LectroBar

Busway Method of Statement
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1. **Introduction:**
   Since 1978, Lectrobar has manufactured and installed thousands of meters of bus ducts. As a leader company in the field of busbar in Egypt Lectrobar provides busbar with a high quality level. Lectrobar also provides busbar installation with the same level of quality as production.

2. **Purpose:**
   To define the fixing & execution method statement for bus duct.

3. **Related Works:**
   All civil works related to the support structure in roof and floor need to be completed and proper clear access for bringing in the busduct should be available.

4. **Reference Drawing:**
   The drawings to be referred are
   i. Electrical shop drawing of the respective location.
   ii. Civil drawings of the respective location.
   iii. Operation information with the number of pieces to be installed.

5. **Installation Requirements:**
   i. Installation, operation and maintenance of busduct should be conducted only by qualified person.
   ii. A qualified person is one who is familiar with the installation, construction and operation of the equipment and the hazards involved.

   **Before installation there are some precautions to take care of them.**

5.1 **Storage precautions at site:**
   i. Busduct sections and fitting to be installed should be stored in a heated building having adequate air circulation and protection from dirt, fumes, water and physical damage, the busduct should covered by waterproof sheet.
   ii. Outdoor busduct is not weather resistant until completely and properly installed and should be treated exactly the same as indoor busduct until after it is installed.
   iii. Busduct should always be placed on the floor horizontally and wooden battens or forms are placed underneath the busduct
5.2 Operation and handling:

i. Provide sufficient horizontal and vertical clearance from walls and ceiling to provide easy access to joints, (the minimum clearance is 10 cm), both for the original installation and possible removal of a section when required.

ii. Avoid subjecting busduct not only to twisting, denting, and impact and in general, rough handling. Especially busduct ends are not to be hit against the structures or equipment.

**According to site conditions:**

iii. Suitable and certified hoisting wire should be used to hoist the busduct for easy installation and also to avoid damage to the housing.

iv. No direct fixing of hosting wire to the joint cover hole on the housing of the busduct, but instead use lifting jig for both horizontal and vertical busduct installation.

The joint hole should not be used for hoisting as it cannot withstand the weight of the busduct, which result break on the welding parts or any damages.
v. Do not drag the busduct across the floor.

vi. When installing vertical riser, it is easier to lower the busduct from the floor above where it will be installed. Vertical sections are often stored on the floor above their final location to facilitate lowering them into position.

vii. While hoisting any feeder ensure that the opposite side of the feeder being hoisted should be rested on a support in order to prevent any damage to the joint.

viii. Hang one busduct unit with two hang units in principle.

ix. Depending on the site condition, preferably flange end, flange end box, and cable feed box shall be installed first.

5.3 Site requirements:

i. Check lighting and ventilation availability before start installation.

ii. Coordinate pipes, HVAC, plumbing and sprinklers installation plan. Done by MEP Contractor.

iii. Check electrical source availability.

6. Protection against ingress of dust and water:

The ingress of dust and water into the busduct will decrease electrical and physical properties and cause dielectric damage.

Some common sources of contamination are:

i. **During construction:** indoor busduct must be protected from moisture during and after installation. Special attention should be given to riser busduct during construction to protect them from moisture from uncompleted roofs, walls, etc. Outdoor busduct is not weather resistant, until completely and properly installed and should be treated exactly the same as indoor busduct until it is installed.

![Diagram of waterproof sheet and wooden battens](image)

ii. **Floor level liquids:** minimum curbs of four inches should be installed around all floor openings for riser busduct to prevent floor level liquids (water, oil spills) from entering the openings.

iii. **Leaking roof:** protect indoor busduct with a temporary sheet metal shield or other protective cover to prevent water from falling onto the busduct until the roof is repaired.

iv. **Pipes:** protect indoor busduct with a temporary sheet metal shield or other protective cover to prevent water from falling onto the busduct until the pipes are repaired. Where –especially- cold
water pipes pass directly above indoor busduct, the busduct should be protected from dripping condensate by insulating the pipe or permanently shielding the busduct with sheet metal or plastic.

v. **Sprinklers**: Protect indoor busduct from direct or indirect spray of sprinklers.

*To prevent this, take precaution against the ingress of dust or water during storage and installation:*
  i. Install busduct after the general construction works are completed.
  ii. Install busduct when possible leaking roof is sealed.
  iii. Install extra cover at the busduct end.

**For busduct installation there are specific tools to be used with a special use of each one.**

7. **Installation Tools:**

Before starting the installation of power busbar following tools shall be arranged:

i. Chain Block Pulley with suitable capacity
   
   *Usage:*
   
   for busduct lifting.

ii. Portable hand tools and metering unit
   
   *Usage:*
   
   Nails and nuts screwing.

iii. Spirit Level
   
   *Usage:*
   
   align the busduct at the same level when the installation is near to the walls.

iv. Level threads (Bubble Level)
   
   *Usage:*
   
   align the busduct at the same level.
v. Portable Drilling Machine  
Usage: 
Make holes for installation and anchor fastener fixation.

vi. Torque wrench  
Usage: 
Fasten the Bolts of the joints.

vii. Air blower  
Usage: 
clean the busduct from the dust or any small particles which can decrease the Electrical and physical properties of the busduct.

8. **Installation measurement devices:**

i. Megger test  
Usage: 
measure the resistance between phases, phase and earth using megger. (the mega ohm readings should not be less than the value recommended by the manufacturer) As an insulation test.
ii. Low resistance test (Continuity test):
   Usage:
   check the line continuity across the bars and the housing.

9. Safety Requirements:

Now more than ever, working safely is essential for all professionals in the electrical industry. New clearances allow a larger population of people to perform electrical and non-electrical work on or around installations and structures, in compliance with prevention rules.

   i. All personnel shall wear helmet at all times when at site.
   ii. All personnel and operatives shall wear safety footwear at all times.
   iii. Work areas and access way are to be free from debris, materials and all tripping hazard.
   iv. All hand tools and portable power tools shall be of good order and shall be used for the purpose intended.
   v. All work on Energized Systems shall be done with a Permit to Work System. Proper Earthing / cordonning off to be done prior to Commencement of work, if working in energized environment.
a) Busduct safety precautions

follow the safety label instructions on the busduct.

b) Personal Protective Equipment (PPE)

PPE are defined as any device or means intended to be worn or held by one person to protect itself against one or several risks liable to threaten its safety or its security.

"Personal Protective Equipment is used to protect individuals who work on or near an installation that presents an electrical hazard."

Equipment complying with the standards in force and appropriate for the type of operation and voltage level of the installation must be used.

c) Collective Protective Equipment (CPE)

Collective protective equipment for preventing electrical hazards contains all the products that close off the hazard by:
- Distance (marking, signs)
- Obstacles (covers, screen, barrier)
- Insulation (insulating blankets, insulating caps, etc.)

CPE must comply with the standards in force.

These washers ensure maintenance free joints.
10. **Joint Assembly:**

The joint section is the heart of the busduct during its operation, so proper tightening of the joint bolt is important to ensure its continuous and satisfactory operation.

i. Ensure all contact surfaces are clean and free of contaminants by using dry cloth.

ii. Align the busduct ends of adjoining section, verifying proper phase alignment.

iii. Slide the sections together; it is done by inserting jointing tool inside the joining holes.

iv. For easier connection of supply and load and less impact on the download of the busduct weight, certain interval has to be kept. Use joint cover by screwing bolt on the lower part of the joint cover then follow by the upper part of the joint cover this would enable easy jointing and accurate jointing intervals.

v. For IP 65 and 67, install side cover with gasket and then fix with bolts on both sides.

vi. Install the joint cover with gasket on the top and bottom of the jointing section.

vii. After side cover and joint cover are fixed, apply sealant around the covers to ensure its protection against water and dust.

viii. Ensure that all busduct installation is in straight alignment, either horizontal or vertical in order to have proper jointing system.
10.1 Joints:

Joints in all ratings are of a two bolts patent design, which can be checked for tightness without de-energizing the system. This design ensures excellent contact between each set of the busbars and the joint. This method exerts more than two tons of pressure on overlapping bus bars at each bolt. This force is distributed over the contact area by two pairs of large diameter spring steel conical shape washers. These washers ensure maintenance free joints.

Ensure that earth pallets direction @ casing side and there aren't at or between phases or neutral bars.

Joint alignment is made by two bolts instead of one bolt in the single bolt design. This design ensures the correct installation of the busduct joint even with non-skilled labor. The joint temperature is less than rest of the busduct due to the specially designed heat sinks and contact surface.

Figure A shows the contact resistance at different torque with the washers. The tightening torque of joint bolt does not run down after initial accommodation, and is maintained at a level that ensures stability of contact resistance and temperature rise.

**The recommended torque is 80 N-m.**

10.1 Bolts:

The bolts are insulated with Teflon coated fiberglass and passed through the joint in a polyamide tube to eliminate any problems arising from joint bolts. Join blocks are used to ensure parallel joints of bars and complete mechanical jointing using non-flammable, US made, fiberglass sheet (2mm) with high dielectric strength (200V/mil,80kV/cm). Double head bolts are used. As optiamted One head breaks at the required
torque so no need for torque wrenches. Also smart bolts can be used as optional for critical sites. Using Smart bolts results in less fatigue for installers, no repeated torque wrench calibration, no sample re-tightening, no turn-of-nut confirmation required.

Installers can easily identify and focus on loose bolts to re-tighten. The ability to visually inspect fasteners also creates safer working conditions particularly in elevated structures and areas exposed to hazardous materials.

Bolts or polyamide Tubes .. Shouldn’t use to alignment holes together to be able to put the bolts through the holes it may cause damage of bolts installation.
11. **Installation Procedures:**

i. Examine the drawing of Bus duct erection layout with respect To the general layout.

ii. Shift the Bus duct from stores to location by means of suitable Truck/lifting arrangement.

iii. Carryout physical verification or any possible damage.

iv. Check for necessary lifting tools and tackles in relation with load to be lifted and ensure safe lifting.

v. Check for the level alignment of the foundation/ structure before starting the erection.

vi. Assemble Busduct at site and provide complete supporting structures as required.

vii. Sections of busduct installed out door shall be supported from ground.

viii. Indoor sections shall be supported from ceiling and/or wall.

ix. Clean all Bus bar joints.

x. Seal off wall bushings shall be provided where the busduct enters a building from its outdoor run as well as from Transformer cell to switch-gear room.
11.1 Horizontal Busway Installation:

i. Fix horizontal hanger to the hanger rod fully threaded rod, and adjust it for correct elevation of the busduct as per site condition.

ii. Lay the busduct on the horizontal hanger.

iii. Ensure the busduct is aligned in straight line.

iv. Install the hanger clamp on both side of the busduct for fixture.

v. Additional horizontal hangers shall be placed on elbows.

vi. Supporting interval of horizontal hanger shall not exceed 1.5 meters for straight length. However each elbows or bends must be supported separately.

Note: Horizontal support hangers should not be over a joint section.

Horizontal busway through the wall:

i. Provide sufficient horizontal clearance from walls to provide easy access to joints, (the minimum clearance is 10 cm), both for the original installation and possible removal of a section when required.

ii. Fire resistance mortar which works as fire barrier from wall to the next one.

A gypsum based fire resistance mortar which expands when activated by water and sets to form an excellent seal around cables, pipes and duct penetrations in walls and floors.
• Horizontal bus way beside the wall hanging:
  i. Use wall supporters cantilevers as per site conditions

• Horizontal support hangers:

<table>
<thead>
<tr>
<th>Ampere Rating</th>
<th>Steel angular fixation type</th>
<th>Steel angle size (mm)</th>
<th>Screw threading on rod in (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 : 1600 A</td>
<td>C – channel</td>
<td>50<em>50</em>50*2(thick)</td>
<td>M 12</td>
</tr>
<tr>
<td>2000 : 6400 A</td>
<td>L – channel</td>
<td>50<em>50</em>3(thick)</td>
<td>M12</td>
</tr>
</tbody>
</table>
i. A busway that is to be mounted vertical should be marked to indicate that is suitable for that service. When the distance between floor supports is more than the busway is marked as suitable for, the manufacturer’s recommendation regarding intermediate supports should be followed, but in no case should support intervals exceed 16 feet (480 cm).

ii. **Vertical Hanger:**
A spring suspension type is used for vertical runs. This hanger equalizes the weight of vertically mounted busduct along all supports. These hangers compensate for expansion and contraction of the busduct. At least one vertical hanger must be used for each floor.
11.3 Installation Spacing:

Minimum installation distance when there are several adjacent lines (in mm).

Minimum installation distance when there are several overlapped lines (in mm).
12. **Steps to be taken before energizing:**
   i. Recheck all joints connections for tightness. Follow the manufacturer’s torqueing recommendations.
   ii. Ensure that all tap-off or plug-in the "OFF" position.
   iii. Isolate the busway run by disconnecting all connections to transformers, switchboards, meters, and so forth.
   iv. Conduct an insulation resistance test with an insulation resistance tester rated 1000 volts to ensure that the system is free from short circuits and grounds (phase-to-ground, phase-to-neutral and phase-to-phase). It should be noted that readings vary inversely with the length of run and width or number of bars per phase. Readings will vary with humidity. If reading of less than 1 mega-ohm for a 100-foot run (MEGHMS= 100 / Length of busway in feet) are obtained.
   v. Verify that the system phasing matches the busway phasing before reconnecting all connections to transformers, switchboards, meters, and so forth.

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We recommend using 2500v megger better and reading should be 1000 per length of busduct in feet
13. Evaluation and Reporting:

13.1 Visual Inspection site report

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Date</th>
<th>Project Code</th>
<th>Conductor Description</th>
<th>Total Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.0</td>
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</table>

**Inspection of the Assembly (Visual Inspection):**

<table>
<thead>
<tr>
<th>Test</th>
<th>Ok</th>
<th>Percentage %</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw &amp; Bolts Connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Visual Problems With Insulators</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance With Runs Alignment</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Phasing and Continuity Test:**

<table>
<thead>
<tr>
<th>Test</th>
<th>Ok</th>
<th>Percentage %</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Phase Relationship</td>
<td>Ok</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phases Continuity</td>
<td>Ok</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth Continuity</td>
<td>Ok</td>
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</tr>
</tbody>
</table>

**Tightening Torque:**

<table>
<thead>
<tr>
<th>Case</th>
<th>Thickness</th>
<th>Head Mark</th>
<th>Actual Torque</th>
<th>Maximum Torque</th>
<th>Ok Or Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>M8</td>
<td>8.8</td>
<td>25 N-M</td>
<td>25 N-M</td>
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<tr>
<td>Joint</td>
<td>M12</td>
<td>8.8</td>
<td>80 N-M</td>
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<tr>
<td>Copper</td>
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<td>50 N-M</td>
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<td>Casing</td>
<td>M6</td>
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<td>12 N-M</td>
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</table>

**Contact Resistance Value:**

<table>
<thead>
<tr>
<th>Total Length (m)</th>
<th>No. Of Joint</th>
<th>Higher actual Value (m.ohm)</th>
<th>Value are less than 100 m.ohm</th>
<th>Ok Or Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Test Engineer: -  Company: -  Issue Date: -  Sing: -

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### Megger Test Site Report

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contactor Name</td>
<td>Project Code</td>
</tr>
<tr>
<td>Type</td>
<td>Conductor Description</td>
</tr>
<tr>
<td>Nominal Voltage</td>
<td>Connector Type</td>
</tr>
<tr>
<td>Busway Rating</td>
<td>Casing Type</td>
</tr>
<tr>
<td>Ingress Protection</td>
<td>Total Length</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>Runs Name</td>
</tr>
</tbody>
</table>

**Insulation resistance at** *(IEC Standard 61439-1,2,6)*

**Megger Value:**

<table>
<thead>
<tr>
<th>Earth to Line</th>
<th>Earth to N</th>
<th>N to Line</th>
<th>Line to Line</th>
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<tbody>
<tr>
<td>E-R</td>
<td>E-N</td>
<td>N-R</td>
<td>R-S</td>
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<tr>
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<td>N-S</td>
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</tr>
<tr>
<td>E-T</td>
<td></td>
<td>N-T</td>
<td></td>
</tr>
</tbody>
</table>

| M. Ohm | M. Ohm | M. Ohm | M. Ohm |

**Notes:**

______________________________________________________________

**Insulation Measurement:**

Values are more than *(100 / Total length by feet ( ) M. Ohm)* at -

<table>
<thead>
<tr>
<th>Test Engineer</th>
<th>Company</th>
<th>Issue Date</th>
<th>Sign</th>
</tr>
</thead>
</table>

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