: *Supply of electricity in buildings and other civil engineering works with the objective of limiting the generation and speread of fire and smoke*.
3. Manufacturer:

   KME ITALY SpA

   Viale della Repubblica, 257 – 55051 Fornaci di Barga (LU), Italy

   Tel. +39 0583 701413-412; Fax. +39 0583 701406; Email: mic@kme.com; www.kme.com
4. AVCP system: ***1+***
5. IMQ SpA as notified body for Regulation No. 305/2011/EU with identification number 0051 performed the determination of product type, the initial inspection and the manufacturing plant and of FPC, the continuous surveillance, assessment and evaluation of the FPC and the audit testing of samples taken before placing the product on the market and issued the certificate of constancy of performance.
6. Declared Performance:

Essential characteristics	***Performance***	***Harmonized tecnica specification***
Reaction to fire	$\mathbf{A_{ca}}$	EN 50575:2014
Dangerous substances	NPD-	

7. The performance of the product identified in point (1) is in conformity with the declared performance in point (6).

This declaration of performance is issued under the sole responsabilità of the manufacturer identified in point (3).

Signed for and on behalf of the manufacturer:

Name and function:

Place and date of issue: Fornaci di Barga, *dd/mm/yyyy*

CE

EU DECLARATION OF CONFORMITY
D*ichiarazione di conformità UE*

The manufacturer:
Il fabbricante:
KME ITALY SPA, Via della Repubblica 257, 55051 Fornaci di Barga (LU)**,** Italia

Declare that the product:
Dichiara che il prodotto:
TERMINATIONS FOR MINERAL INSULATED CABLES (Artt. RAD-RN)
TERMINAZIONI PER CAVI AD ISOLAMENTO MINERALE (Artt. RAD-RN)

type:
modello:
Standard termination or with earth conductor for mineral insulated cables –Thread form: ISO or Gas UNI ISO 228 or Gas UNI 6125 – HEAVY SERIES
Terminazioni per cavi ad isolamento minerale standard o con filo di terra – Forma della filettatura: ISO o Gas UNI ISO 228 o Gas UNI 6125 – SERIE PESANTE

is in conformity with the relevant Union harmonization legislation:
è conforme alla pertinente normativa di armonizzazione dell'Unione:
2014/35/EU Directive - LOW VOLTAGE DIRECTIVE (LDV)
Direttiva 2014/35/UE – DIRETTIVA *BASSA TENSIONE*

References to the relevant harmonised standards used:
Riferimento alle pertinenti Norme utilizzate:
EN 60702–2:2002+A1:2015 - Mineral insulated cables and their termination with a rated voltage not exceeding 750 V – Part 2: Terminations / *Cavi per energia ad isolamento minerale e loro terminazioni con tensione nominale non superiore a 750 V – Parte 2: Terminazioni*

This declaration of conformity is issued under the sole responsibility of the manufacturer
La presente dichiarazione di conformità è rilasciata sotto la responsabilità esclusiva del fabbricante

Name/*Nome*:
Position/*Funzione*: Plant Manager
Place and date of Issue/ *Luogo e data di emissione*: Fornaci di Barga, dd/mm/yyyy

EU DECLARATION OF CONFORMITY (N. nn/yy)
D*ichiarazione di conformità UE (N. nn/yy)*

The manufacturer / *Il fabbricante:*

KME ITALY SPA, Via della Repubblica 257, 55051 Fornaci di Barga (LU)**,** Italia

declare that the product /*dichiara che il prodotto:*

type/*modello*: RAD G ½" 1H16-3H1.5 Lot Nr./*Lotto N.*:nn *Data/Date* – dd/mm/yyyy

is in conformity with the relevant Union harmonization legislation/ *è conforme alla pertinente normativa di armonizzazione dell'Unione:*

Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014
Direttiva 2014/34/UE del Parlamento Europeo e del Consiglio del 26 Febbraio 2014

References to the relevant harmonised standards used/ *Riferimento alle pertinenti Norme utilizzate:*

- EN IEC 60079-0:2018, Explosive Atmosphere – Part 0: Equipments - General Requirements / *Atmosfere Esplosive – Parte 0: Apparecchiature – Prescrizioni Generali*
- EN 60079-1:2014, Explosive Atmosphere – Part 1: Equipment protection by flameproof enclosures "d" / *Atmosfere Esplosive – Parte 1: Apparecchiature protette mediante custodia a prova d'esplosione "d"*
- EN IEC 60079-7:2015+A1:2018, Explosive Atmosphere – Part 7: Equipment protection by increased safety "e" / *Atmosfere Esplosive – Parte 7: Apparecchiature con modo di protezione a sicurezza aumentata "e"*
- EN 60079-31:2014, Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure &quot:t&quot / *Atmosfere Esplosive – Parte 31: Apparecchi con modo di protezione mediante custodie "t" destinati ad essere utilizzati in presenza di polveri combustibili*

This declaration of conformity is issued under the sole responsibility of the manufacturer.
La presente dichiarazione di conformità è rilasciata sotto la responsabilità esclusiva del fabbricante.

Additional Information/ *Informazioni aggiuntive*:

Protection mode/ *Modo di protezione*: Ex II 2G Ex eb IIC Gb Ex db IIC Gb
Ex II 2D Ex tb IIIC Db IP65

Ambiente temperature/ Temperatura ambiente: -20°C ÷ + 70°C
Service Temperature/ Temperatura di servizio: -20°C ÷ +250 °C

EU-Type Examination Certificate/ Certificato di esame UE del Tipo: IMQ 17 ATEX 027 X
Notified Body/ Organismo Notificato responsabile per la sorveglianza: N. 0051 | IMQ S.p.A | Via Quintiliano 43 – 20138 Milano (MI), Italy | www.imq.it
Product quality assurance notification/ Notifica della garanzia della qualità del prodotto: IMQ 18 ATEX 004 Q

Name/*Nome*:
Position/*Funzione*: ATEX Reference

Place and date of Issue/ *Luogo e data di emissione*: Fornaci di Barga, dd/mm/yyyy