VITALink®
Circuit Integrity Cable

VITALink® MC-metric

VITALink® MC-metric cables are for use outside USA and Canada

A Fit for Purpose Wiring System

MARMON

Marmon Industrial
Energy & Infrastructure

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VITALink® MC-metric Cable Installation Manual (See separate manual)

MARMON INDUSTRIAL ENERGY & INFRASTRUCTURE

Marmon Industrial Energy & Infrastructure (Marmon IEI) manufactures electrical and electronic wire, cable, and traced tubing bundles for the industrial, energy and infrastructure markets for applications where reliability and resistance to harsh environments is required. Marmon IEI provides innovative solutions to end users who require continuous and uninterrupted performance from power, control, instrumentation and data cables for mission critical systems and equipment..

Marmon IEI consists of 5 cable manufacturing facilities and 1 traced tubing manufacturing facility with over 600 associates with expertise in many different industries and types of cable and tubing bundles. Marmon IEI is one group of business within Marmon Electrical which consists of 18 cable companies known for their high-performing wire and cable products, innovative solutions, and dependable service. As with all Marmon companies, Marmon Electrical strictly adheres to the principles of 80/20, which simplifies the businesses and leads to segmentation. This allows companies to develop markets and corresponding products, setting them up as separate autonomous business units. The segmentation leads from innovative solutions to in-service problems and the certainty that a customer will be working with an expert in their industry and products.

With this concept in mind, Marmon Electrical acquired various well-established companies in early 2018, uniting them together to help provide technologies and products for mission critical systems for demanding environments while helping reduce costs and improve grid reliability within the electrical industry. These companies consisted of RSCC Wire & Cable, Comtran Corp., Dekoron Unitherm, Dekoron Wire & Cable, and Kerite ESP Pump Cable.

In early 2021, Marmon Electrical purchased Harbor Industries Canada, adding them to their threshold of high-performance wire and cable within the Canadian market space. During these transitions, the groups worked as individual brands but with one main purpose: the customer.

In late 2021, the final development of Marmon IEI came to fruition as these six entities unified their resources within the industry. Combining resources and efforts, Marmon IEI can now be the ultimate force within the wire, cable, pre-insulated and traced tubing industry utilizing its six various locations and expertise throughout the organization to provide customers with the most robust portfolio of products, while effectively pulling resources from each location to get the job done effectively and remaining reliable, dependable, and exceeding industry standards.

BACKGROUND

Evolution of testing methods for fire resistant electrical cables in many countries has led to important divergences between the fire performances required by building emergency equipment and the fire performances provided by the cables meeting today's common circuit integrity test methods.

The first cable ever to be considered for fire survival applications was a mineral insulated design, originally employing one or a combination of pulverized glass, siliceous rocks or asbestos for the dielectric. This design was patented by Swiss inventor Arnold Francois Borel in 1896. We now know this design as MIMS (mineral insulated metal sheath) or MI cable.

Whilst certainly an excellent technical solution for circuit integrity and overall fire safety, mineral insulated cables do have practical disadvantages. Special tools and fittings are needed for terminating the cables as the mineral insulation (magnesium oxide) is often hydroscopic, leading to a reduction in insulation resistance at cut cable ends where left un-terminated. Due to the solid conductor design with compacted mineral insulation, cables are more rigid and installation time is often longer.

This situation led to a desire from the market for cable manufacturers to design and supply a more flexible cable with easy installation. In the absence of any widely accepted test method at that time, there was a need to develop and standardize these test methods. Subsequently tests were introduced and adopted, including IEC 331 in 1970 and BS 6387CWZ in 1983, which the newer flexible plastic insulated fire resistant cables could pass.

At that time, there were no tests developed based on equivalency of the overall fire performances provided by mineral insulated cables of the day, so the result was a general dilution of fire performance provided by these new plastic flexible cables when compared with the original mineral insulated design. As plastic extruded cables were cheaper than MI cables, it only took 10 years for these polymeric based fire resistant cables to largely displace MI cable in most global markets.

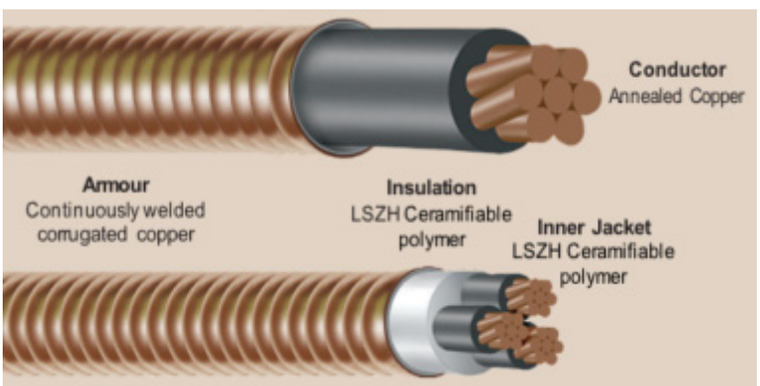
The common understanding of most owners, occupiers, specifiers and installers of fire-resistant cables is that the products they buy and use will provide a level of electrical circuit integrity performance during emergency fire conditions for a time commensurate with the testing procedure in order to maintain functionality of the equipment connected.

With a growing realisation that many polymeric flexible fire resistant cables fail to provide an adequate level of circuit integrity performance when installed in buildings, some countries have revised test standards and moved to furnace testing to align with the test protocols used for all other building components and structures needing a Fire Resistance Level (FRL). These countries include: Germany, Belgium, Australia and New Zealand. In America and Canada, Underwriters Laboratories (UL) withdrew all certifications for fire resistive cables in 2012, due to negative and interference reactions found between the cables and their installation components. Subsequently, UL revised their testing and certification protocols, requiring fire resistive cable to only be certified as part of a wiring system, which must be tested together with all installation components in a realistic scale fire in both horizontal and vertical installations. This test protocol mimics the actual installation of cable circuits in buildings and with representative fire-fighting interventions. From this, a revised test and performance protocol (UL 2196) was developed.

VITALink® cables and wiring systems were developed to meet this new fire resistance standard and were first certified in 2014. Resisting fire temperatures over 1,000°C for 2 hours when tested in realistic scale, both vertically and horizontally, then immediately surviving a full pressure fireman's hose test. VITALink® MC-metric wiring systems offer a fully 'Fit for Purpose' electrical wiring system as an integral part of the critical life safety and firefighting equipment in major public buildings, for retail, commercial, industrial, and transit applications and in power infrastructure.

CONSTRUCTION

Manufactured with high conductivity metric copper conductors according to IEC 60228, VITALink® MC-metric cables use a proprietary inorganic ceramifiable polymer insulation combined with a fully welded impervious corrugated copper jacket to provide a cable design that mimics the full mechanical ruggedness of legacy mineral insulated cables, while offering flexibility and ease of installation of polymer-based cables.



The cable design to UL 1569 allows standard installation methods to be used with standard terminations. This removes the need for any special training or special tools. The cable design eliminates the problems of moisture ingress, low insulation resistance and capacitive issues common with MI cables.

The copper outer jacket is sized to act as the ground conductor complying with both National Electric Code (NEC) and local codes.

VITALink® MC-metric cables have a continuous operating temperature of up to 150°C[1], enjoying higher current ratings. They are suitable for use in applications where high temperatures are experienced, such as in industrial processes and petrochemical facilities. The copper jacket makes the cable perfect for use where directly exposed to sunlight, ozone, oil and in hazardous locations where used with the respective Ex-e or Ex-d cable glands.

VITALink® MC-metric cables are available in a full range of types and sizes: 0.6/1kV power cables; 2kV rated VSD motor cables; and control, communication, signal and data cables.

Description

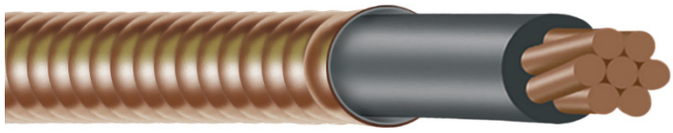
Marmon Industrial Energy & Infrastructure's VITALink® MC-metric cable is UL-listed electrically and fire resistive rated for a maximum of 2 hours to UL 2196 in sizes 2.5 mm^2 through 300 mm^2. The separate installation instructions provide information on how to install the cable for a 2-hour system, so the cable system described, can be used with any of Marmon IEI's metric 1 hour or 2-hour fire resistive rated wiring systems.

VITALink® MC-metric insulation is rated for 2kV rms. The cable is fire tested at 600 volts according to UL 2196 (phase to phase) and is compliant with the NEC requirements for Type MC.

Cable sizes and constructions range from 2.5 mm^2 through 300 mm^2 and single conductor to twelve conductors. A complete list of available constructions is provided within this document and on UL's website under FHJT R15365.

Once a fire resistive rated splice is introduced into the wiring system, the system hourly fire resistive rating (FRR), the max. voltage and current allowed will be the lesser of the splice or the cable.

[1]Bare copper armour VITALink® MC-metric cables are rated at 150°C. Low smoke, zero halgen jacketed cables are rated at 110°C.



Single core bare copper

Multicore bare copper

Multicore with LSZH sheath

PRODUCT CERTIFICATION AND APPROVALS

VITALink® MC-metric cables are certified by Underwriters Laboratories:

- Cable listing: FHJT 2 hour FRR (Fire Resistance Rating to UL 2196:2018)
- Wiring System listing: FHIT 120M 2 hour FRR (Fire Resistance Rating UL 2196:2018)
- Electrical listings: PJAZ (UL1569) and ZKST (UL44)
- Quality system to: ISO 9001

International — VITALink® MC-metric cables comply with:

- BS 6387 CWZ (3 hour fire resistance test + a fire with water spray and fire with mechanical shock test)
- IEC 61034-2 (smoke obscuration test)
- IEC 60332-3 parts 22 and 24 (flame propagation test)
- IEC 60754-1 (halogen acid gas test)
- IEC 60754-2 (acid gas pH test)
- VITALink® MC-metric cables are lead free and comply with RoHS

Product Certification

VITALink® MC-metric cables are tested and certified by UL, the world's leading fully independent testing and certification body.

All certified VITALink® MC-metric cables bear the UL mark which ensures that:

1. The cable has been manufactured and tested to the appropriate standards.
2. The manufacturer's quality control procedures have been checked by independent inspectors.
3. The cable complies with all safety provisions.

All UL certified cable products can be confirmed on the UL iQ product directory.

Product Supply

VITALink® MC-metric cables are only sold by Marmon Industrial Energy & Infrastructure groups certified distribution partners who have been checked and cleared as independent, ethical, reliable and financially secure. Marmon IEI groups certified distribution partners are officially appointed and supported by the Marmon Electrical group to ensure seamless and reliable continuity of supply from the smallest developments to the largest projects.

FEATURES AND BENEFITS

Fireproof: VITALink® MC-metric cables are tested to neither burn nor support combustion. VITALink® MC-metric cables are designed to function when exposed directly to fire and firefighting interventions, such as fire sprinklers and fireman's hose suppression.

Bare VITALink® MC-metric cables are inorganic meeting international tests for smoke and toxic halogen emissions and do not propagate flame even at elevated temperatures.

Wiring and Conduit Combined: VITALink® MC-metric cables have a fully impervious copper jacket which provides for excellent earthing and core protection. The cable is sufficiently pliable to allow intricate cable routing and easy installation.

High Operating Temperatures: Bare copper VITALink® MC-metric cables' Fire-Roc® ceramifiable insulation system can be used for emergency operation at temperatures as high as 180˚C for several hours, although the bare copper jacket cable is rated to a 150°C for continuous operation. This allows the cable to be installed in areas of high temperatures and where exposed directly to weather, sunlight, ozone, under steel roofs or on covered trays in exposed coastal or offshore applications.

Where VITALink® MC-metric cables are provided with a low smoke, zero halogen and flame-retardant polymer jacket, the cables' continuous operating temperature is limited to 110°C.

Non-Aging: VITALink® MC-metric cables are made with inorganic materials and due to the high continuous operating temperature, the life span for VITALink® MC-metric cables is up to 10 times longer than many other polymeric fire performance cable types. This means VITALink® MC-metric cables are designed with a useful lifetime equaling or surpassing the normal project design life, so are unlikely to ever need replacing.

Waterproof: VITALink® MC-metric cables have a copper sheath, which is fully waterproof and impervious to oil and gas.

Earth Continuity: VITALink® MC-metric cables do not need a separate earth circuit grounding conductor as the copper sheath serves this purpose, providing an excellent low resistance protective conductor conforming with all local wiring regulations such as BS 7671.

Pliable: VITALink® MC-metric cables are made with a corrugated copper armour which is fully annealed, enabling it to be easily bent to follow intricate shapes without detriment to its electrical characteristics.

Great Mechanical Strength: VITALink® MC-metric cables are extremely robust and can withstand a considerable amount of abuse such as bending, flattening and twisting whilst continuing to carry current. With a full copper armour VITALink® MC-metric cables are resistant to rodents, insects and mold.

High Corrosion Resistance: VITALink® MC-metric cables' copper armour has a continuous fully-welded seam which has a high resistance to corrosion, is impervious to water and in most environments needs no additional protection. Where exposed to chemicals corrosive to copper, a LSZH protective outer jacket is available.

Competitive Installed Cost: Major contributors to installation cost are the cable fixings and supports. VITALink® MC-metric cable requires far fewer fixings than conventional cables and can save up to 40% on fixing costs and time to install. Because VITALink® MC-metric cable has its own copper jacket, there is no need for additional conduit, saving further time and cost.

High Degree of Electrical Screening: VITALink® MC-metric cables have a solid copper sheath, which provides an excellent high frequency electrostatic screen with no pin holes. This design maximises electromagnetic compatibility (EMC) and provides protection from EMP and NEMP effects, making them eminently suitable for critical military installations. For specialized data ethernet, communication and instrumentation applications, VITALink® cables are available.

PRODUCT RANGE — SINGLE CORE 0.6/1kV

Product Code	Size (mm^2)	No. of Conductors	Nom. Core Dia. (mm)	Nom. Armour Dia. (mm)	Net Weight (kg/m)
VM01050-500	50	1	16.4	25.9	1.15
VM01070-500	70	1	18.0	26.5	1.29
VM01095-500	95	1	19.7	29.3	1.58
VM01120-500	120	1	22.0	30.9	1.87
VM01150-500	150	1	23.7	33.0	2.21
VM01185-500	185	1	25.4	34.3	2.55
VM01240-500	240	1	27.8	35.8	3.08
VM01300-500	300	1	30.9	40.3	3.75
VM01400-500	400	1	34.3	43.9	4.72

Other sizes available including:
Fire rated armoured Data, Coax and Instrumentation and VSD (Variable Speed Drive cables)

PRODUCT RANGE — MULTICORE 0.6/1kV

Product Code	Size (mm^2)	No. of Conductors	Nom. Core Dia. (mm)	Nom. Armour Dia. (mm)	Net Weight (kg/m)
VM022X5-500	2.5	2	12.8	20.8	0.58
VM02004-500	4	2	13.8	23.4	0.73
VM02006-500	6	2	16.0	25.9	0.89
VM02010-500	10	2	17.8	26.5	0.93
VM02016-500	16	2	19.8	29.3	1.15
VM032X5-500	2.5	3	13.6	22.4	0.68
VM03004-500	4	3	14.7	22.5	0.71
VM03006-500	6	3	17.0	25.5	0.88
VM03010-500	10	3	18.9	27.3	1.06
VM03016-500	16	3	21.2	29.3	1.31
VM03025-500	25	3	24.5	33.0	1.73
VM03035-500	35	3	26.5	35.8	2.10
VM03050-500	50	3	32.1	42.4	2.84
VM03070-500	70	3	35.6	45.6	3.57
VM03095-500	95	3	39.3	49.5	4.45
VM03120-500	120	3	44.8	57.4	5.55
VM03150-500	150	3	48.3	62.7	6.78
VM03185-500	185	3	51.9	63.0	7.69
VM03240-500	240	3	57.1	68.8	9.51
VM03300-500	300	3	64.6	79.5	11.84
VM042X5-500	2.5	4	14.9	24.5	0.79
VM04004-500	4	4	16.2	25.9	0.90
VM04006-500	6	4	18.8	26.5	0.99
VM04010-500	10	4	20.9	29.3	1.16
VM04016-500	16	4	23.6	31.4	1.47
VM04025-500	25	4	27.1	35.8	2.08
VM04035-500	35	4	29.3	38.1	2.54
VM04050-500	50	4	35.6	45.6	3.47
VM04070-500	70	4	39.5	49.5	4.41
VM04095-500	95	4	44.2	57.2	5.42
VM04120-500	120	4	49.8	64.8	7.16
VM04150-500	150	4	53.7	68.8	8.52
VM04185-500	185	4	57.8	71.6	9.76
VM04240-500	240	4	64.4	81.8	12.68
VM052X5-500	2.5	4 cores+Earth	16.3	25.9	0.89
VM05004-500	4	4 cores+Earth	17.8	26.5	0.94
VM05006-500	6	4 cores+Earth	20.7	29.3	1.17
VM05010-500	10	4 cores+Earth	23.1	31.4	1.45
VM05016-500	16	4 cores+Earth	26.1	35.8	1.91
VM05025-500	25	4 cores+Earth	29.9	40.3	2.35
VM072X5-500	2.5	7	17.9	26.5	0.91
VM102X5-500	2.5	10	22.9	31.4	1.22
VM122X5-500	2.5	12	23.9	33.0	1.32

Other sizes available including: Fire rated armoured Data, Coax, Instrumentation and VSD cables

CABLE PREPARATION AND INSTALLATION OF FIRE RATED WIRING SYSTEMS

Materials Required

Only the components listed in these instructions shall be used to maintain the respective fire resistive rating. Further details on the materials beyond the list below are provided inside the document.

- VITALink® MC-metric cable with or without an overall polymeric jacket, and with or without ground(s) or segmented ground wire(s).
- Steel mounting components.

For more information on the certification, please see the system published on the UL website.

Tools Required

- Utility Knife
- Socket Wrench
- Screw Driver
- Pipe Cutter
- Cable Cutter

Tools needed to remove cable outer copper armour

Listings/Certifications/Compliance

VITALink® MC-metric fire resistive cable certified to UL 2196 for a 2hr. Fire Resistive Rating (FRR) for use in the following systems:

- 2 Hour 600V FHIT 120M – 2 Hour 600V
- 2 Hour 480V FHIT 120AM – 2 Hour 480V Block Splice
- 1 Hour 600V FHIT 60M – 1 Hour 600V Block Splice w/Optional Fuse
- 1 Hour 480V FHIT 60AM – 1 Hour 480V Block Splice w/Optional Fuse

General

These instructions provide the minimum installation requirements for installing a cable to the systems described above.

Electrical circuit integrity systems consist of components and materials that are intended for installation as protection for specific electrical wiring systems, with respect to the disruption of electrical circuit integrity upon exterior fire exposure. The specifications for the protective system and its assembly are important details in the development of the ratings.

These protective systems are evaluated by the fire exposure and water hose stream test as described in UL 2196. Ratings apply only to the entire protective system assembly. Individual components and materials are designated for use in a specific system(s) for which corresponding ratings have been developed and are not intended to be interchanged between systems. Ratings are not assigned to individual system components or materials.

Authorities Having Jurisdiction (AHJ) should be consulted in all cases as to the specific requirements covering the installation and use of these classified systems.

Cables and supports should be routed and supported separately from non-fire resistive rated circuits. They should be positioned where any hazard of non-fire resistive rated systems collapsing or failure will not disturb the system.

These requirements must be followed to maintain the hourly rating in the fire area.

The VITALink® MC-metric cable system must be installed by qualified personnel familiar with generally accepted construction techniques and safe electrical practices.

Take all appropriate precautions when installing VITALink® MC-metric wiring systems, including following Occupational Health and Safety (OHS) and other applicable regulations.

The installation must comply with all national and local electrical codes and all the requirements of the UL/ULC Electrical Circuit Integrity System certification requirements, and carefully follow the installation instructions as prescribed in the FHIT system(s) available on the UL Product iQ website.

Ensure the cable is in good condition prior to commencing splice installation. Do not pull cables around corners that have sharp edges, such as corners in cable trays, or other obstructions. See VITALink® MC-metric cable handling and installation instructions for more information.

Cable Preparation

To remove the outer jacket:

Measure the length of jacket to be removed and mark. With a sharp knife, score around the jacket to about half its thickness. Do not score the armour.

Starting at the end of the cable, cut the jacket completely through for the first half inch, continue scoring, but not more than half the thickness of the jacket, back to the score mark.

Using pliers, pull the jacket away from the armour starting at the end of the cable and proceed to tear lengthwise along the score mark to the ring score. Remove the jacket.

Mark where the armour is to be cut. Use a tubing cutter to cut the armour. The cutting wheel should be adjusted at the crest of a corrugation and rolled back and forth in ever increasing arcs while advancing the wheel until a 360-degree turn can be made without the tool wobbling off track.

If required, mildly flex the cable until the sheath separates at the cut.

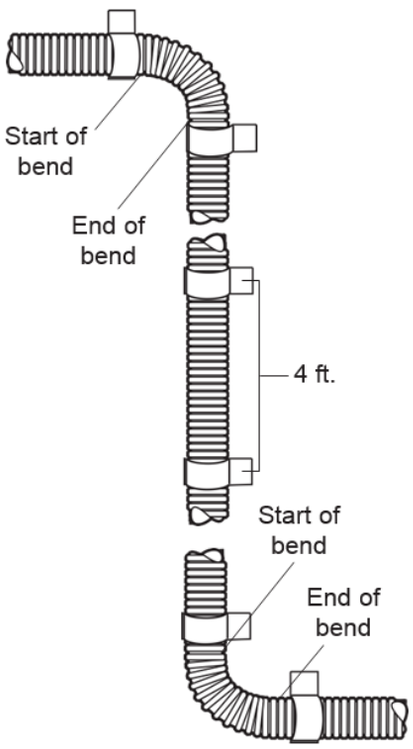
Mark where outer jacket is to be cut back. Use a knife to longitudinally cut inner jacket the required distance. Only cut 50% into jacket then peel away. Leave inner jacket on where possible for additional protection.

Mark where jacket is to be cut. Use a knife on the cable end to cut into the silicone and peel back jacket with hand to avoid accidentally cutting through conductors with knife. Strip cable inner insulation away to the required length and terminate conductor in the same way as any other XLPE or PVC cable.

Fixing and Support of VITALink® MC-metric cables to comply with 2-hour Fire Resistance Rating (FHIT 120M)

Cable shall be supported horizontally or vertically every 1.2 meters unless otherwise stated in this document.

Cables shall also be supported on each side of a bend and not to exceed 1.2 meters.



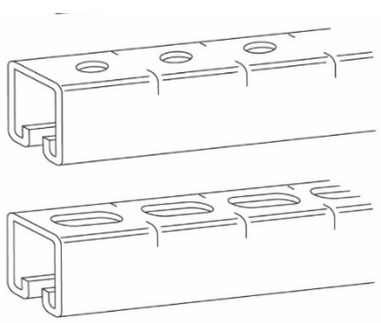
Support Methods

Drywall is not an acceptable means of support.

Strut

Box and cables are mounted on 22.2mm or larger minimum 12-gauge slotted steel strut. Painted or galvanized strut is acceptable. (Aluminum strut is NOT acceptable)

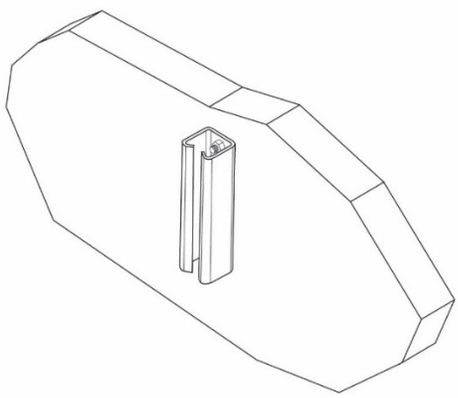
Strut longer than 500mm shall be a minimum of 40mm 12-gauge steel.

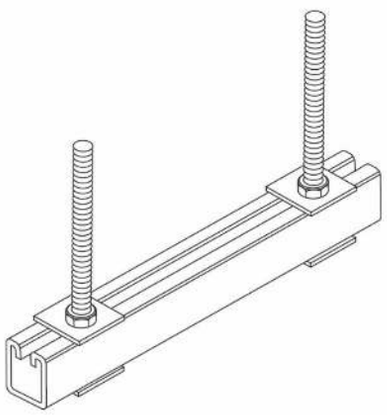


Secure strut to concrete wall using a minimum 8mm diameter steel concrete screws by a minimum 60mm in length.

Alternatively, secure strut to concrete wall using a minimum 8mm diameter steel masonry anchor by a minimum 45mm in length. The deeper the penetration, the more secure the strut is mounted to the wall. Please account for spalling.

Strut shall be secured to structure at a minimum on each end, and one in the center for spans 1.5 meters or greater. Strut shall be secured to a 2-hour fire rated building structure with fixing spacings no greater than 1 meter apart.





Trapeze

Trapeze style installation is acceptable using a minimum 10mm diameter steel threaded rod with steel strut washers and nuts. Secure strut into 2 hour rated structure to the appropriate depth to account for supported weight and spalling. 20mm strut is not allowed for trapeze style mounting. The attachment into the concrete should be a steel anchor or screw that allows for securement/attachment of the threaded rod. Note: Epoxy/plastic/etc. will burn in a fire and may cause the support to fail.

Cable Tray and Ladder

Steel cable tray is an acceptable support method and shall be supported every 1.5 meters.

Conduit

This section applies to cables installed outside of the fire zone and in circumstances acceptable to AHJ.

Some installation may require that the cable is routed through conduit. Cable should not exceed fill ratio and be de-rated as necessary. Rigid conduit is not permitted.

EMT or IMC is acceptable for wall penetrations or short sections. Conduits shall be fire stopped, with a material compatible with plastic and copper, where the cable enters and exits the conduit. The conduit shall be supported every 1.5 meters. Couplings for steel conduit shall also be steel.

Some conduits are routed underground and enter the building. PVC conduit is acceptable for these instances as they are directly buried or in concrete. Where the conduit enters the building, the conduit should be fire stopped. Routing through PVC conduit is not allowed after entrance into the building.

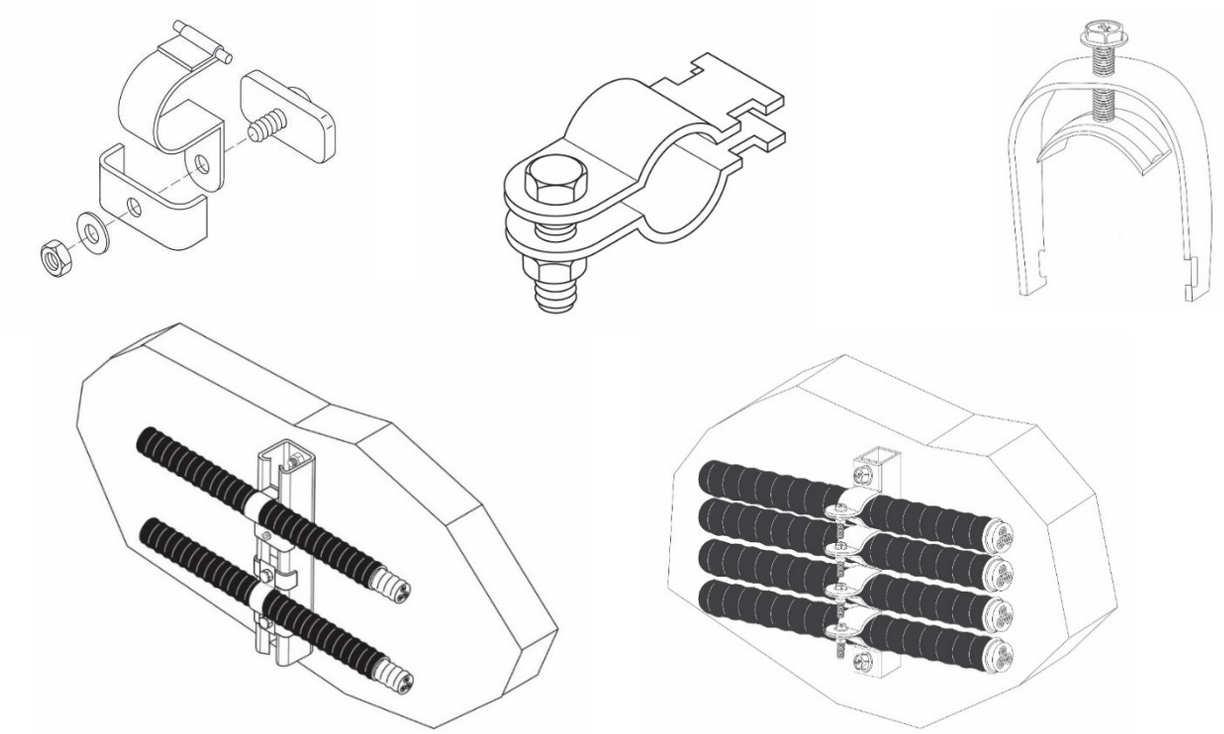
Cable Securement

Some configurations may require ampacity de-ratings. Follow NEC or local governing code. All straps shall be steel and secure without slack onto cable. Straps thickness shall be 1.1mm minimum. Trapeze style installations for any cable type may use any strap referenced in this guide.

Overall Polymeric Jacketed Cable

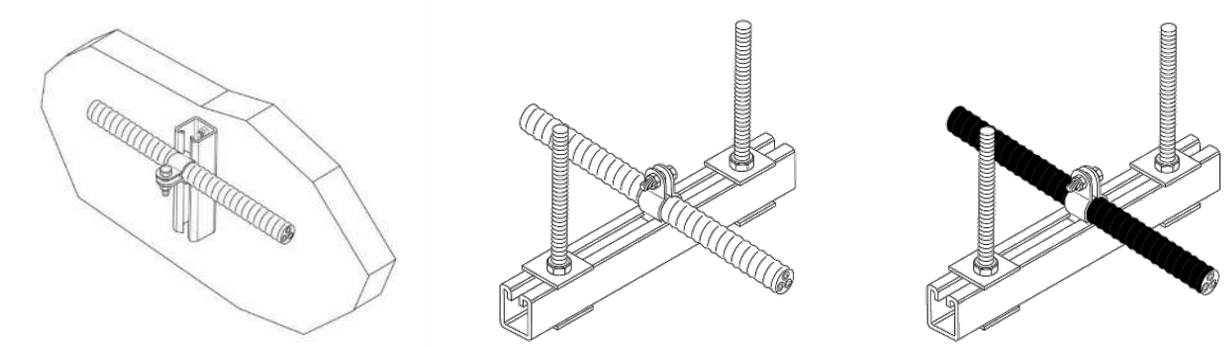
T&B J-800 or equivalent as approved by the AHJ, two-hole one-piece strap, two-piece single hole with strut nut and washer on each side of cable (each side of outermost cables if arrayed without gaps between the straps, Figure 1 below) and in contact with the strap.

Some illustrations of straps and configurations are provided below.



Non-Jacketed Cable (Bare Copper Armour)

T&B J-800, two-hole one-piece strap, two-piece single hole, saddle clamp, two-hole copper or steel clips that wrap around cable. Electrical tape may be used between cable and strap if isolation is required due to concerns with galvanic action.



Cable Tray and Ladder

Cables laid in steel tray shall be neatly arranged and be secured with steel banding or steel ties every 1.2 meters. Cables shall be secured tightly but not so much that armour becomes deformed. Ties should be compatible with tray, cable and environment.

Grounding

The armour may be used as an equipment ground. For grounding equivalents, see the VITALink® MC-metric Installation Manual.

Pulling Lubricant

Any acceptable lubricant suitable for conventional polymer cables may be used for VITALink® MC-metric cables with polymeric jacket.

Any lubrication non-deleterious or non-corrosive to bare copper is acceptable for bare copper armoured/sheathed cable.

Other Installation Conditions

Contact Marmon Industrial Energy & Infrastructure.

CABLE GLANDS AND CONNECTORS

Where the copper corrugated armour is used as the grounding or earthing conductor, it is recommended to use the properly grounded cable glands/connectors.

American Connectors Inc. manufacture cable glands which are specially designed to provide an excellent electrical bonding between the cable armour and the cable gland meeting the requirements of UL 514B for earth grounding continuity.

Other cable gland manufacturers such as the CMP TMC NPT series glands are also suited to copper corrugated armoured cables. (Check with manufacturer for specific types in hazardous areas UL, IECEx, ATEX, cCSAus)

Where VITALink® MC-metric cables are run for power circuits and armour is used as the ground/earthing conductor or as a combined Neutral and Earth conductor, such as in ESR (Earth Sheath Return) systems, it is important the cable armour is bonded at each end of the cable run. For single core VITALink® MC-cables, the copper corrugated armours must be electrically bonded at each end.

Supplemental earthing tags and additional lock rings may be used for ensuring earth continuity through junction boxes or joints.

TERMINATIONS AND ACCESSORIES

VITALink® MC-metric cables use standard IEC 60228 Class 2 stranding copper conductors and can be terminated exactly the same as any standard stranding conductor with XLPE or PVC cables, using copper compression terminations.

It is recommended to use good quality cable terminations from reputable manufacturers like Burndy, Thomas and Betts, Panduit, Tyco or other quality brands meeting IEC 61238-1. It is also important to use the correct crimping tool and compression dies to ensure a high-quality, low resistance termination.

TECHNICAL INFORMATION

Current Ratings – Single Core Cables

Product Code	Size (mm^2)	No. of Conductors	Ampacity [2] 90˚ C conductor	Ampacity [3] 110˚ C conductor
VM01050-500	50	1	207	246
VM01070-500	70	1	268	311
VM01095-500	95	1	328	388
VM01120-500	120	1	383	452
VM01150-500	150	1	444	520
VM01185-500	185	1	510	603
VM01240-500	240	1	607	721
VM01300-500	300	1	703	835
VM01400-500	400	1	823	974

[2]Ampacity 90˚C conductor BS 7671-2018 table 4E1A Column 10 — single core 30˚C ambient. Trefoil — in free air.

[3]Ampacity for 110˚C conductor from AS/NZS3008:2017-1-2 Table 9 Column 4 (single core) 30˚C ambient. Trefoil group in free air.

VITALink® MC-metric cables current ratings are based on BS 7671-2018 tables 4E1A (single core) and 4E2A (multicore) for a 90˚C conductor temperature in a 30˚C ambient. These ratings are the same as given in IEC 60364-5-52 tables A.52-12 (for single and multicore in a 30˚C ambient).

For current ratings using a conductor temperature of 110˚C, we recommend reference to AS/NZS 3008:2017.1.2 (for 30˚C ambient) or AS/NZS 3008:2017-1.1 (for 40˚C ambient).

It is also acceptable to use the current ratings for armoured cables in BS 7671:2018 tables 4E3A (single core with non-magnetic armour) and table 4E4A (multicore armoured).

Whichever international standard is used for the current ratings, the same standard should be used for derating factors, for other installation methods, for derating of groups and for different ambient temperatures.

For other cables or sizes, contact Marmon Industrial Energy & Infrastructure or reference local codes.

Current Ratings – Multicore Core Cables

Product Code	Size (mm^2)	No. of Conductors	Ampacity [4] 90˚ C conductor	Ampacity [5] 110˚ C conductor
VM022X5-500	2.5	2	36	44
VM02004-500	4	2	49	59
VM02006-500	6	2	63	74
VM02010-500	10	2	86	102
VM02016-500	16	2	115	135
VM032X5-500	2.5	3	32	37
VM03004-500	4	3	42	50
VM03006-500	6	3	54	63
VM03010-500	10	3	75	87
VM03016-500	16	3	100	114
VM03025-500	25	3	127	154
VM03035-500	35	3	158	189
VM03050-500	50	3	192	231
VM03070-500	70	3	246	291
VM03095-500	95	3	298	361
VM03120-500	120	3	346	418
VM03150-500	150	3	399	478
VM03185-500	185	3	456	551
VM03240-500	240	3	538	654
VM03300-500	300	3	621	750
VM042X5-500	2.5	4	32	37
VM04004-500	4	4	42	50
VM04006-500	6	4	54	63
VM04010-500	10	4	75	87
VM04016-500	16	4	100	114
VM04025-500	25	4	127	154
VM04035-500	35	4	158	189
VM04050-500	50	4	192	231
VM04070-500	70	4	246	291
VM04095-500	95	4	298	361
VM04120-500	120	4	346	418
VM04150-500	150	4	399	478
VM04240-500	185	4	456	551
VM04300-500	240	4	538	654
VM052X5-500	2.5	4 cores + Earth	32	37
VM05004-500	4	4 cores + Earth	42	50
VM05006-500	6	4 cores + Earth	54	63
VM05010-500	10	4 cores + Earth	75	87
VM05016-500	16	4 cores + Earth	100	114
VM05025-500	25	4 cores + Earth	127	154
VM072X5-500	2.5	7	23	30
VM102X5-500	2.5	10	21	26
VM122X5-500	2.5	12	20	25

[4] Ampacity for 90˚C conductor to BS 7671-2018 table 4E2A Column 8/9 (3&4 core) 30˚C ambient in free air.

[5] Ampacity for 110˚C conductor based on AS/NZS3008:2017-1-2 tables 12/15 Column 2 (multicore) at 30˚C ambient in free air.

NOTE: Where using ampacities which in a maximum ambient could result in conductors operating up to 110˚C, there are factors which should be taken into consideration:

- Touch temperatures and fire protective clearances.
- Watt losses (I2R) caused by higher conductor resistances at 110˚C and associated electricity running cost. See also the provisions of AS/NZS 3008:2017.1.1/2 clause 2.6 “Determination of cable size based on economic optimization”.
- Termination device temperature rating should match conductor temperature rating.

Conductor and Armour Information

Conductor area (mm²)	Conductor diameter (mm)	Cdr Short Circuit (5 S kA) T1-90 T2-250	1 core Copper armour (mm²)	2 core Copper armour (mm²)	3 core Copper armour (mm²)	4 core Copper armour (mm²)	5 core Copper armour (mm²)	Conductor resistance DC 20˚C (Ω/km)	Conductor resistance DC 90˚C (Ω/km)	Conductor resistance DC 110˚C (Ω/km)
2.5	2	0.192	-	-	33.6	42.4	42.4	7.41	9.448	10.031
4	2.5	0.297	-	33.6	33.6	42.4	42.4	4.61	5.878	6.241
6	3	0.435	-	33.6	42.4	42.4	42.4	3.08	3.927	4.169
10	3.9	0.706	-	42.4	42.4	53.5	53.5	1.83	2.333	2.477
16	5	1.1	-	42.4	42.4	53.5	53.5	1.15	1.466	1.557
25	6.4	1.7	-	42.4	53.5	53.5	67.4	0.727	0.927	0.984
35	7.3	2.3	-	-	67.4	67.4	-	0.524	0.668	0.709
50	8.9	3.3	42.4	-	67.4	85	-	0.387	0.493	0.524
70	10.5	4.6	42.4	-	85	85	-	0.268	0.342	0.363
95	12.2	6.2	42.4	-	85	85	-	0.193	0.246	0.261
120	13.8	7.9	53.5	-	85	107	-	0.153	0.195	0.207
150	15.4	9.8	53.5	-	85	107	-	0.124	0.158	0.168
185	17.1	12.1	53.5	-	85	107	-	0.099	0.126	0.134
240	19.5	15.6	67.4	-	-	127	-	0.075	0.096	0.102
300	21.8	19.5	67.4	-	-	-	-	0.06	0.077	0.081
400	25.2	26	67.4	-	-	-	-	0.047	0.060	0.064

Conductor mm²	Inductance (mH/km)	Reactance (Ω/km)	Impedance 20°C (Ω/km)	Inductance (mH/km)	Reactance (Ω/km)	Impedance 20°C (Ω/km)
	Single core cables			Multicore cables		
2.5	-	-	-	0.379	0.119	20.727
4	-	-	-	0.351	0.110	12.914
6	-	-	-	0.346	0.109	8.647
10	-	-	-	0.320	0.101	5.156
16	-	-	-	0.299	0.094	3.256
25	-	-	-	0.279	0.088	2.074
35	-	-	-	0.269	0.085	1.506
50	0.311	0.098	1.132	0.273	0.086	1.126
70	0.296	0.093	0.797	0.262	0.082	0.792
95	0.284	0.089	0.586	0.253	0.080	0.581
120	0.282	0.089	0.475	0.255	0.080	0.471
150	0.274	0.086	0.393	0.249	0.078	0.389
185	0.267	0.084	0.323	0.244	0.077	0.319
240	0.259	0.081	0.255	0.238	0.075	0.252
300	0.258	0.081	0.213	0.239	0.075	0.210
400	0.250	0.078	0.176	-	-	-

Armour area in (mm2)	DC Resistance 20°C (Ω/km)
33.6	0.5312
42.4	0.4196
53.5	0.3346
67.4	0.2657
85	0.2106
107	0.1673
127	0.1414

Three Phase Voltage Drop (V_c) at 50 Hz

SINGLE CORE insulated & sheathed cables with copper conductors in trefoil

1	2	3	4	5	6	7	8	9	10	11
Conductor size mm²	Three Phase voltage drop (Vc) at 50 Hz mV/A.m									
	Conductor Temperature ˚C									
	45		60		75		90		110	
	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.
1.5	25.9	—	27.3	—	28.6	—	30	—	31.9	—
2.5	14.1	—	14.9	—	15.6	—	16.4	—	17.4	—
4	8.77	—	9.24	—	9.71	—	10.2	—	10.8	—
6	5.86	—	6.18	—	6.49	—	6.81	—	7.23	—
10	3.49	—	3.67	—	3.86	—	4.05	—	4.3	—
16	2.2	—	2.31	—	2.43	—	2.55	—	2.7	—
25	1.4	—	1.47	—	1.54	—	1.62	—	1.72	—
35	1.01	—	1.07	—	1.12	—	1.17	—	1.24	—
50	0.757	—	0.795	—	0.834	—	0.872	—	0.924	—
70	0.537	—	0.563	—	0.589	—	0.615	—	0.65	—
95	0.402	—	0.42	—	0.439	—	0.457	—	0.481	—
120	0.332	—	0.345	—	0.359	—	0.373	—	0.392	—
150	0.284	—	0.295	—	0.305	—	0.316	—	0.331	—
185	0.245	0.245	0.253	0.253	0.261	—	0.269	—	0.28	—
240	0.211	0.208	0.216	0.214	0.221	0.22	0.227	0.226	0.235	0.234
300	0.191	0.185	0.195	0.19	0.198	0.195	0.202	0.199	0.208	0.206
400	0.175	0.166	0.178	0.169	0.181	0.173	0.183	0.176	0.187	0.181
500	0.165	0.15	0.166	0.153	0.168	0.156	0.17	0.158	0.172	0.162

MULTICORE 3 & 4 core cables with circular with copper conductors

1	2	3	4	5	6	7	8	9	10	11
Conductor size mm²	Three Phase voltage drop (Vc) at 50 Hz mV/A.m									
	Conductor Temperature ˚C									
	45		60		75		90		110	
	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.	max	0.8 p.f.
1.5	25.9	—	27.3	—	28.6	—	30	—	31.9	—
2.5	14.1	—	14.9	—	15.6	—	16.4	—	17.4	—
4	8.77	—	9.24	—	9.71	—	10.2	—	10.8	—
6	5.86	—	6.18	—	6.49	—	6.8	—	7.22	—
10	3.49	—	3.67	—	3.86	—	4.05	—	4.29	—
16	2.19	—	2.31	—	2.43	—	2.55	—	2.7	—
25	1.39	—	1.47	—	1.54	—	1.61	—	1.71	—
35	1.01	—	1.06	—	1.11	—	1.17	—	1.24	—
50	0.751	—	0.79	—	0.829	—	0.868	—	0.92	—
70	0.53	—	0.556	—	0.583	—	0.609	—	0.645	—
95	0.394	—	0.413	—	0.431	—	0.45	—	0.475	—
120	0.323	—	0.337	—	0.351	—	0.366	—	0.385	—
150	0.274	—	0.285	—	0.296	—	0.307	—	0.322	—
185	0.234	—	0.242	—	0.251	—	0.259	—	0.271	—
240	0.198	0.198	0.204	0.204	0.21	0.21	0.216	0.216	0.224	—
300	0.178	0.175	0.182	0.18	0.186	0.185	0.19	0.189	0.196	0.196

The Vc values given above are based on a balanced three-phase circuit where no current flows in the neutral conductor.

For single phase Vc, the current in the neutral must be considered. Multiply the three-phase values by: $\frac{2}{\sqrt{3}} = 1.155$

EARTH LOOP IMPEDANCE — 1 Core Cables

Resistance & Earth Fault Loop Impedance: Single-core cables, bare copper or LSZH sheath											
The cables copper armours shall be electrically bonded at each end. Value of R1 & R2 adjusted to establish the Earth Loop Impedance at 70˚C under normal operating conditions											
Phase conductor				One cable isolated		Two cables single phase		Three cables three phase		Four cables three phase	
Cable Size		Conductor DC Resistance at 20°C	Conductor DC Resistance at 70°C (R1)	Effective Sheath area	Sheath DC Resistance at 20°C (R2)	Effective Bonded Sheath area	Earth Fault Loop Impedance (R1+R2) 70°C	Effective Bonded Sheath area	Earth Fault Loop Impedance (R1+R2) 70°C	Effective Bonded Sheath area	Earth Fault Loop Impedance (R1+R2) 70°C
cores	mm2	Ω/km	Ω/km	mm2	Ω/km	mm2	Ω/km	mm2	Ω/km	mm2	Ω/km
1	50	0.387	0.4630	42.4	0.42	85	0.6730	127	0.6030	170	0.5680
1	70	0.268	0.3207	42.4	0.42	85	0.5307	127	0.4607	170	0.4257
1	95	0.193	0.2309	42.4	0.42	85	0.4409	127	0.3709	170	0.3359
1	120	0.153	0.1831	53.5	0.335	107	0.3506	161	0.2947	214	0.2668
1	150	0.124	0.1484	53.5	0.335	107	0.3159	161	0.2600	214	0.2321
1	185	0.0991	0.1186	53.5	0.335	107	0.2861	161	0.2302	214	0.2023
1	240	0.0754	0.0902	67.4	0.266	135	0.2232	202	0.1789	270	0.1567
1	300	0.0601	0.0719	67.4	0.266	135	0.2049	202	0.1606	270	0.1384
1	400	0.047	0.0562	67.4	0.266	135	0.1892	202	0.1449	270	0.1227

EARTH LOOP IMPEDANCE — Multicore Cables

Resistance and Earth Fault Loop Impedance for Multi-core cables, bare copper or LSZH sheath													
Value of R1 & R2 adjusted to establish the Earth Loop Impedance at 70˚C under normal operating conditions							Value of R1 & R2 adjusted to establish the Earth Loop Impedance at 70˚C under normal operating conditions						
Cable Size							Cable Size						
cores	mm²	Conductor Resistance at 20°C	Conductor Resistance at 70°C (R1)	Sheath Resistance at 20°C (R2)	Earth Fault Loop impedance (R1+R2) 70°C Ω/km	Effective Sheath area in mm²	cores	mm²	Conductor Resistance at 20°C	Conductor Resistance at 70°C (R1)	Sheath Resistance at 20°C (R2) max	Earth Fault Loop impedance (R1+R2) 70°C Ω/km	Effective Sheath area in mm²
2	2.5	7.410	8.866	0.531	9.397	33.6	4	2.5	7.410	8.866	0.42	9.286	42.4
2	4	4.610	5.516	0.531	6.047	33.6	4	4	4.610	5.516	0.42	5.936	42.4
2	6	3.080	3.685	0.42	4.105	42.4	4	6	3.080	3.685	0.42	4.105	42.4
2	10	1.830	2.190	0.42	2.610	42.4	4	10	1.830	2.190	0.335	2.525	53.5
2	16	1.150	1.376	0.42	1.796	42.4	4	16	1.150	1.376	0.335	1.711	53.5
3	2.5	7.410	8.866	0.531	9.397	33.6	4	25	0.727	0.870	0.335	1.205	53.5
3	4	4.610	5.516	0.531	6.047	33.6	4	35	0.524	0.627	0.266	0.893	67.4
3	6	3.080	3.685	0.42	4.105	42.4	4	50	0.387	0.463	0.211	0.674	85
3	10	1.830	2.190	0.42	2.610	42.4	4	70	0.268	0.321	0.211	0.532	85
3	16	1.150	1.376	0.42	1.796	42.4	4	95	0.193	0.231	0.211	0.442	85
3	25	0.727	0.870	0.335	1.205	53.5	4	120	0.153	0.183	0.167	0.350	107
3	35	0.524	0.627	0.266	0.893	67.4	4	150	0.124	0.148	0.167	0.315	107
3	50	0.387	0.463	0.266	0.729	67.4	4	185	0.099	0.119	0	0.119	107
3	70	0.268	0.321	0.211	0.532	85	4	240	0.075	0.090	0.141	0.231	127
3	95	0.193	0.231	0.211	0.442	85	5	2.5	7.410	8.866	0.42	9.286	42.4
3	120	0.153	0.183	0.211	0.394	85	5	4	4.610	5.516	0.42	5.936	42.4
3	150	0.124	0.148	0.211	0.359	85	5	6	3.080	3.685	0.335	4.020	42.4
3	185	0.099	0.119	0.211	0.330	85	5	10	1.830	2.190	0.335	2.525	53.5
3	240	0.075	0.090	0.167	0.257	107	5	16	1.150	1.376	0.335	1.711	53.5
3	300	0.060	0.072	0.141	0.213	127	5	25	0.727	0.870	0.266	1.136	67.4
6	2.5	7.41	8.866	0.4196	9.286	42.2	10	2.5	7.41	8.866	0.3346	9.201	53.5
7	2.5	7.41	8.866	0.4196	9.286	42.2	11	2.5	7.41	8.866	0.3346	9.201	53.5
9	2.5	7.41	8.866	0.3346	9.201	53.5	12	2.5	7.41	8.866	0.3346	9.201	53.5

Paralleling Single Core Cables

Conductors to be joined in parallel should be 50mm^2 or larger. See local codes as applicable.

The paralleled conductors in each phase, neutral or grounded circuit conductor shall:

- Be the same length
- Have the same conductor material
- Be the same conductor size
- Have the same insulation type
- Be terminated in the same manner
- Laid in the same configuration

Where conductors are used in parallel, space in enclosures and termination points shall be given consideration.

Where equipment grounding/earthing conductors are used with parallel conductors, they shall be sized according to the combined total active conductor size or Article 250 of the NEC or local codes as applicable.

Bonding/Grounding

Metal raceways, cable armour and other metal enclosures for conductors shall be metallically joined together into a continuous electric conductor and shall be connected to all boxes, fittings and cabinets so as to provide effective electrical continuity.

VITALink® MC-metric copper armour may be used as an equipment ground.

Note that increases in non-grounded conductor size due to voltage drop will warrant an increase in ground conductor size proportionately.

Splices/Terminations

Non-fire rated joints shall follow practices outlined in local codes. The resistance of the copper armour across the joint must equal the resistance across an equivalent length of unjointed cable. Fire rated splices shall follow the instructions sheets for the fire resistive system being installed.

Induced Currents in Metal Enclosures or Metal Raceways

Where conductors carrying alternating current are installed in metal enclosures or metal raceways, they shall be arranged so as to avoid heating the surrounding metal by induction. To accomplish this, all phase conductors and, where used, the grounded conductor and all equipment grounding conductors shall be grouped together.

Where a single conductor carrying alternating current passes through metal with magnetic properties, the inductive effect shall be minimized by:

1) cutting slots in the metal between the individual holes through which the individual conductors pass, or

2) passing all the conductors in the circuit through a single opening or through a non-magnetic material like a brass gland plate sufficiently large for all of the conductors of the circuit.

Supplemental Notes for VITALink® MC-metric cables:

- Cables are supplied with bare corrugated copper sheath as standard or with low smoke zero halogen (LSZH) jacket if required.
- Cables are manufactured to UL 1569 — 2018 edition, for a voltage rating of 2kV.
- Cables comply with UL 2196:2018 for a 2-hour fire rating. UL 2196:2018 is a 600V test standard.
- Cables core colors are black with white numbers. If the cable is ordered with internal ground conductor this will be yellow/green.
- Cables can be supplied with 3 split earth conductors for variable speed drive (VSD / VFD) applications.
- Jacketed cables' standard outer sheath color is black. Other colours upon request.
- Cables have an installation bending radius of 10 x outer cable diameter and can be fixed with a minimum bend radius of 7 x outer diameter. Please see separate installation instructions.
- Cables are suitable for direct burial. It is recommended to use a protective outer jacket in areas where corrosive chemicals might degrade the copper armour.
- The cables' corrugated copper armour is designed to be used as the ground conductor. As such, the cable armour must be securely connected to cable entry gland plates or terminations with suitable grounding glands and connected to earth.
- The cables' corrugated copper armour can be used in Earth Sheath Return systems for the combined earth neutral conductor and in such cases is subject to the same regulations as other metallic sheathed cables used in ESR systems.

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