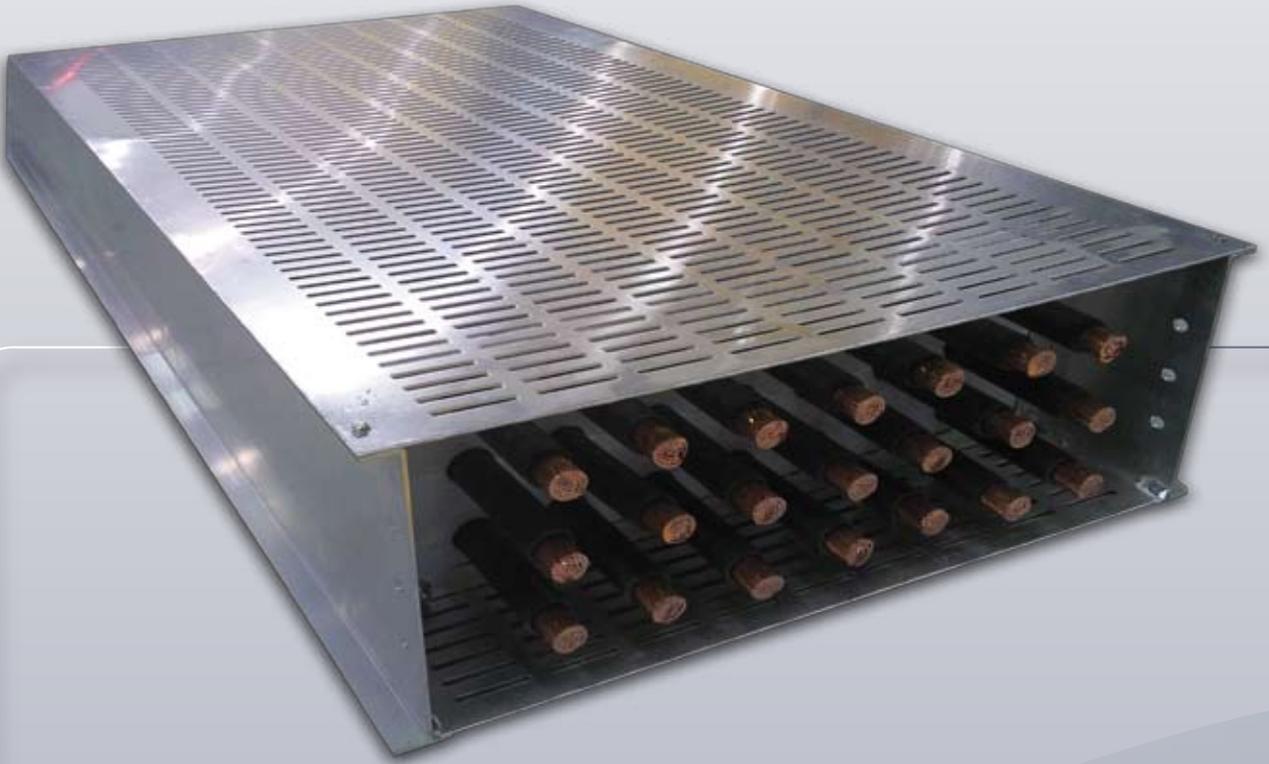




شركة واجة العربية السعودية للإمدادات الكهربائية المحدودة
Wahah Electric Supply Co. of Saudi Arabia (Ltd.)



CABLE BUS

Power for All Voltages

0.6kV - 15kV

1000Amp - 5000Amp

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Cable Bus

Introduction

CABLE BUS is an assembly of fully insulated conductors mounted in a ventilated metal housing which maintains designed cable spacing. The welded aluminum alloy enclosure is provided in custom lengths, with each piece sized to fit the specific installation. The system includes all necessary equipment connections, flanges, cable, wall entrance seals, fire stops, elbows, offsets, terminal lugs, termination kits, and assembly hardware. A complete set of match-marked layout drawings shows the location of each section and accessories, for a simple and fast installation.

WESCOSA CABLE BUS is field proven for years to be the most reliable, cost-effective, flexible and maintenance-free power distribution system. Typical applications range from 1000 through 5,000 Amps / 600V,5kV and 15kV. The system is used for a wide range of busway lengths, including relatively short feeders (10—30 feet) through electrical feeders that are several thousand feet long. And WESCOSA CABLE BUS is proven in some of the most extreme environments and conditions including Oil Refineries, Fossil Fuel Burning Facilities, Chemical Plants, Heavy Salt Environments, Hot Areas and Tropical Areas.

Superior performance is achieved by utilizing high quality continuous conductors that are positioned in an engineered spacing and phasing arrangement. This designed spacing and arrangement allows for optimal balance of loads between the conductors, minimized impedance and voltage drop, as well as maximum load carrying capacity through free air rated conductors. The cables are run in parallel without interleaving throughout the entire bus housing, and the system utilizes specific cable support blocks that brace the cables to withstand large momentary short circuit.

WHEN RELIABILITY AND EFFICIENCY ARE A MUST, AND DOWNTIME IS NOT AN OPTION, WESCOSA'S CABLE BUS IS THE SOLUTION FOR YOUR ELECTRICAL BUS DUCT AND ELECTRICAL FEEDER REQUIREMENTS.

Superior Reliability

Years of field use and independent testing have proven WESCOSA CABLE BUS to be one of the most reliable systems in the market.

Five key features contributing to superior reliability:

- High quality cables are reliable and are continuous from termination to termination, eliminating faulty splices.
- WESCOSA CABLE BUS utilizes fully insulated conductors that are designed and manufactured to withstand the outdoor environment with no further protection of the conductors being required against moisture or sunlight. Since our system design is not affected by moisture and is ventilated for indoor and outdoor applications, it does not require heater strips, filter breathers, or thermostats that competitive technologies require to try and keep moisture out of their systems.
- The system's short circuit capacity has been tested to 100,000RMS symmetrical amperes. Support blocks restrain the cable throughout the entire system.
- Top and bottom covers are ventilated for optimum free air rating. Cables in CABLE BUS run cooler than cable in tray or conduit, as well as bus bars in bus duct.

Lowest Cost

In most electrical applications over 1,000 amperes, CABLE BUS costs significantly less than non-segregated bus duct or conduit and wire systems. As ampacity or the cost of copper increases, the cost savings of CABLE BUS over other systems is even greater.

Since CABLE BUS is continuous there are no power losses from intermediate splices or connections. CABLE BUS has a lower impedance and lower voltage drop because its conductors are properly phased, spaced and secured in a pre-engineered system. This reduces operating costs by providing long-term energy savings. The use of parallel conductors, combined with our free air rating, allows you to operate fully and efficiently with smaller cables than would be called for with other types of systems.

Flexibility

The design of WESCOSA CABLE BUS is such that the installation of our system can accommodate unexpected differences between engineering drawings and actual construction, with little or no delay in the project. WESCOSA provides additional cable & CABLE BUS housing to accommodate misplaced equipment in the field. If the placement of equipment requires a shorter bus length, CABLE BUS sections can easily be cut in the field to adjust to the required length.

Cable Bus

Specification

1.0 General

- 1.1 CABLE BUS Systems shall be provided in accordance with this specification and technical data sheet; including all necessary materials, insulated conductors, enclosure connectors, entrance fittings, taps boxes, termination boxes, cable termination lugs, termination kits and all other accessories as required to form a complete CABLE BUS System.
- 1.2 All elements of the CABLE BUS Enclosure shall be so designed as to eliminate any sharp edges and/or any projections that may injure personnel or conductor insulation.
- 1.3 All CABLE BUS Systems are to be suitable for indoor/outdoor use with conductor spacing and ventilation maintained throughout the system. All ventilation openings are to be such that will not permit the penetration of a ¼" (6.35mm) rod.
- 1.4 The CABLE BUS System shall be as manufactured by WESCOSA.

2.0 Construction

- 2.1 CABLE BUS Housing is to be manufactured from natural finished aluminum, with all load carrying members fabricated from extruded aluminum alloy 6063-T6, the maximum allowable stress used in design shall be 10,000 PSI.
- 2.2 All Horizontal and Vertical elbows shall have a radius of not less than 24 inches (609.6mm) unless the cable minimum bending radius requires a larger radius.
- 2.3 The top and bottom CABLE BUS Housing Covers are to be slotted for ventilation. The cover ventilation is to permit the use of the free air rating for the conductors within the CABLE BUS Enclosure, All bottom covers are to be installed by welding. All Top Covers (installed at Site) shall be fastened to the CABLE BUS Enclosure with self tapping screws spaced approximately 2 feet on centers and shall be removable for inspection.
- 2.4 Conductor Support Blocks are to be in segments to maintain a minimum of one conductor (Cable) diameter in horizontal and/or vertical planes, for a free air conductor rating. All Cable Support Blocks shall be spaced every 36" (914.4mm) for all horizontal straight runs and every 18" (457.2mm) for all vertical straight runs and elbows.
- 2.5 CABLE BUS Housing sections shall have splice plates bolted to the housing using high pressure splined bolts type of design which avoids any structural weakness at the connection.

3.0 Electrical

- 3.1 All current carrying conductors are to be insulated with XLPE or EPR insulation, thickness of the insulation to be suitable for the voltage class of the CABLE BUS System requested. Current carrying conductors shall be rated for 90°C operating temperature, in accordance with IEEE Std. 835-1994/ICEA publication #P-46-426/N.E.C. and IEC for the ampacity and voltage specified.
- 3.2 Conductors shall be of continuous length and pulled in after the CABLE BUS housing is in place. Electrical connectors shall be used at the termination of conductor runs or at tap points. All connectors are to be furnished by the CABLE BUS vendor.
- 3.3 The conductors within the CABLE BUS enclosure shall be phased, spaced and supported to maintain low impedance and assure the mechanical strength necessary to prevent cable movement or damage under short circuit currents. The conductor shall be arranged in a phasing pattern which exhibits minimal inter-phase and intra-phase imbalance.
- 3.4 Cable transpositions within the CABLE BUS Enclosure are not permitted. Any transpositions if required must occur at the conductor termination points.

Cable Bus

Features & Benefits

Reliable

- Our system utilizes continuous runs of power cable (no faulty splices) from termination to termination.
- WESCOSA utilizes high quality XLPE insulated cables from SAUDI/RIYADH or OMAN Cables.

Lowest Cost

- Free Air Rating allows greater amperage capacity with less copper, achieving significant cost savings.
- Substantial savings on materials and installation costs compared to other systems.

Flexible & Adaptable

- Unlike non-segregated bus duct, WESCOSA CABLE BUS systems are easily adjusted in the field to accommodate misplacements of equipment that often occur during construction.
- Easily routed around unforeseen field obstructions, i.e. piping, structural steel, equipment, etc.
- Our extensive custom fabrication capabilities ensure that we can manufacture a system to meet all of your difficult coordination challenges.

Free Air Rating for Conductors

- Up to 40% less conductive material (copper or aluminum) is needed to carry full rated current.
- Minimum temperature rise due to ventilated enclosure and maintained cable spacing by custom support blocks.
- Maximum ampacity in accordance with W.E.C. / ICEA & IEC listings for 90 degree Celsius rated conductors.

Match-Marked Layout Drawings

- CABLE BUS system layout drawings are shipped complete with match-marked numbers that correspond to each CABLE BUS section.
- Facilitates easy field erection.

Proper Phase Balance

- WESCOSA utilizes an Inductive Reactance Calculations to achieve the proper cable spacing and phasing arrangement that ensures low impedance and low voltage drop.
- Balanced load carrying of conductors prevent over- heating of cables.

Indoor or Outdoor Applications

- Standard WESCOSA CABLE BUS system is utilized for indoor or outdoor applications.
- No special finishes are required with housing available in Aluminum.
- Excellent protection against adverse environments including Fossil, Chemical Plants, cold, hot and tropical locations.
- Powder Coat Epoxy Paint is available for corrosive environments.

Labor Savings

- Cables run in parallel throughout entire bus housing.
- Our system does not interleave or transpose cables in the bus housing.
- Lightweight ventilated enclosure in which two men can easily lift 12' or 24' length into position.
- No special heavy erection equipment required.

Cable Bus

Features & Benefits

Less Support Material

- Design criteria accomplishes high load carrying ability on long spans with minimal support material.
- Flush bottom design allows for use of standard support material.

Safe

- WESCOSACABLE BUS is an all welded rigid construction.
- Workmen free of shock hazards—no exposed bus elements, only insulated conductors used.
- Ventilated design prevents entry of foreign objects.
- Support block design assures proper arrangement of conductors.

Complete System

- WESCOSA CABLE BUS systems are complete with all necessary fittings for direction and elevation changes.
- Termination boxes, equipment seals, firestops and bus end flanges (including weatherproof boxes—NEMA 4).
- Lugs, termination kits and adapter bus bars.

Factory Fabricated—All Welded

- Bottom cable support block is factory pre-installed in CABLE BUS housing.
- Entire system is factory fabricated to fit the specific requirements of each individual project.
- All welded construction for maximum strength
- Bottom cable support block is factory pre-installed in CABLE BUS housing.
- Entire system is factory fabricated to fit the specific requirements of each individual project.
- All welded construction for maximum strength.

Testing and Certification

- Heat-Rise Test Report is available upon request.
- 20' span Load Test.
- Short-circuit tested to 100kA RMS Symmetrical.

Cable Bus

Technical Information

Selection of the proper CABLE BUS system must be undertaken with care to assure that it compliments the design of the overall electrical power system.

ELECTRICAL DESIGN

To ensure an efficient, dependable, high quality installation, every WESCOSA CABLE BUS System is engineered fully with particular emphasis placed on CABLES, SYSTEM BALANCE, SHORT CIRCUIT CAPABILITY and GROUNDING REQUIREMENTS. Each one of these key design considerations must be analyzed separately to determine how they affect the overall system design.

PARALLEL CONDUCTORS

Parallel conductors (more than one per phase) can be used to an advantage in CABLE BUS where large conductor sizes are encountered. The ampacity per circular mil of conductor decreases as the circular mil of conductor increases. Smaller conductors running parallel are more flexible during installation and have greater current carrying capability than fewer, larger conductors.

VOLTAGE DROP

Proper system design dictates that voltage drop be considered for both the power feeders separately as well as the entire power system.

An approximate line to neutral voltage drop can be calculated by using the following formula:

$$V.D._{L-N} = I (R \cos \theta + X \sin \theta)$$

$$\% V.D. = \frac{KVA (R \cos \theta + X \sin \theta)}{10 (KV)^2}$$

SHIELDING

Shielding is used on power cables to confine the dielectric field of the conductor to the cable insulation. Shielded Power Cables are used in CABLE BUS for applications above 2500 volts and when any of the following conditions exist:

1. Where cables are subject to soot or other heavy deposits that may form paths to ground.
2. Where electrostatic discharge can effect nearby computerized control cables or other low level signals.
3. Concern for Personnel safety.

When installing shielded cable the metallic shielding must be solidly grounded and the installation must be studied to determine the best grounding method. This is necessary as voltage is induced in the shield of a single conductor cable carrying alternating current due to mutual inductance between its shield and any other conductor in its vicinity. This induced voltage can result in two conditions:

1. Metal shields bonded or grounded at more than one point have circulating currents flowing in them. The magnitude of the circulating currents depends on the mutual inductance to the other cables, the current in these conductors, and the resistance of the shield.
2. Shields bonded or grounded at only one point will have a voltage build up in the sheath.

Cable Bus

Technical Information

SYSTEM BALANCE

CABLE BUS is a power distribution system using single conductor insulated power cables and support blocks to maintain cable spacing. Each phase consists of one or more cables connected in parallel. The complete assembly is enclosed in a ventilated aluminum or steel enclosure for support and protection.

Parallel conductor transmission lines, using widely spaced conductors, have been in use for many years. The electrical coupling between the conductors of a parallel conductor system, which is a function of the geometry of the location of the conductors, can cause an imbalance in the conductor currents. In a widely spaced overhead transmission line transposition of conductors can economically be used to balance the conductor currents.

The spacing of the conductors in CABLE BUS is one cable diameter, (i.e. one to three inches), as compared to the typical value of thirty feet used in overhead lines. This close spacing and the relatively short lengths, as compared to hundreds of miles for overhead lines, make the transposition of conductors for balancing purposes a practical impossibility.

The objective of the CABLE BUS design was to obtain the optimum balance for an electrical circuit using parallel conductors (no transposition) with close spacing. WESCOSA has designed CABLE BUS Systems with minimal imbalance.

WESCOSA CABLE BUS is designed for balance of conductors within a phase (intra-phase) and balance between the phases (inter-phase). Many phasing arrangements will provide inter-phase balance of currents due to the load impedance, but the majority of these phasing arrangements provide intra-phase current imbalance.

WESCOSA's CABLE BUS design provides a phasing arrangement that achieves inter-phase current balance, as well as intra-phase current balance, therefore reducing the amount of parallel conductor imbalance to a minimum.

SHORT CIRCUIT CAPACITY

A CABLE BUS system must be able to withstand the dangerous mechanical forces created by short circuit currents. These forces are transmitted from the conductors to the cable supports. In the case of CABLE BUS, the support elements include the support blocks and enclosure.

Short circuit currents are made up of two parts; a symmetrical AC component and a rapidly decreasing DC component (Fig.1 on next page). A CABLE BUS system must be selected so that its mechanical strength will withstand the maximum instantaneous current and to a lesser degree the 5-8 cycle resultant symmetrical current. The symmetrical current is the actual value that a high voltage breaker will interrupt.

Since CABLE BUS is often used for main feeder Connections,(e.g. substation or generator to switchgear, load centers and high voltage Machines), the available short circuit current will be that of the utility or generator supply through the transformers. In some cases, the CABLE BUS feeds large motors and the motor contribution to short circuit must also be considered. Numerous tables are available listing motor contributions for various operating conditions.

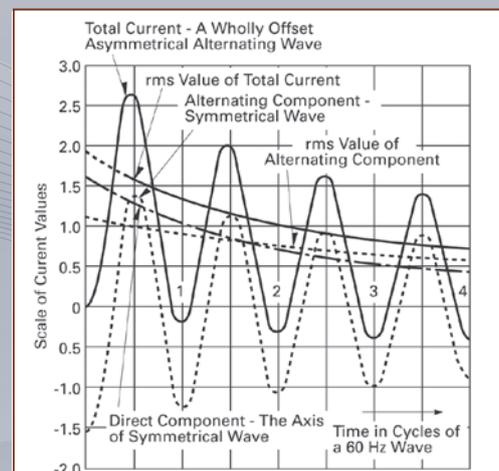


Fig.1

Cable Bus

Technical Information

Available fault currents can be limited to some extent by conductor impedance. The impedance can be in the form of either conductor length, size or a combination of both.

The WESCOSA CABLE BUS design ignores these added conductor impedance; instead the worst fault conditions are always assumed. For design consideration a three phase short circuit current will result in the maximum mechanical forces for design considerations.

If CABLE BUS is fed directly from the utility company service then short circuit current data will be available from the utility.

Where CABLE BUS is connected to the transformer secondary the three-phase fault current can be calculated using the following formula:

$$I = \frac{\text{KVA} \times 1000 \times 100}{1.73 \times E \times Z}$$

I = RMS Symmetrical Fault Current
KVA = Transformer Rating
E = Secondary Voltage of Transformers
Z = Impedance of Transformer in Percent

Where motor contributions are considered, the fault current due to the motor feedback will be a function of the voltage and is usually expressed as multiples of the motor full load current. NEMA standards are available which list these factors. Certified tests have been conducted to determine the short circuit performance of CABLE BUS using various supporting arrangements.

SHORT CIRCUIT TESTING

The tests performed on the 15KV/4KA CABLE BUS were conducted similar to the tests outlined in IEEE C37.23.

The tests were conducted on a 3 phase, 60Hz circuit having a power factor of less than 20% at voltages from 600 to 634 volts. One end of the CABLE BUS was connected to the source terminals and the other was short circuited to create a three phase bolted fault.

WESCOSA's CABLE BUS has been subjected to currents of 100,000 RMS symmetrical amperes with asymmetrical currents greater than 200,000 amperes. CABLE BUS withstood the mechanical forces of the test without any damage to the cables, support blocks or enclosure.

GROUNDING

A CABLE BUS system must afford protection to life and property against faults caused by electrical disturbance. Lightning, electrical system failures, as well as failures in the system corrected equipment all constitute possible fault hazard locations.

For this reason, all metal enclosures of the system, as well as non-current carrying or neutral conductors should be tied together and reduced to a common potential. This includes the structural steel of the building, water, steam and gas piping.

There are two distinct divisions to the system and equipment grounding problem. The system ground is the connection of the distribution system to earth by means of a neutral or grounded conductor and system grounding serves to limit the voltage, which might appear on a circuit due to lightning or accidental contact.

Cable Bus

Technical Information

CABLE BUS systems should be grounded to substation structure and thus to the substation ground grid and to the building steel by means of the CABLE BUS support materials. CABLE BUS should also be grounded to the equipment or switchgear enclosure by means of a box connector.

It is an accepted fact that ground currents tend to concentrate near power conductors and that cable enclosures take a large portion of the ground currents; therefore, it is important to consider CABLE BUS as a major carrier of ground currents.



Cable Bus

System Cross Sections & Dimensions

System Cross Sections & Dimensions

NEC/IEC 600V

TYPICAL AMPACITY	HEIGHT (H)	WIDTH (W)
1000A	203mm (8")	356mm (14")
1200A	203mm (8")	356mm (14")
1600A	203mm (8")	508mm (20")
2000A	203mm (8")	508mm (20")
2500A	203mm (8")	508mm (20")
3000A	254mm (10")	508mm (20")
3200A	254mm (10")	508mm (20")
3500A	254mm (10")	508mm (20")
4000A	254mm (10")	661mm (26")
5000A	254mm (10")	661mm (26")

NEC/IEC 5kV

TYPICAL AMPACITY	HEIGHT (H)	WIDTH (W)
1000A	203mm (8")	356mm (14")
1200A	203mm (8")	356mm (14")
1600A	203mm (8")	508mm (20")
2000A	203mm (8")	508mm (20")
2500A	203mm (8")	508mm (20")
3000A	203mm (8")	508mm (26")
3500A	254mm (10")	661mm (26")
4000A	254mm (10")	661mm (26")
5000A	254mm (10")	712mm (28")

NEC/IEC 15kV

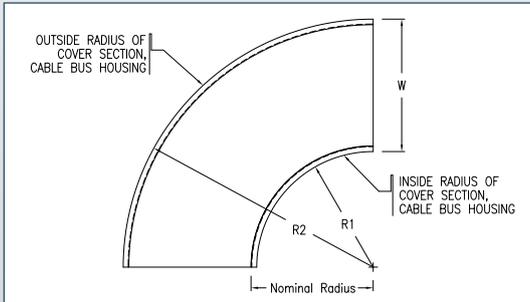
TYPICAL AMPACITY	HEIGHT (H)	WIDTH (W)
1000A	203mm (8")	356mm (14")
1200A	203mm (8")	356mm (14")
1600A	203mm (8")	508mm (20")
2000A	203mm (8")	661mm (26")
2500A	203mm (8")	661mm (26")
3000A	305mm (10")	661mm (26")
3500A	305mm (12")	661mm (26")
4000A	305mm (12")	712mm (28")
5000A	305mm (12")	813mm (32")

- Systems shown are 3 Phase / 3 Wire without system ground.
- Systems can be 3 Phase / 4 Wire with full, half or partial neutral with/without a system ground.
- Combining circuits within the same enclosure is available.
- For additional amperage and voltage requirements please contact the factory.

Cable Bus

Design Cross Sections & Dimensions

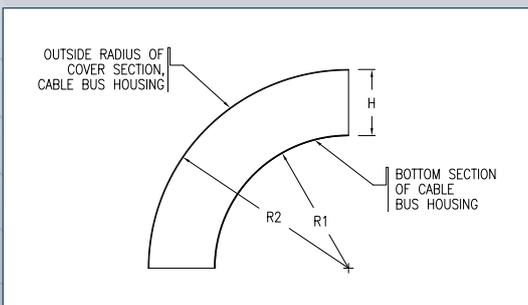
90° Horizontal Radius Fitting



*Radii shown are to outside flange.
Cable radius will be nominal radius or greater.

Nominal Radius	CABLE BUS Width "W"(Total)	Inside Radius "R1"	Outside Radius "R2"
12"	356mm (14")	279mm (11")	635mm (25")
	508mm (20")	279mm (11")	787mm (31")
	661mm (26")	279mm (11")	940mm (37")
18"	356mm (14")	432mm (17")	788mm (31")
	508mm (20")	432mm (17")	940mm (37")
	661mm (26")	432mm (17")	1093mm (43")
24"	712mm (28")	432mm (17")	1144mm (45")
	356mm (14")	584mm (23")	940mm (37")
	508mm (20")	584mm (23")	1093mm (43")
24"	661mm (26")	584mm (23")	1245mm (49")
	712mm (28")	584mm (23")	1296mm (51")
	813mm (32")	584mm (23")	1397mm (55")

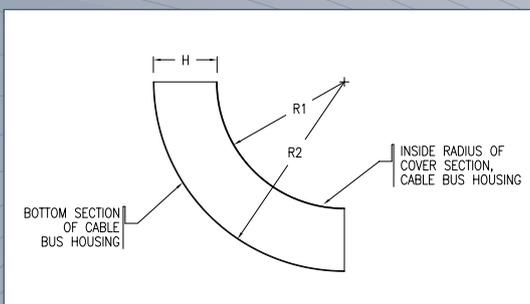
90° Vertical Outside Radius Fitting



*Radii shown are to outside flange.
Cable radius will be nominal radius or greater.

Nominal Radius	CABLE BUS Height "H"	Inside Radius "R1"	Outside Radius "R2"
12"	203mm (8")	305mm (12")	508mm (20")
	254mm (10")	305mm (12")	559mm (22")
	305mm (12")	305mm (12")	610mm (24")
18"	203mm (8")	457mm (18")	660mm (26")
	254mm (10")	457mm (18")	711mm (28")
	305mm (12")	457mm (18")	762mm (30")
24"	203mm (8")	610mm (24")	813mm (32")
	254mm (10")	610mm (24")	864mm (34")
	305mm (12")	610mm (24")	915mm (36")

90° Vertical Inside Radius Fitting



*Radii shown are to outside flange.
Cable radius will be nominal radius or greater.

Nominal Radius	CABLE BUS Height "H"	Inside Radius "R1"	Outside Radius "R2"
12"	203mm (8")	305mm (12")	508mm (20")
	254mm (10")	305mm (12")	559mm (22")
	305mm (12")	305mm (12")	610mm (24")
18"	203mm (8")	457mm (18")	660mm (26")
	254mm (10")	457mm (18")	711mm (28")
	305mm (12")	457mm (18")	762mm (30")
24"	203mm (8")	660mm (24")	813mm (32")
	254mm (10")	660mm (24")	864mm (34")
	305mm (12")	660mm (24")	915mm (36")

Cable Bus

Installation

The following techniques are suggested to pull cables into place:

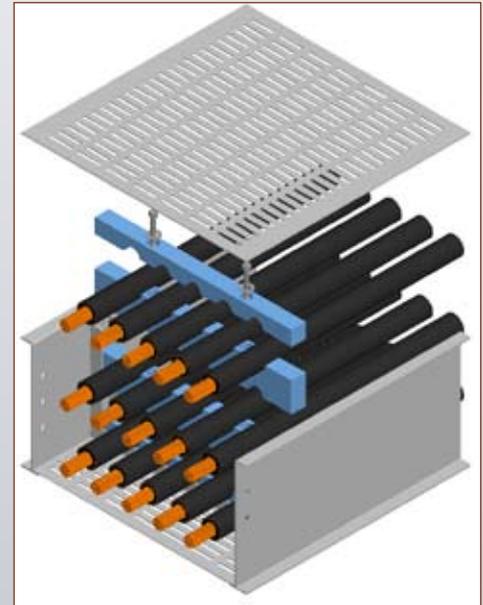
Cables with an O.D. larger than 2" can be pulled by pulling eye or a basket grip.

If the strain does not elongate or damage the insulation then short lengths and small diameter cables may be pulled with a basket grip only.

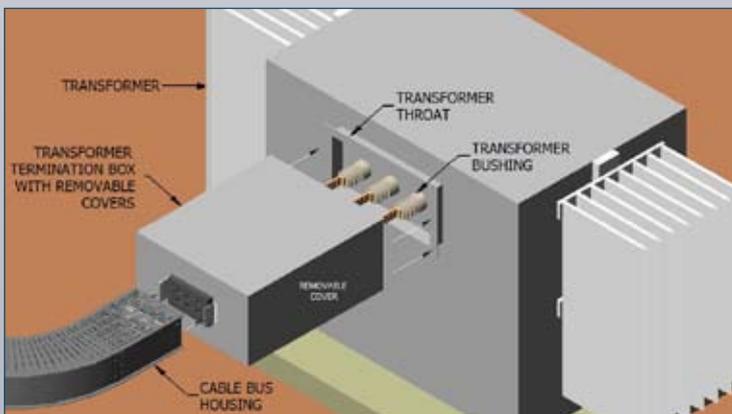
Long lengths of conductor (up to 1,000 ft.), with as many as a dozen bends, should be pulled in one continuous operation at a speed of 20 to 25 ft. per minute. It may be necessary to employ a braked reel to reduce sagging of the conductor between horizontal rollers.

The most economical spacing of horizontal rollers depends on the weight of cable to be pulled. In general, the spacing of horizontal rollers should range between approximately 10 ft. for cable weighing over 8 pounds per foot and 16 feet for cable weighing less than 2 pounds per foot.

TYPICAL ASSEMBLY



System Components



TERMINATION BOXES

Termination Boxes, designed and supplied by WESCOSA, guarantee the needed space to properly collect the phases and terminate the conductors to the electrical equipment. Standard termination boxes are aluminum welded angle frame construction with bolted removable side panels and welded fixed panels as needed. Outdoor boxes are NEMA 4 and use gasketed removable panels, fully seam welded fixed panels, and an equipment seal to ensure a water-tight enclosure.



Cable Termination Kits

Heat Shrinkable Termination materials are supplied for all medium voltage CABLE BUS systems.

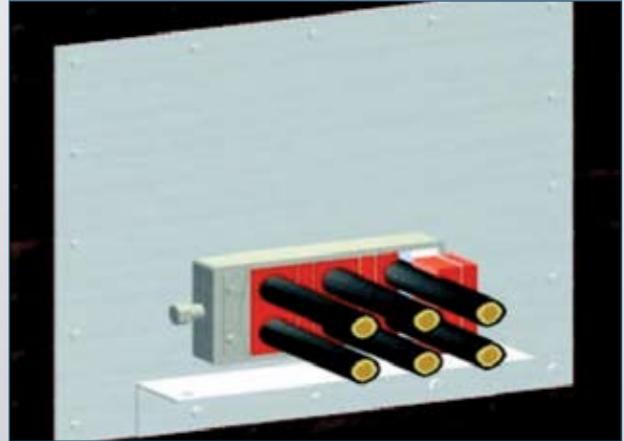
Cable Bus

System Components



BUS END FLANGE

Box connectors are used to terminate CABLE BUS at switchgear or other metal structures for indoor applications and are furnished with all necessary hardware.



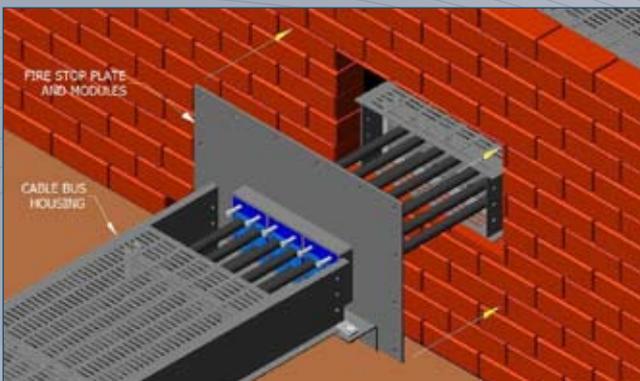
MCT

FIRESTOP/WATERTIGHT SEAL

MCT seals are used when an absolutely watertight fitting is required. Neoprene blocks are inserted after the cables are installed for ease of pulling. They are UL listed for a 2 hour fire rating and come with all necessary hardware.

WATERTIGHT SEALS Seal Flange

These fittings form a seal with walls and can also be used for floor penetrations that must be watertight. Conductors are sealed with RTV silicone sealant. Entrance fittings are furnished with all necessary hardware.



Cable Bus

System Components

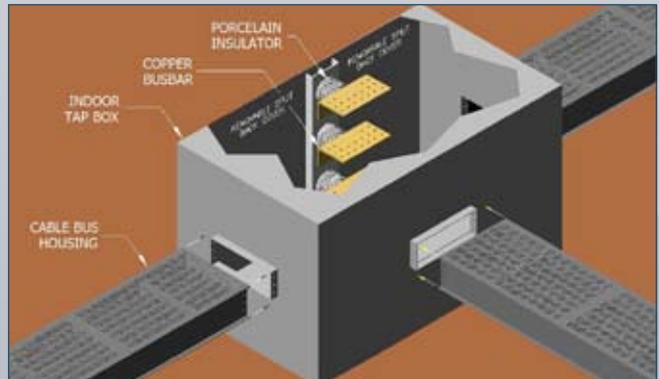


Electrical Connectors

Two Hole Long barrel compression type lugs and Silicone bronze termination hardware are supplied with each project to ensure reliable connection with electrical equipment.

Tap Boxes

Tap boxes allow for intermediate load tapping. The design provides system voltage rated air separation between live parts and adjacent surfaces to eliminate the necessity of tapping all energized components.



The tap box consists of:
Aluminum framed enclosure
Removable covers (gasketed for outdoor applications)
Porcelain or Epoxy post stand off insulators
Bus bars

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