Installation Manual
Low Voltage

for betobar-r cast-resin insulated busducts

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INTRODUCTION

This installation manual is designed to assist in the safe and efficient offloading, handling and installation of betobar-r busducts. The instructions are in addition to normal safe working practices as required by the local health & safety regulations. These instructions do not in any way advocate a departure from these requirements. Should any further information be required do not hesitate to contact your local Eta-com representative, who will always obtain answers to your inquiries.

In Annex E – Checklist, there is a Checklist, designed to be used throughout the installation of the busduct system, to ensure that all parts of the installation instructions are followed. At the end of this manual, Annex F – Material Safety Data Sheets, you will also find a reference to product safety information. These product safety data sheets can be obtained on request or by visiting www.etacomcs.com.

EX installations: After completing installation, the system and its connections need to be certified by a notified body as a complete unit. Betobar-r busducts have component certification: “-U”.

TO DO

- Check the number and dimensions of the crate/pallet against the delivery note.

- Ensure adequate equipment.

- Store resins, hardeners and fillers in controlled conditions and check whether the shelf life or storage dates are not expired.

- In order to ensure good quality of mixing and casting, store the mixes (resin, hardener and fillers) 24 hours before use at a temperature between 18°C and 25°C.

- Mark out the complete route before commencing the installation of the busduct elements.

- Start the installation of elements at one end (preferably at the switchboard) and work progressively to the other end termination.

Please, contact your local representative for advice if in any doubt.

NOT TO DO

- Start the installation without fully reading the installation manual.

- Cast joints without carrying out the required tests first.

- Cast joints with an insulation reading lower than 1 GΩ.

- Use out of date BIM mixes.
SAFETY (PPE MUST ALWAYS BE IN ACCORDANCE WITH LOCAL REGULATIONS)

Important: PPE must always be in accordance with local regulations

Recommended PPE by Eta-com:

General use:
1. Safety helmet
2. Hearing protection
3. Safety goggles
4. Protective fire-retardant clothing (Nomex, Proban) with long sleeves/long trousers
5. Fluorescent / reflective vest or jacket
6. Safety gloves with long sleeves
7. Safety shoes S3 with steel sole and tip

Adapted PPE:
For working at height
8. Approved fall protection

At harmful concentrations of particulate matter in the air (mixing, grinding and drilling activities)
9. P2/FFP2 or FFP3/P3 masks in case of normally ventilated rooms (for handling of epoxy or when in doubt, use P3 or FFP3 filters).
   *Remark*: for practical reasons, we recommend to use combined A2P3R filters when preparing the epoxy mixture to cast the junctions.
10. Safety helmet with face shield and forced filtered air via P3R (or FFP3) filter if there is insufficient ventilation in the room during the work.
11. Gloves in grain leather for assembly, handling and finishing of Betobar-r.

Handling of chemicals (resin and hardener):
12. Half mask with A2 filter
   *Remark*: for practical reasons, we recommend to use combined A2P3R filters when preparing the epoxy mixture to cast the junctions.
13. Protective gloves for use with chemicals:
   a. Resin and hardener: EN388 0010 & EN374-3 BCI cat III e.g. type Honeywell Butoject 898 or Ansel Edmont

TOOLS

1. Set of flat- or ring spanners 10,13,16,17,18,19 and 24mm (metrical)
2. Socket wrench with sockets 10,13,16,17,18,19 and 24mm (metrical)
3. Set of screwdrivers 4 to 10mm (metrical)
4. Torque spanner (torque range 10Nm – 180 Nm) Compatible with sockets under “2”
5. Set of Allen keys
6. Chalk-line
7. Water leveling instrument or laser
8. Spirit level
9. 1kg hammer
10. Plastic hammer
11. Handsaw (metal/wood)
12. File (flat and round)
13. Stanley knife
14. Pipe wrench 17mm
15. Adjustable spanner
16. Plummet
17. Tape measure or carpenter’s ruler
POWER TOOLS

1. Drill hammer + drill 12 + 14 for concrete
2. Low speed drill ¾ (max. 900 R.P.M) for mixing
3. Hot air blower 0,5/1kW – 220V single phase

TEST INSTRUMENTS

1. Insulation tester (1kV DC tester, range 10 000 MΩ)
2. A digital self-contained micro-ohmmeter, having a resolution of 0.1 µΩ
3. 2 LV junction resistance measurement probes
4. Voltmeter (in order not to work on live bars)

TOOLS FOR HANDLING/STORAGE

1. Forklift
2. Two slings
3. Wooden battens
4. Eye bolt + sliding nut (to lift elements from unistrut)

TOOLS TO CAST THE JUNCTIONS

1. Nylon cleaning pads (Scotch Brite or similar)
2. Paint brush Ø1” (for de-moulding agent)
3. Mixing helix
4. Putty knife
5. Casting moulds and de-moulding agent supplied by vendor (for types and quantities see list of materials/packing list)
6. Duct tape

MISCELLANEOUS

1. Coarse abrasive paper (Size 80)
2. Lighting
3. Extension cord
4. Scaffolding

LIST OF REQUIRED TOOLS FOR REPAIR:

1. For repair of the busduct, the same list of tooling is applicable as for installation (see paragraph 1)
Module A: Handling, receipt and storage

A.1. MATERIALS REQUIRED

☐ Materials delivered by Eta-com
  ○ See delivery note

☐ Materials by installation contractor
  ○ Nail-extractor
  ○ 2 ropes or straps with double noose
  ○ Wooden battens (high enough to allow forklift handling)

A.2. HANDLING

☐ Keep crates always in upright position. Use no hooks. First, remove top cover, then wooden spacers and brackets, use nail-extractor before lifting elements. Avoid use of crowbars.

☐ Use two ropes or straps with double noose to lift elements. DO NOT use steel wire cables. Short elements may be lifted with a single rope or strap, but keep weight in balance.

☐ Avoid shocks and do not push with forklift when handling. Other material SHOULD NOT be stored on top of the elements.
A.3. RECEIPT

- If packing and/or material seems to be damaged on arrival prior to unloading, this should be mentioned on the CMR document. Please, contact your Eta-com sales representative immediately.

- On arrival, immediately check number, types, dimensions of all products and accessories with the packing list.

- Inspect also all equipment for damage and/or missing items.

- Report all deficiencies to your betobar-r agent and confirm in writing within 48 hours.

A.4. STORAGE

If the elements cannot be stored in the original packing, then follow next instructions:

- Stow elements on wooden battens, approximately 1.5 meter apart.

- Elements may be stowed up to five layers high.

- Store all goods in a dry location. All products for casting (white buckets and tin cans) are to be protected from excessive temperatures (min. 5 °C and max. 45°C) as well as from direct sunrays. Avoid open fires in the proximity of resins and hardeners.
Module B: Preparing busduct run

B.1. INTRODUCTION

This module lists the steps to be taken before actually installing elements.

B.2. MATERIALS REQUIRED

- Materials by installation contractor
  - Measuring tape or range finder
  - Spirit level
  - Leveling instrument (laser)
  - Tracing chalk

B.3. PREPARING BUSDUCT RUN

- Check the position of the equipment to be connected with regard to the layout drawing(s).
- Watch out particularly for floor level differences, straightness and squareness of walls, shafts and equipment. If necessary, adjust or correct.
- Check if busduct run is completely free over full length and if wall and floor apertures have been provided as required.
- Check lengths, angles and levels of busduct run against layout drawing dimensions.
- In case the building tolerances exceed the adjustment range (+/- 10 mm) of the combined junctions, please contact your betobar-r sales representative for other means of compensation.
- Trace the run of busduct and the position of all the supports in accordance with the layout drawings, starting preferably with the switchboard end.
Module C: Installation of supports

C.1. INTRODUCTION

This section describes the most common types of support. For individual projects or situations, the type of support may differ. Always refer to the engineering drawings.

C.2. MATERIALS REQUIRED

- Materials delivered by Eta-com
  - Busduct supports
  - Threaded rods
  - Plugs as required
  - Profiles as required + connection pieces

- Materials by installation contractor
  - Drill with hammer function (with vacuum cleaner if required)
  - Correct drill bits concrete / steel
  - Set of spanners
  - Set of hex heads (Allen keys)
  - Hammer
C.3. GENERAL INSTRUCTIONS

- Assemble and install supports as indicated on the general layout and support detail drawings.
- If using plugs/dowels, follow manufacturer's instructions.
- Should relocation of brackets be required, we refer to values hereunder and illustration 2 in chapter C4.

<table>
<thead>
<tr>
<th>Type</th>
<th>WxH(mm) 3-7 cond.</th>
<th>WxH(mm) 8-9 cond.</th>
<th>( A_{\text{max}} ) (mm)</th>
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<tbody>
<tr>
<td></td>
<td>Hor. position</td>
<td>Vert. position</td>
<td>K min. (mm)</td>
</tr>
<tr>
<td>LA04</td>
<td>104x80</td>
<td></td>
<td>1500</td>
</tr>
<tr>
<td>LA08</td>
<td>104x120</td>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>LA12</td>
<td>104x160</td>
<td></td>
<td>2500</td>
</tr>
<tr>
<td>LA16</td>
<td>104x200</td>
<td></td>
<td>3000</td>
</tr>
<tr>
<td>LB04</td>
<td>138x80</td>
<td>168x80</td>
<td>2000</td>
</tr>
<tr>
<td>LB08</td>
<td>138x120</td>
<td>168x120</td>
<td>3000</td>
</tr>
<tr>
<td>LB12</td>
<td>138x160</td>
<td>168x160</td>
<td>4000</td>
</tr>
<tr>
<td>LB16</td>
<td>138x200</td>
<td>168x200</td>
<td>4000</td>
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- Fix brackets with bolts or welding as indicated on general layout drawing(s). Do not exceed maximum permissible load of brackets and fixing details.
- Level and line out brackets with leveling instrument.
- If applicable, please refer to the additional instructions for:
  - Expansion elements see Module J – Installation of expansion elements
  - Spring supports see Module L – installation of spring supports
- Depending on requirements, busduct supports, as well as all other metal parts in a building, are to be earthed with a cable or a copper strip of sufficient section (this is not standard supplied by Eta-com).
C.4. ILLUSTRATION 2

Convenient casting height of 370 mm using standard B/M buckets.
Module D: General instructions

D.1. INTRODUCTION

This section describes the physical installation of the busduct elements.

D.2. MATERIALS REQUIRED

- Materials delivered by Eta-com
  - Busduct elements
- Materials by installation contractor
  - Lifting device
  - Ropes or slings
  - Temporary supports
  - Tape measure
  - Spirit level
  - Set of spanners
  - Hot air blower
  - Insulation measurement device
D.3. INSTALLATION OF BUSDUCT ELEMENTS

- Remove plastic protection bags from the insulation ends of the element you will install.
- Do not remove the protection tape from the insulation ends until fitting of casting moulds.
- Always check the dimensions of the elements according to the layout drawing.
  - Check element lengths knowing that elements are one cm shorter than layout drawing says (see explanation junctions).
- Check elements and conductor ends for damage and butted edges. Do not install if damage is noticed.
- Check whether the insulation resistance of the elements to be installed meets Eta-com standards. If necessary, dry the conductors and the creepage path with a hot air blower.
- Install the terminal elements on its supports. Check horizontal and vertical alignment of the terminal flanges with the equipment. See **module E - Installation of terminal elements**.
- Install the elements on supports, starting at the terminal element at one extremity of the line (preferably on the switchboard side). Check horizontal and vertical alignment as well as the copper positioning of all elements (see drawing below).
- Install the elements on the supports one by one, systematically towards the other end of the line. The distance between the conductor ends of the junctions can be adjusted to compensate for the building tolerances, as follows:
  - Straight junctions 0-20 mm
  - Elbow junctions 0-10 mm on either side of the elbow
- DO NOT exceed the maximum adjustment.

The installation of expansion elements is described in **module J - Installation of expansion elements**. Follow the instructions meticulously. DO NOT use the expansion element to compensate for building tolerances.
The positioning of elements including a fireproof penetration relative to the wall/ceiling is very important. See module K – Installation of fireproof penetrations.

The installation of phase exchange and phase compensation elements is identical to standard elements. Check phase sequence of phase compensation elements.

The standard straight junction has an opening of 10 mm ±10 mm tolerance. Should the building tolerances require for more, please contact your local representative for alternative methods.
**Module E: Installation of terminal elements**

**E.1. INTRODUCTION**

This section describes the installation of terminal elements and adaptor boxes.

There are 4 possibilities to seal of the connections:

1. With a bellow  
   IP55
2. With a flat membrane  
   IP55
3. With a packing in full rubber  
   IP55
4. With a packing in foam rubber  
   IP44

The mentioned ingress protection can only be achieved when the seal is correctly installed.

Note: In case of installation with a bellow or a flat membrane, the electrical connection must be made with flexible links. In case of a packing in full or foam rubber, the electrical connection can be made with flexible or rigid links.

**E.2. OVERVIEW**

![Figure E. 1: With a bellow](image1)

![Figure E. 2: With a flat membrane](image2)

![Figure E. 3: With a rubber packing](image3)

![Figure E. 4: With a foam packing](image4)
E.3. MATERIALS REQUIRED

- Materials delivered by Eta-com
  - Busduct elements
  - Adaptor boxes: optional
  - Sealing foam, packing, membranes or bellow
  - Pressure strips (N/A for packing with foam rubber)
  - Spares: optional

- Materials by installation contractor
  - Torque spanner
  - Set of sockets
  - Set of Allen keys
E.4. INSTALLATION OF TERMINAL ELEMENTS

- First, check the phase sequence.

- Support the terminal element. 4 inserts are provided at both sides of the terminal head, allowing to support the element both in horizontal and vertical position. Use the delivered LV-support-bracket (ETL00042).

Bolt the support brackets to the terminal head, using M10 bolts and spring washers (torque 20 Nm).
The threaded rods, connected to the supporting structure, can be fixed in the oblong hole by means of a bolt above and a bolt beneath. Use a locking flanged nut at either sides (see Figure E. 5: locking flanged nut) or a plain washer at one side and a spring washer at the other side.

Make sure the terminal flanges are lined-out correctly with the equipment, so the connection with rigid or flexible links can be made. See Module M – Connections.

E.5. CONNECTION WITH SWITCHGEARS, ADAPTOR BOXES,…

Follow the information exactly as indicated on the detailed drawing and/or layout drawings, supplied with each project.

Check the flange dimensions and drillings of the switchgear against the equipment to be connected.

Remove all covers of the switchgear and install the frame on the equipment to be connected.

Install the seal on the flange of the termination head with fixing strips. Foam packings are glued to the termination head, no flange required.

Install the bolts and fix them (torque of 10 Nm), check whether the packing is tight.

Protect the equipment (transformer, switchgear …) against rain until the covers are installed. Check whether possible drain holes are not concealed.
E.6. SEALING OF THE CONNECTIONS

The sealing is made by pressing a rubber or foam between two rigid planes. The rubber or foam is flexible and fills the irregularities of the planes, effectively sealing the openings.

It is important to respect the recommended torque of 10 Nm when tightening the seals:

- When the torque is low, it cannot be guaranteed that all irregularities in the planes are filled, so openings can be left open.
- When the torque is high, pressure strips of flanges can be deformed, creating openings.

Possible planes can be:

- On betobar-r side:
  - Flange of the terminal head
  - The terminal head in case of a foam packing
  - Pressure strips

- On the equipment side:
  - An adaptor plate
  - An adaptor box
  - An extension collar
    - To enlarge the distance between the equipment and the terminal head
    - To adapt the flange of the equipment according to the drilling pattern on the bellow or membrane.
  - A resopal box (inside use only)

General: After installation, check if an adequate sealing can be guaranteed.
E.6.1. With a bellow

In case of a bellow, first install the membrane on the flange of the terminal element by using pressure strips or a bellow shield. Tighten the bolts with a recommended torque of 10 Nm. Then place the bellow on the box (adaptor box, extension collar, transformer cover, switchgear top cover …) and connect with matching fixing strips.

Figure E 3: Section view of a terminal connection sealed with a bellow
When the outer pressure strip is replaced by a bellow shield, the connection is made like this:

![Diagram showing connection with bellow and bellow shield]

**Figure E 4: terminal element with bellow and bellow shield**

The bellow shield protects the bellow against damage and ageing (UV).
E.6.2. With a flat membrane

In case of a flat membrane, first install the membrane on the flange of the terminal element by using fixing strips. Tighten the bolts with a recommended torque of 10 Nm. Then place the membrane on the box and connect with matching fixing strips.
E.6.3. With a packing in full rubber

Place the **packing** on the flange of the equipment or connection box before installing the terminal element. Tighten the bolts with a recommended torque of 10 Nm.
E.6.4. With a foam packing

Foam packing is glued to the termination head and does not require bolts. Foam packing are limited to inside use only, since they have a lower ingress protection rating: IP44.

Glue the foam rubber on the flange of the equipment or connection box before installing the terminal element. Make sure the terminal head is pressed against the foam, so adequate ingress protection is obtained. However, the cover plate on equipment side should not carry the weight of the terminal head.
Module F: Installation of junctions

F.1. INTRODUCTION

Casting of junctions with Beto-Iso-Mix is split up into 4 modules:

- Module F: Installation of junctions
- Module G: Installation of the moulds
- Module H: Beto-Iso-Mix instructions
- Module I: Casting of junctions

F.2. OVERVIEW

The picture below gives an overview of the different types of junctions.

Figure F. 1: St 26
Figure F. 2: St 27
Figure F. 3: St 29
Figure F. 4: Extended junctions
F.3. MATERIALS REQUIRED

☐ Materials delivered by Eta-com

  o A package containing:
    ▪ A junction pack
    ▪ Content and reference sheet

    Check the quantity and dimensions of the content.

  o Nylon cleaning pads (Scotch Brite or similar)

☐ Materials by installation contractor

  o Torque spanner (torque range at least up to 80Nm)
  o Set of flat- or ring spanners
  o Plastic hammer
F.4. STRAIGHT JUNCTION ST 26

- Check the quantity and dimensions of the contents with the content and reference sheet inside the package.

- The insulation phase barriers of the junction plates should protrude 10mm on all sides of the junction plate conductor. (Figure F. 5)

Figure F. 5: Protruding of the insulation phase barriers

- Cleaning of conductor and junction plate contact surfaces, DO NOT USE CONTACT GREASE!:
  - Copper: with nylon cleaning pads (Scotch Brite or similar).
  - Aluminium: No cleaning required: it is tin-plated. If necessary, remove dirt with cotton cloth.

- Before installing the junction, make sure that the elements are lined up correctly.

- The distance between the conductor ends may be adjusted between 0 and 20 mm, allowing compensation of building tolerances. (Figure F. 6)

Figure F. 6: Distance between the conductors of 2 betobar-r elements
Slide a junction pack between each pair of conductors. Start in the middle. Mind the orientation of the junction packs. (Figure F. 7 and Figure F. 8) Check whether the conductors of the junction packs are flush with the conductors of the elements at the top AND the bottom. If this is not the case, rotate the junction packs 90°.

To avoid damage of the insulation phase barriers when inserting and/or positioning, use a plastic hammer.
Make sure that the overlapping on both conductor ends is the same and that the junction plates are flush with the conductors. (Figure F. 9)

Fix the two steel compression plate packs after installing all junction plates on both sides and right in the middle of the junction pack. (Figure F. 10)
Now tighten the nuts of each pressure plate with a torque spanner (Figure F. 11). Go back and forth between the 4 bolts of the compression plate, gradually tightening the bolts, making sure that the build-up of the force between the 4 bolts proceeds simultaneously. This is necessary to ensure that the pressure is distributed evenly over the junction.

- Types LA, LB  Bolts M10 Torque 43 Nm (= 4.3 kgm)

Pay attention to keep correct distance between the underlying bolt and outgoing conductors. (Figure F. 12)

- The junction contact resistance and insulation resistance (Annex A: Electrical site test) should be checked prior to the casting.

- After installation of the junctions, cover them at once. For example with plastic to protect it against dust, rain…

- When the installation of ALL the junctions is finished, proceed to "Module G: Installation of the moulds".
F.5. ELBOW JUNCTION ST27

- Check the quantity and dimensions of the contents with the content and reference sheet inside the package.

- The insulation phase barriers of the junction plates should protrude 10mm on all sides of the conductor. (Figure F. 13)

![Figure F. 13: Protruding of the insulation phase barriers](image)

- Cleaning of conductor and junction plate contact surfaces, DO NOT USE CONTACT GREASE!:
  - Copper: with nylon cleaning pads (Scotch Brite or similar).
  - Aluminium: No cleaning required: it is tin-plated. If necessary, remove dirt with cotton cloth.

- Before installing the junction, make sure that the elements are lined up correctly.

- The distance between the conductor ends may be adjusted as indicated in Figure F. 14, allowing compensation of building tolerances.

![Figure F. 14: Distance between the conductors of 2 betobar-r elements](image)
- Slide a junction pack between each pair of conductors. Starting in the middle. Mind the orientation of the junction packs. (Figure F. 15 and Figure F. 16)

- To avoid damage of the insulation phase barriers when inserting and/or positioning, use a plastic hammer.

**Figure F. 15: Sequence to assemble the junction pack**

**Figure F. 16: Assembly of the junction pack**
Make sure that the overlapping on both conductor ends is the same and that the junction plates are flush with the conductors. (Figure F. 17)

Figure F. 17: Overlapping on both conductor ends

Fix the two steel compression plate packs after installing all junction plates on both sides and aligned with the junction pack. (Figure F. 18)

Figure F. 18: Fixing of compression plates
Now tighten the nuts of each pressure plate with a torque spanner. Go back and forth between the 4 bolts of the compression plate, gradually tightening the bolts, making sure that the build-up of the force in the 4 bolts proceeds simultaneously. This is necessary to ensure that the pressure is distributed evenly over the junction.

Types LA, LB  Bolts M10 Torque 43 Nm (= 4,3 kgm)

Pay attention to keep correct distance between the underlying bolt and out coming conductors. (Figure F. 20)

The junction contact resistance and insulation resistance (Annex A: Electrical site test) should be checked prior to the casting.

After installation of the junctions, cover it. For example with plastic to protect it against dust, rain…

When the installation of ALL the junctions is finished, proceed to “Module G: Installation of the moulds”.
F.6. STRAIGHT JUNCTION ST29 FOR VERTICAL BETOBAR-R LINES

- Check the quantity and dimensions of the contents with the content and reference sheet inside the package.

- The insulation phase barriers of the junction plates should protrude the conductor as shown in Figure F. 21. (Not applicable for LA04, LB04, LA08, LB08)

![Figure F. 21: Protruding of the insulation phase barriers](image)

- Cleaning of conductor and junction plate contact surfaces, DO NOT USE CONTACT GREASE!
  - Copper: with nylon cleaning pads (Scotch Brite or similar).
  - Aluminium: No cleaning required: it is tin-plated. If necessary, remove dirt with cotton cloth.

- Before installing the junction, make sure that the elements are lined up correctly.

- The distance between the conductor ends may be adjusted between 0 and 20 mm, allowing compensation of building tolerances. (Figure F. 22)

![Figure F. 22: Distance between the conductors of 2 betobar-r elements](image)
Slide a junction pack between each pair of conductors. Starting in the middle. Mind the orientation of the junction packs. The extended side of the insulation plate must always be mounted upwards and be lodged in the creepage path (see Figure F. 23 and Figure F. 24). Check whether the conductors of the junction packs are flush with the conductors of the elements at the front and the back.

To avoid damage of the insulation phase barriers when inserting and/or positioning, use a plastic hammer.

Insert the junction plates as high as possible, with a minimum overlap of 5mm, in the “U”-shaped creepage path.
Fix the two steel compression plate packs after installing all junction plates on both sides and right in the middle of the junction pack. (Figure F. 25)

Now tighten the nuts of each pressure plate with a torque spanner (Figure F. 26). Go back and forth between the 4 bolts of the compression plate, gradually tightening the bolts, making sure that the build-up of the force in the 4 bolts proceeds simultaneously. This is necessary to ensure that the pressure is distributed evenly over the junction.

Types LA, LB  Bolts M10  Torque 43 Nm (= 4.3 kgm)

Pay attention to keep correct distance between the underlying bolt and out coming conductors. (Figure F. 27)
- The junction contact resistance and insulation resistance (Annex A: Electrical site test) should be checked prior to the casting.

- After installation of the junctions, cover it. For example with plastic to protect it against dust, rain…

- When the installation of ALL the junctions is finished, proceed to “Module G: Installation of the moulds”.
F.7. STRAIGHT EXTENDED JUNCTIONS

- Check the quantity and dimensions of the contents with the content and reference sheet inside the package.

- The insulation phase barriers of the junction plates should protrude 10mm on all sides of the conductor. (Figure F. 28)

![Figure F. 28: Protruding of the insulation phase barriers](image)

- Cleaning of conductor and junction plate contact surfaces, DO NOT USE CONTACT GREASE:
  - Copper: with nylon cleaning pads (Scotch Brite or similar).
  - Aluminium: No cleaning required: it is tin-plated. If necessary, remove dirt with cotton cloth.

- In some cases the junction plates are split in the middle. In case of LA & LB 12 &16 the junction can be nearly square, so it is important to observe the direction of the seam: It must be parallel to the axis of the system. (Figure F. 29 and Figure F. 30)

![Figure F. 29: Junction plates](image)
Slide a junction pack between each pair of conductors. Starting in the middle. Mind the orientation of the junction packs. (Figure F. 30) Check whether the conductors of the junction packs are flush with the conductors of the elements at the top AND the bottom. If this is not the case, rotate the junction packs 90°.

To avoid damage of the insulation phase barriers when inserting and/or positioning, use a plastic hammer.

Figure F. 30: Sequence to assemble the junction pack

Figure F. 31: Assembly of the junction pack
Make sure that the overlapping on both conductor ends is the same (55±5mm) and that the junction plates are flush with the conductors of the betobar-r. (Figure F. 32)

![Figure F. 32: Overlapping on both conductor ends](image)

Fix the two steel compression plate packs after installing all junction plates on both sides and right in the middle of the junction pack. (Figure F. 33)

![Figure F. 33: Fixing of compression plates](image)

Now tighten the nuts of each pressure plate with a torque spanner (Figure F. 34). Go back and forth between the 4 bolts of the compression plate, gradually tightening the bolts, making sure that the build-up of the force in the 4 bolts proceeds simultaneously. This is necessary to ensure that the pressure is distributed evenly over the junction.

Types LA, LB  Bolts M10 Torque 43 Nm (= 4,3 kgm)
Pay attention to keep correct distance between the underlying bolt and out coming conductors. (Figure F. 35)

The junction contact resistance and insulation resistance (Annex A: Electrical site test) should be checked prior to the casting.

After installation of the junctions, cover it. For example with plastic to protect it against dust, rain…

When the installation of ALL the junctions is finished, proceed to “Module G: Installation of the moulds”.
Module G: Installation of the moulds

G.1. INTRODUCTION

Casting of junctions with Beto-Iso-Mix is split up into 4 modules:

- Module F: Installation of junctions
- Module G: Installation of the moulds
- Module H: Beto-Iso-Mix instructions
- Module I: Casting of junctions

Please ensure that all preceding modules have been completed before proceeding.

G.2. OVERVIEW

Figure G. 1: St 26

Figure G. 2: St 27

Figure G. 3: St 29
G.3. MATERIALS REQUIRED

☐ Materials delivered by Eta-com

  o A package containing:
    - Casting moulds with sealing rubbers
    - Content and reference sheet

  Check the quantity and dimensions of the content.

  o Demoulding agent
  o Tape to make sure the mould is leakage tight

☐ Materials by installation contractor

  o (Paint)Brush
  o Socket wrench with sockets
  o Set of flat- or ring spanners
  o Stanley knife
  o Rag
  o Mastic
  o Coarse abrasive paper

☐ Demoulding agent is a material that needs to be used with caution. More information about precautions of this material can be found in Annex F: Material Safety Data Sheets. Please read this sheet before proceeding.
G.4. STRAIGHT JUNCTION ST26

- Remove the protection tapes from the insulation ends (see Figure G. 4). Avoid contact with the hands of the roughened sections at the insulation ends of the betobar-r (see Figure G. 5).

Betobar-r conductors, junction plates and insulation or creepage insulators need to be clean and dry. If required, clean conductor ends and junction plates with nylon cleaning pads; roughen insulation ends with coarse abrasive paper, grain size 80. Assure the junction is free from dust and humidity. Use a hot air blower if required.

- Install the bottom and two sides of the mould using the bolts and nuts. Do not tighten these completely so that the mould can easily be slid over the rubber seals in a later stage of the installation (see Figure G. 6). **ATTENTION!** The flanges of the two sides of the mould must always be inwards.
Apply demoulding agent thinly on inner mould surfaces and rubber seals (see Figure G. 7). Let dry thoroughly.

Make a cut in the rubber seals for an easier installation of the rubber seals around the betobar-r (see Figure G. 8). Now put the rubber seals around the betobar-r. At this stage of the installation the distance between the two rubber seals is ±300mm (see Figure G. 9).
Fit the mould over the junction as shown in Figure G. 10.

Make sure that the flanges of the sides fit into the grooves of the rubber seals (see Figure G. 11).
Install the two fixing bridges by means of the bolts and nuts (see Figure G. 12). Now tighten all the bolts and nuts.

At the 4 corners at the bottom of the mould are cavities that need to be covered with tape (usually supplied by Eta-com) to avoid leaking of the Beto-Iso-Mix (see Figure G. 13). The cavities can also be filled up with mastic. Also cover up or fill up the cuts that have been made in the rubber seals.

Prepare as many moulds as possible for one casting operation.

After installation of the moulds please proceed to the Beto-Iso-Mix instructions (Module H).
G.5. ELBOW JUNCTION ST27

- Remove the protection tapes from the insulation ends (see Figure G. 14). Avoid contact with the hands of the roughened sections at the insulation ends of the betobar-r (see Figure G. 15).

- Betobar-r conductors, junction plates and insulation or creepage insulators need to be clean and dry. If required, clean conductor ends and junction plates with nylon cleaning pads; roughen insulation ends with coarse abrasive paper, grain size 80. Assure the junction is free from dust and humidity. Use a hot air blower if required.

- Install the elbow (1) and two sides of the mould (4) using the bolts (2) and nuts (1) (See Figure G. 16). **ATTENTION!** The flanges of the two sides of the mould (4) and the elbow (1) must always be inwards.

Figure G. 14: Remove the protection tapes  
Figure G. 15: Avoid contact with hands  
Figure G. 16: Assembly of elbow and two sides of the mould
Do not tighten the nuts and bolts so that the mould can easily be slid over the rubber seals in a later stage of the installation (see Figure G. 17).

![Figure G. 17: DO NOT tighten the nuts and bolts completely](image)

Apply demoulding agent thinly on inner mould surfaces and rubber seals (see Figure G. 18: Applying demoulding agent). Let dry thoroughly.

![Figure G. 18: Applying demoulding agent](image)
Make a cut in the rubber seals for an easier installation around the betobar-r (see Figure G. 19).

Now put the rubber seals around the betobar-r. Hold the lower rubber seal in place by means of a temporary support (see Figure G. 20).
Fit the mould over the junction as shown in Figure G. 21.

Make sure that the flanges of the sides fit into the grooves of the rubber seals (see Figure G. 22).

Install the fixing bridge and closing plate (see Figure G. 23) and tighten by means of the bolts and nuts (see Figure G. 24).
At the 4 corners of every rubber seal are cavities that need to be covered with tape (usually supplied by Eta-com) to avoid leaking of the Beto-Iso-Mix (see Figure G. 1325). The cavities can also be filled up with mastic. Also cover up or fill up the cuts that have been made in the rubber seals.

Prepare as many moulds as possible for one casting operation.

After installation of the moulds please proceed to the Beto-Iso-Mix instructions (Module H).
G.6. STRAIGHT JUNCTION ST29

- Remove the protection tapes from the insulation ends (see Figure G. 26). Avoid contact with the hands of the roughened sections at the insulation ends of the betobar-r (see Figure G. 27).

![Figure G. 26: Remove the protection tapes](image1)

![Figure G. 27: Avoid contact with hands](image2)

- Betobar-r conductors, junction plates and insulation or creepage insulators need to be clean and dry. If required, clean conductor ends and junction plates with nylon cleaning pads; roughen insulation ends with coarse abrasive paper, grain size 80. Assure the junction is free from dust and humidity. Use a hot air blower if required.

- Install the bottom and two sides of the mould using the bolts and nuts. Do not tighten these completely so that the mould can easily be slid over the rubber seal in a later stage of the installation (see Figure G. 28). **ATTENTION!** The flanges of the two sides of the mould must always be inwards.

![Figure G. 28: Assembly of the front and the two sides of the mould](image3)
Apply demoulding agent thinly on inner mould surfaces and the rubber seal (see Figure G. 29). Let dry thoroughly.

Make a cut in the rubber seal for an easier installation of the rubber seal around the betobar-r (see Figure G. 30).
Hold the rubber seal in place by means of a temporary support (see Figure G. 31).

Fit the mould over the junction as shown in Figure G. 32. Make sure that the flanges of the sides fit into the grooves of the rubber seals.
Install the closing plate (see Figure G. 33) and tighten by means of the bolts and nuts (see Figure G. 24).

Put the pouring aid over the closing plate of the mould (see Figure G. 35 and Figure G. 36).
At the 4 corners at the bottom of the mould are cavities that need to be covered with tape (usually supplied by Eta-com) to avoid leaking of the Beto-Iso-Mix (see Figure G. 1337). The cavities can also be filled up with mastic. Also cover up or fill up the cuts that have been made in the rubber seals.

Prepare as many moulds as possible for one casting operation.

After installation of the moulds please proceed to the Beto-Iso-Mix instructions (Module H).
Module H: Beto-Iso-Mix mixing instructions

H.1. INTRODUCTION

Casting of junctions with Beto-Iso-Mix is split up into 4 modules:

- Module F: Installation of junctions
- Module G: Installation of the moulds
- Module H: Beto-Iso-Mix mixing instructions
- Module I: Casting of junctions

Please ensure that all preceding modules have been completed before proceeding.

H.2. OVERVIEW

Figure H. 1: RAL 7032

Figure H. 2: RAL 6011
H.3. Materials required

- Materials delivered by Eta-com
  - Tin cans (0.75 liter) of hardener type A, B or C
  - Tin cans (2 liters) of resin
  - Buckets 12l containing:
    - 1 Content and reference sheet
    - 1 plastic bag with fillers
    - Beto-Iso-Mix mixing instructions
    - 1 desiccant pack
    - 1 pair of plastic gloves

- Other required equipment
  - Electric hand drill ¾ "
  - Mixing paddle
  - Screwdriver
  - Safety overalls, gloves and goggles
H.3.2. Storage

- Store fillers, resin and hardener under cover in original container, securely sealed at room temperature 5°C till maximum 45°C, as in Figure H. 3. Store away from food and food containers. Store out of reach of children.
- Prior to casting, store all products at a temperature between 18°C and 25°C for at least 24 hours in order to acclimatize.

Figure H. 3: Store free from radiation, frost and humidity

H.3.3. Handling and precaution

- Ensure good ventilation and local exhaustion of working areas and avoid inhalation of vapor.
- Wear eye / face protection, overalls and gloves.
- Apply protective cream on exposed skin to avoid sensitizing.
- Do not eat, drink or smoke on working areas.
- After the use of Beto-Iso-Mix, immediately wash hands with soap and warm water.
- Hardener, resin and fillers are materials that need to be used with caution. More information about precautions of these materials can be found in Annex F: Material Safety Data Sheets. Please read these sheets before proceeding.

H.3.4. Mixing

- Check validity date on labels. NEVER EXCEED THIS DATE.
- Check ambient temperature range of hardener (Figure H. 4). Use only if ambient temperature on the day is within the range. Delay casting if the required ambient temperatures cannot be maintained for a minimum of 6 hours. If it’s too cold, place a tent with a hot air blower over the junctions to be cast.
- Temperature of the casting mix must be at least 18°C when pouring.
- Do not cast at ambient temperature below 5°C or above 45°C.

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>Hardener type</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°C - 15°C</td>
<td>A</td>
<td>Champagne coloured</td>
</tr>
<tr>
<td>15°C - 35°C</td>
<td>B</td>
<td>Light honey coloured</td>
</tr>
<tr>
<td>25°C - 45°C</td>
<td>C</td>
<td>Dark honey coloured</td>
</tr>
</tbody>
</table>

Figure H. 4: Ambient temperature range of hardener

- Resin and hardener should look transparent and free of crystals. Do NOT use if opaque or crystallized. Resin should look clear to light colored.
Open the 12l-bucket (Figure H. 5) and check if fillers (sand) are absolutely dry (inspect the desiccant bag). Do not use if damage to inner liner indicates that filler may be contaminated. Be particularly cautious of water contamination. Break the 4 clips to open the resin can (see Figure H. 6) and open the hardener can (see Figure H. 7).

Pour 1 tin can of resin (2 liters) and 1 tin can of hardener (0,75 liter) in an empty, dry and clean bucket (Figure H. 8).

Mix thoroughly during +/- 1 minute with electric hand drill and mixing paddle (Figure H. 9).

Gradually add 1 bag of sand and continue mixing for about 5 min. till a smooth and homogeneous mixture is reached (Figure H. 10).

After preparation of the Beto-Iso-Mix please proceed to the Casting of junctions-instructions (Module I)

H.3.5. Waste

Leftovers of BIM-mixes may be disposed of as inert polymer concrete, by mixing and allowing to cure. This way, the leftovers can be treated as regular waste. Unused and full buckets or bottles must be treated as chemicals and either be disposed of according to local environmental laws or returned to our works.

In case of accidental spillage of unmixed resins or hardeners, take up with absorbent inert material (e.g. sand) and dispose of it in a suitable container for chemical waste. Desiccant packs, over aged resin and hardener should be disposed of as chemical waste.
H.4. RAL6011 BETO-ISO-MIX

H.4.1. Materials required

☐ Materials delivered by Eta-com

  - Tin cans (0,75 liter) of hardener type A, B or C
  - Tin cans (2 liters) of resin
  - Buckets 12l containing:
    - 1 Content and reference sheet
    - 1 plastic bag with fillers
    - Beto-Iso-Mix mixing instructions
    - 1 desiccant pack
    - 1 pair of plastic gloves
    - Green pigment

☐ Other required equipment

  - Electric hand drill ¾”
  - Mixing paddle
  - Screwdriver
  - Safety overalls, gloves and goggles
**H.4.2. Storage**

- Store fillers, resin and hardener under cover in original container, securely sealed at room temperature 5°C till maximum 45°C, as in Figure H. 11. Store away from food and food containers. Store out of reach of children.
- Prior to casting, store all products at a temperature between 18°C and 25°C for at least 24 hours in order to acclimatize.

**Figure H. 11: Store free from radiation, frost and humidity**

**H.4.3. Handling and precaution**

- Ensure good ventilation and local exhaustion of working areas and avoid inhalation of vapor.
- Wear eye / face protection, overalls and gloves.
- Apply protective cream on exposed skin to avoid sensitizing.
- Do not eat, drink or smoke on working areas.
- After the use of Beto-Iso-Mix, immediately wash hands with soap and warm water.
- **Hardener, resin, green pigment and fillers are materials that need to be used with caution. More information about precautions of these materials can be found in Annex F: Material Safety Data Sheets. Please read these sheets before proceeding.**

**H.4.4. Mixing**

- Check validity date on labels. NEVER EXCEED THIS DATE.
- Check ambient temperature range of hardener (Figure H. 12). Use only if ambient temperature on the day is within the range. Delay casting if the required ambient temperatures cannot be maintained for a minimum of 6 hours. If it’s too cold, place a tent with a hot air blower over the junctions to be cast.
- Temperature of the casting mix must be at least 18°C when pouring.
- Do not cast at ambient temperature below 5°C or above 45°C.

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<td>Light honey coloured</td>
</tr>
<tr>
<td>25°C - 45°C</td>
<td>C</td>
<td>Dark honey coloured</td>
</tr>
</tbody>
</table>

**Figure H. 12: Ambient temperature range of hardener**

- Resin and hardener should look transparent and free of crystals. Do NOT use if opaque or crystallized. Resin should look clear to light colored.
Open the 12l-bucket (Figure H. 13) and check if fillers (sand) are absolutely dry (inspect the desiccant bag). Do not use if damage to inner liner indicates that filler may be contaminated. Be particularly cautious of water contamination.

Break the 4 clips to open the resin can (Figure H. 14)

Pour 1 tin can of resin and the green pigment in an empty, dry clean bucket. (see Figure H. 15)

Mix thoroughly until color is homogeneous with electric hand drill and mixing paddle (Figure H. 16).

When green color is uniform: open the hardener can (Figure H. 17), add hardener (Figure H. 18) and mix ±1 minute (Figure H. 19).

Gradually add 1 bag of sand and continue mixing for about 5 min. till a smooth and homogeneous mixture is reached (Figure H. 20).

After preparation of the Beto-Iso-Mix please proceed to the Casting of junctions-instructions (Module I)

H.4.5. Waste

Leftovers of BIM-mixes may be disposed of as inert polymer concrete, by mixing and allowing to cure. This way, the leftovers can be treated as regular waste. Unused and full buckets or bottles must be treated as chemicals and either be disposed of according to local environmental laws or returned to our works.

In case of accidental spillage of unmixed resins or hardeners, take up with absorbent inert material (e.g. sand) and dispose of it in a suitable container for chemical waste. Desiccant packs, over aged resin and hardener should be disposed of as chemical waste.
Module I: Casting of junctions

I.1. INTRODUCTION

Casting of junctions with Beto-Iso-Mix is split up into 4 modules:

Module F: Installation of junctions
Module G: Installation of the moulds
Module H: Beto-Iso-Mix instructions
Module I: Casting of junctions

Please ensure that all preceding modules have been completed before proceeding.

I.2. OVERVIEW

Figure I. 1: St 26
Figure I. 2: St 27
Figure I. 3: St 29

I.3. MATERIALS REQUIRED

Materials by installation contractor

- Putty knife
- Hot air blower
I.4. STRAIGHT JUNCTION ST26

I.3.1. Casting

- Avoid draught and DO NOT cast at ambient temperature below 5°C or above 45°C.
- Make sure the mix is at least 18°C when starting to pour.
- Pour the Beto-Iso-Mix immediately after mixing but slowly into the mould.

Figure I. 4: Pouring of the Beto-Iso-Mix

- Pour from one side only to avoid air enclosures. (see Figure I. 5)

Figure I. 5: Pour from one side

- Fill up as shown in Figure I. 6.

Figure I. 6: Pouring level
Smoothen top surface with a putty knife for glossy finish.

![Figure I. 7: Smoothen top surface with a putty knife](image1)

![Figure I. 8: Smoothened surface](image2)

Allow casting mix to harden. Remove mould not sooner than after 8 hours of curing time. Remove any casting flash on edges and corners. Wait at least another 4 hours to test the betobar-r under tension. NEVER test the system with the mould still in place.

![Figure I. 9: Casting of a junction](image3)

I.3.2. Cleaning

- Clean the putty knife and mixing paddle (used during mixing) immediately after use with lukewarm water and soap and allow to dry thoroughly.

- Clean the moulds and seals but DO NOT use solvent.
I.5. ELBOW JUNCTION ST27

I.6.1. Casting

- Avoid draught and DO NOT cast at ambient temperature below 5°C or above 45°C.
- Make sure the mix is at least 18°C when starting to pour.
- Pour the Beto-Iso-Mix immediately after mixing but slowly into the mould.

Figure I. 10: Pouring of the Beto-Iso-Mix

- Pour from one side only to avoid air enclosures. (see Figure I. 11)

Figure I. 11: Pour from one side
☐ Fill up as shown in Figure I. 12.

Figure I. 12: Pouring level

☐ Smoothen top surface with a putty knife for glossy finish.

Figure I. 13: Smoothen top surface with a putty knife

Figure I. 14: Smoothened surface

☐ Allow casting mix to harden. Remove mould not sooner than after 8 hours of curing time. Remove any casting flash on edges and corners. Wait at least another 4 hours to test the betobar-r under tension. NEVER test the system with the mould still in place.
I.6.2. Cleaning

- Clean the putty knife and mixing paddle (used during mixing) immediately after use with lukewarm water and soap and allow to dry thoroughly.

- Clean the moulds and seals but DO NOT use solvent.
I.6. STRAIGHT JUNCTION ST29

I.9.1. Casting

- Avoid draught and DO NOT cast at ambient temperature below 5°C or above 45°C.
- Make sure the mix is at least 18°C when starting to pour.
- Pour the Beto-Iso-Mix immediately after mixing but slowly into the mould.

- Pour from one side only to avoid air enclosures.
- Fill up as shown in Figure I. 17.

Figure I. 16: Pouring of the Beto-Iso-Mix
Figure I. 17: Pouring level
Remove the pouring aid and smoothen top surface with a putty knife for glossy finish.

Allow casting mix to harden. Remove mould not sooner than after 8 hours of curing time. Remove any casting flash on edges and corners. Wait at least another 4 hours to test the betobar-r under tension. NEVER test the system with the mould still in place.

I.9.2. Cleaning

Clean the putty knife and mixing paddle (used during mixing) immediately after use with lukewarm water and soap and allow to dry thoroughly.

Clean the moulds and seals but DO NOT use solvent.
Module J: Installation of expansion elements

J.1. INTRODUCTION

The purpose of an expansion element is to allow thermal dilatation (expansion and contraction) of the busduct run if necessary. These dilatations are caused by external and internal temperature fluctuations: day - night cycles, seasonal cycles and power up/down cycles.

To manage the dilatation, the line will be divided in multiple sections that will be provided with separate expansion elements and 2 fixed point supports per section. In case of multiple expansion elements in one straight length, the adjacent sections have a fixed point in common.

Fixed point supports are engineered to fit with the primary support available on site, so it exists in many shapes and sizes, but generally it looks like this:

![Figure J 1: Generic fixed point construction](image)

For the site-specific fixed point support, see detail drawings of the supports of the project.

Correct operation of the expansion elements can only be guaranteed when the installation is done conform the Eta-com specifications including:

- Correct installation of the primary supporting structure to allow assembly the secondary supports in accordance with the GA and support drawings.
  - Horizontal supports allowing pendulum movement caused by the dilatation (standard supports with threaded rods)
  - Fixed point busduct supports forcing the dilatation to act in 1 direction.
  - Other support types
- Correct length presetting of the expansion element. The procedure is described in this document.
- Correct position of all the elements including the expansion elements in accordance with the GA drawings.
J.2. OVERVIEW

Figure J 2: Concept drawing of a LV expansion element

J.3. MATERIALS REQUIRED

- Materials delivered by Eta-com
  - Expansion element
    - Including length preset table, associated with this specific expansion element.

- Other required equipment
  - Spanner size 17
  - Tape measure
  - Lifting equipment
  - Thermometer
  - Safety overalls, safety shoes, gloves and goggles

J.4. STORAGE AND HANDLING

J.4.1. Storage

Do not stack the expansion elements.

J.4.2. Handling

Handling of the expansion element must be done with great care, since the enclosure may not be damaged.
The expansion element may be lifted using slings.
Do not lift the expansion element by the threaded rods or L-profiles.
J.5. INSTALLATION

- The general installation instructions Module D: General instructions remain valid, unless stated otherwise below. Check first:
  - Free longitudinal movement of busduct line.
  - Lateral guiding of the busduct line, to avoid sideways deflection in accordance with the detailed drawings of the supports.
  - Position of fixed point supports, in accordance with GA drawings.

J.5.1. Mount the supports

As indicated on the GA drawings.
Mount the supports as described in Module C: Installation of supports.

J.5.2. Mount the busducts

Mount the busducts as described in Module D: General instructions.
Align the elements between the two fixed points of the section, including the preset expansion element. The expansion element must hang from temporary slings, as there are no supports for the expansion element.

J.5.3. Preset the length of the expansion element (L1_{installation}, Lx_{installation})

Explanation:

The expansion element has been designed for compensation of thermal dilatation in a range of +10 mm to –40 mm. This 50 mm is defined as the maximum working range of the expansion element and means that the L1 dimension can vary from 960 mm to 1010 mm.

Note: The physical length of the expansion element (as it is delivered) is 990 mm, while the L1 dimension is 1000 mm, since the L1 dimension considers the gap between the elements as drawn in the GA drawings.

![Figure J 3: Functional dimensions L1 and Lx](image-url)
Preset value:

- The length of the expansion element must be preset, based on the actual ambient temperature at the moment of installation.
- For easy measurement during preset of the length, the Lx value can be used instead of the L1 value to preset the expansion element. Both values are indicated in the length preset table.
- For the correct length presetting: see the length preset table that is delivered with the expansion element.
  - **Important! Each expansion element has its dedicated length preset table!**
  - **Interpretation of the length preset table:**
    - The left column is the actual ambient temperature during installation.
    - The right columns are the functional lengths of the expansion element for installation: L1 and Lx.

- Example of a preset table for a section of 20 m with a minimum ambient temperature of -5°C:

  ![Example Preset Table](image)

  **Figure J 4: Example of a length preset table**

Presetting the physical length of the expansion element:

- Adjust the length Lx of the expansion element using the bolts on the 4 threaded rods, until Lx (and L1) equals the values found in the table according to the actual ambient temperature while installing the expansion element.
Adjust the length Lx of the expansion element until Lx equals the value found in the table according to the actual ambient temperature.

Same adjustment required on the bottom side!

Figure J 5: Adjusting to obtain the correct preset length
J.5.4. Install the junctions

- Fix the junctions according to Module F: Installation of junctions.
- Start at the extremity of the section away from the expansion element and work towards the expansion element, installing and measuring the junctions.
- The 2 junctions of the expansion element are the last junctions to be installed. Check whether the actual ambient temperature corresponds with the preset length of the expansion element.

J.5.5. Finalization

- When all junctions are installed Module F: Installation of junctions and measured Annex A: Electrical site tests, remove the temporary support slings and the threaded rods.

Figure J 6: Finalizing: remove the threaded rods
Module K: Installation of fireproof penetrations

K.1. INTRODUCTION

- The busduct routing can be engineered to run through a wall or floor. In that case, it is recommended to seal off the remaining opening using fire resistant materials to slow down the fire spreading from one room to another. The concept for the fireproof penetrations is similar for wall and floor penetrations.

- A fireproof penetration consists of two subassemblies:
  - The basic wall/floor penetration: a tailor-made sleeve that is placed on the element at the Eta-com factory.
  - The completion kit: a per betobar-r type defined kit that completes the basic wall/floor penetration.

- It is up to the installing party to assemble the wall/floor penetration, according to the specifications, so that it is compliant with the certification.

K.2. OVERVIEW

![Figure K. 1: Single lines](image1)
![Figure K. 2: Double lines](image2)

K.3. MATERIALS REQUIRED

- Materials delivered by Eta-com
  - A completion kit containing the following items:
    - Content and reference sheet
    - Closing plates
    - Promaseal-S
    - Promat glue K84
    - Rockwool D100
    - Dowels

  The completion kit is defined per betobar-r type. Inside this package you'll find a content and reference sheet. Check the quantities and dimensions of the content.

- Materials required by installation contractor
  - Putty knife
  - Stanley knife
  - Drill
K.4. STORAGE, HANDLING AND PRECAUTION

- Store all components and products (Promat glue K84, Promaseal-S and PROMAXON Type A boards) in a dry place and keep out of the sun. Minimum storage temperature for the chemicals is 5°C.

- Check the validity of the expiry dates of Promat glue K84 and Promaseal-S before usage. Important: Protect from frost at all times, also during transport.

- Promat glue K84, Promaseal-S and Rockwool D100 are materials that need to be used with caution. More information about precautions of these materials can be found in Annex F: Material Safety Data Sheets. Please read these sheets before proceeding.

K.5. INSTALLATION INSTRUCTIONS

K.5.1. Single lines

- Put the element in place, according to the layout-drawing(s) (Figure K. 3). The position of the element in the hole is very important. Measured from the PROMAXON sleeve, the distance to the rim of the opening must be 50 ± 25 mm. If possible, adjust the position of the element within the tolerances of the junctions. Escalate every deviation in writing to the site responsible.

Attention: try to center the sleeve as much as possible according to wall/floor (see figure K.4). The PROMAXON sleeve must always protrude the wall/floor + completion kit (45 mm) covering the wall/floor aperture.
o Fill up the gap between the sleeve and the wall / floor with the high density Rockwool D100 (see Figure K. 5 and Figure K. 6).

![Figure K. 5](image)
![Figure K. 6](image)

o Apply some pressure and ensure no gaps are left open (Figure K. 7).

![Figure K. 7](image)

o First check the drawing on the content and reference sheet inside the package for correct positioning of the two layers of the PROMAXON boards.

o Glue the first layer of PROMAXON board 20 mm with Promat glue K84 and stick it in place to the wall / floor (See Figure K.8 and Figure K.9).

![Figure K. 8](image)
![Figure K. 9](image)
Glue the second layer of PROMAXON board 20 mm with Promat glue K84 and stick it in place on top of the first layer (See Figure K. 10 and Figure K. 11). The 2nd layer is inverted to avoid overlap of the seams.

Drill the required holes, according to the drawing on the content and reference sheet, through the PROMAXON boards in the wall / floor.

A centerline distance of 200mm between holes is sufficient. As in practice the holes are drilled in one go (closing plate against wall or floor) with the holes in the wall or floor itself.

Fix the PROMAXON board with the dowels. Make sure every panel has at least one dowel fixing it (See Figure K. 12 and Figure K. 13).

Repeat the procedure for the other side of the penetration.

Finish all seams and all dowels with Promaseal-S. (See Figure K. 14)

Finally, mark the wall / floor penetration with the official certification sticker (when required by local regulations)
A grey label, signed by the installer, must be placed on both sides of the wall/floor, see Figure K. 15.
K.5.2. Double lines

- Put the elements in place, according to the layout-drawing(s) (See Figure K. 16). The position of the element in the hole is very important. Measured from the PROMAXON sleeve, the distance to the rim of the opening must be 50 +/- 25 mm. If possible, adjust the position of the element within the tolerances of the junctions. Escalate every deviation in writing to the site responsible.

- Attention: try to center the sleeve as much as possible according to wall/floor (see figure K.17). The PROMAXON sleeve must always protrude the wall/floor + completion kit (45 mm) covering the wall/floor aperture.

- Fill up the gap between the sleeve and the wall / floor with the high density Rockwool D100 (See Figure K. 18 and Figure K. 19).
- Apply some pressure and ensure no gaps are left open (See Figure K. 20).

- First check the drawing on the content and reference sheet inside the package for correct positioning of the two layers of the PROMAXON boards.

- Glue the first layer of PROMAXON board 20 mm with Promat glue K84 and stick it in place to the wall / floor (See Figure K. 21 and Figure K. 22).
Glue the second layer of PROMAXON board 20 mm with Promat glue K84 and stick it in place on top of the first layer (See Figure K. 23 and Figure K. 24). The 2nd layer has a 180° rotation compared to the first layer to avoid overlap of the seams.

Drill the required holes, according to the drawing on the content and reference sheet, through the PROMAXON boards in the wall / floor.

A centerline distance of 200 mm between holes is sufficient. As in practice the holes are drilled in one go (closing plate against wall or floor) with the holes in the wall or floor itself.

Fix the PROMAXON board with the dowels. Make sure every panel has at least one dowel fixing it (See Figure K. 25 and Figure K. 26).

Repeat the procedure for the other side of the penetration.
☐ Finish all seams and all dowels with Promaseal-s. (See Figure K. 27)

![Figure K. 27](image)

☐ Finally, mark the wall / floor penetration with the official certification sticker (when required by local regulations)

- A grey label, signed by the installer, must be placed on both sides of the wall/floor, see Figure K. 28.

![Figure K. 28](image)
K.6. REMARKS

K.6.1. Penetrations with a rating S30, S60, S90,... fire resistance class.

- Even if a fire resistance class lower than S120 is requested, the penetration must be installed exactly as described in this installation instruction, even if the wall or floor is less thick. Every deviation has to be approved by a national authority.
- Walls thinner than 150 mm, floors thinner than 200 mm, plasterboard walls, or in general walls or floors withstanding less than 120 min. in fire conditions:
  - The wall or floor at the penetration must have the same or greater thickness than described in the test report: wall thickness at least 150 mm, floor thickness at least 200 mm.
  - The extra thickness may be achieved by adding PROMAXON boards, or materials with a fire resistance class and density equal to or higher than the wall or floor itself.

K.6.2. Outdoor wall / floor penetrations

The wall / floor penetrations must be prevented from getting wet by rain or dripping water. Provide adequate cover to protect all the PROMAXON boards.

For example with a roof:

Or a weather resistant water proof coating.

K.6.3. Supports

- Distance of first support from the wall or floor
  - Wall penetration:
    - The maximum distance is 250 mm from the wall (both sides). The support may be placed on the PROMAXON sleeve.
  - Floor penetration:
The minimum distance is 250 mm from the sealing or the floor. Larger distances are allowed as long as the mechanical resistance of the betobar-r is guaranteed even in fire conditions. The support may not be placed on the PROMAXON sleeve.

**K.6.4. Elbows close to the wall / floor penetration**

- The PROMAXON sleeve must protrude at least 150 mm from the wall / floor. If the elbow is closer, the sleeve must follow the elbow.

**K.6.5. Junctions, phase exchange elements or expansion elements**

- Never put a junction, phase exchange element, phase equalizing element or expansion element in a wall- or floorpenetration. This is never allowed.

**K.6.6. Deviations**

- Openings in wall- or floor penetrations too small or distance between wall or floor and betobar-r too small compared with the requirements of the engineering specifications.
  - This situation is not compatible with the test report unless approved by national authority.
  - If the required space cannot be achieved by repositioning the betobar-r (eg using tolerances within the junctions), we strongly recommend to ask the client in writing to modify the opening. This is to avoid later discussions and unwanted liabilities.

**K.6.7. Authorised installers**

- Be aware that some countries (eg Germany) require installers of certified wall- or floor penetrations to be authorized by the manufacturer. Furthermore the installer may be responsible and liable for the correct functioning of the wall- or floorpenetration under fire conditions. Please inform yourself at the national organization of the country where the betobar-r has to be installed.
- If required, ETA-COM B can organize a training session and provide a document authorizing people to install wall- and floor penetrations according to the test report / certificate.

**K.6.8. Third-party application in the same wall- / floor penetration as the betobar-r.**

- Cables, water pipes, air treatment,... can never be part of the betobar-r wall- and floorpenetrations. This third-party application must have its own penetration concept with its own characteristics for which ETA-COM cannot be responsible.
- Always make sure that the third-party application has sufficient distance (min. 300 mm) from the betobar-r penetration.
Module L: Installation of spring supports

L.1. INTRODUCTION

- This module describes the function of the different types of spring supports, when they must be used and how they must be installed.

- The main task of a spring support is to provide continuous and unchanged carrying capacity to vertically positioned busduct runs subject to thermal dilatation that is not negligible.

- Eta-com provides hanging and standing spring supports. These supports have the same functionality, but are mounted differently:
  - Hanging spring supports are used for vertical busduct runs, when the supporting structure is located above the support.
  - Standing spring supports are used for vertical busduct runs, when the supporting structure is located below the support.

L.2. OVERVIEW

- Materials delivered by Eta-com
  - A package containing:
    - All required parts for assembly of the spring supports
    - A content and reference sheet
  
  Check the quantity and dimensions of the content

- Materials by installation contractor
  - Torque spanner
  - Set of flat- or ring spanners
L.4. SPRING SUPPORT HANGING VERSION

- Exploded View

Be aware that the upper and lower shafts (items 3 and 4) have a different purpose. It is very important that these shafts are mounted correctly because the springs must always be subjected to compressive forces caused by the weight of the individual busduct. In case of hanging spring support, the upper shaft (3) will clamp the busduct while the lower shafts (4) will allow the busduct to slide.

N.B.: The color of the springs shown in the pictures can be different from the springs you find in the box.
ATTENTION!

NEVER unscrew any of the nuts shown on the figure below as the springs are preloaded! Disassembly of the unit is dangerous and proper function of the unit can no longer be guaranteed.

Please verify the element weight against the weight class of the spring support. You can find the identification sticker as shown in the figure below. Check if the unique code behind every betobar-r element on the material list corresponds with the one you should find on the identification sticker.
Starting from the bottom of the line, put the betobar-r element in place and secure with temporary supports. Each individual betobar-r element must hang completely free, not touching the lower or upper element. As the spring support is preloaded the distance between the upper betobar-r element and the lower betobar-r element should be approximately 40mm in this stage of the installation. This is shown in the figure below. Hang element in spring support and adjust with the below element before proceeding with the element above.

Keep the fixation point of the spring support, this is where the fixed L-supports are assembled by means of the fixing shaft, above the centre of gravity of the betobar-r element. If not possible, supply (temporary) gliding support to keep the element upright. Leave at least 300mm free of top end and bottom end of the betobar-r element as shown in the figure below to enable the installation of the junction casting box.
Assemble the two half spring supports around the betobar-r element so it can be placed at the correct height. The gliding L-supports (2) can be tightened right away using the shafts (4), washers (6) and nuts (8). Apply 43 Nm torque.
Connect the spring support by means of the shaft (9) and the threaded rod (10) to the available supporting structure (11).
Tighten the fixed L-supports (1) by means of the shafts (3), washers (5) and nuts (7). Apply 43 Nm torque.
Transfer the weight of the element to the spring support and check if the element swings freely. **Attention!** The upper element will descend about 30mm. If necessary use the threaded rod (10) to compensate the height. The standard distance between the elements is 10mm ± 9 as shown in the figure below.

![Diagram of elements](image)

Only when all elements are put in place and hang freely, the junctions can be assembled and cast over.

N.B: Be sure to test the insulation resistance and contact resistance before casting each joint.
L.5. SPRING SUPPORT HANGING VERSION LIGHT

Be aware that the upper and lower shafts (items 3 and 4) have a different purpose. It is very important that these shafts are mounted correctly because the springs must always be subjected to compressive forces caused by the weight of the individual busduct. In case of hanging spring support, the upper shaft (3) will clamp the busduct while the lower shafts (4) will allow the busduct to slide.

N.B.: The color of the springs shown in the pictures can be different from the springs you find in the box.
ATTENTION!

NEVER unscrew any of the nuts shown on the figure below as the springs are preloaded! Disassembly of the unit is dangerous and proper function of the unit can no longer be guaranteed.

Please verify the element weight against the weight class of the spring support. You can find the identification sticker as shown in the figure below. Check if the unique code behind every betobar-r element on the material list corresponds with the one you should find on the identification sticker.
Starting from the bottom of the line, put the betobar-r element in place and secure with temporary supports. Each individual betobar-r element must hang completely free, not touching the lower or upper element. As the spring support is preloaded the distance between the upper betobar-r element and the lower betobar-r element should be approximately 40mm in this stage of the installation. This is shown in the figure below. Hang element in spring support and adjust with the below element before proceeding with the element above.

Keep the fixation point of the spring support, this is where the fixed L-supports are assembled by means of the fixing shaft, above the centre of gravity of the betobar-r element. If not possible, supply (temporary) gliding support to keep the element upright. Leave at least 300mm free of top end and bottom end of the betobar-r element as shown in the figure below to enable the installation of the junction casting box.
Assemble the two half spring supports around the betobar-r element so it can be placed at the correct height. The gliding L-supports (2) can be tightened right away using the shafts (4), washers (6) and nuts (8). Apply 43 Nm torque.
Connect the spring support by means of the shaft (9) and the threaded rod (10) to the available supporting structure (11).
Tighten the fixed L-supports (1) by means of the shafts (3), washers (5) and nuts (7). Apply 43 Nm torque.
Transfer the weight of the element to the spring support and check if the element swings freely. **Attention!** The upper element will descend about 30mm. If necessary use the threaded rod (10) to compensate the height. The standard distance between the elements is 10mm ± 9 as shown in the figure below.

Only when all elements are put in place and hang freely, the junctions can be assembled and cast over.

N.B: Be sure to test the insulation resistance and contact resistance before casting each joint.
L.6. SPRING SUPPORT STANDING VERSION

- Exploded View

Be aware that the upper and lower shafts (items 3 and 4) have a different purpose. It is very important that these shafts are mounted correctly because the springs must always be subjected to compressive forces caused by the weight of the individual busduct. In case of a standing spring support, the upper shaft (3) will clamp the busduct while the lower shafts (4) will allow the busduct to slide.

N.B.: The color of the springs shown in the pictures can be different from the springs you find in the box.
ATTENTION!

NEVER unscrew any of the nuts shown on the figure below as the springs are preloaded! Disassembly of the unit is dangerous and proper function of the unit can no longer be guaranteed. The only nuts to be used during the installation are the adaptor nuts and locking nuts.

Please verify the element weight against the weight class of the spring support. You can find the identification sticker as shown in the figure below. Check if the unique code behind every betobar-r element on the material list corresponds with the one you should find on the identification sticker.
Starting from the bottom of the line, put the betobar-r element in place and secure with temporary supports. Each individual betobar-r element must hang completely free, not touching the lower or upper element. As the spring support is preloaded the distance between the upper betobar-r element and the lower betobar-r element should be approximately 40mm in this stage of the installation. This is shown in the figure below. Hang element in spring support and adjust with the below element before proceeding with the element above.

Keep the fixation point of the spring support, this is where the fixed L-supports are assembled by means of the fixing shaft, above the centre of gravity of the betobar-r element. If not possible, supply (temporary) gliding support to keep the element upright. Leave at least 300mm free of top end and bottom end of the betobar-r element as shown in the figure below to enable the installation of the junction casting box.
Assemble the two half spring supports around the betobar-r element so it can be placed at the correct height. The gliding L-supports (2) can be tightened right away using the shafts (4), washers (6) and nuts (8). Apply 43 Nm torque.
Connect the spring support by means of the shaft (9) and the adaptor nut (10) to the available supporting structure (ceiling or floor) (11). Secure the spring support by means of the washer (12) and the locking nut (13). Apply 43 Nm torque.
Tighten the fixed L-supports (1) by means of the shafts (3), washers (5) and nuts (7). Apply 43 Nm torque.
Transfer the weight of the element to the spring support and check if the element swings freely. **Attention!** The upper element will descend about 30mm. If necessary use the adaptor nut (11) to compensate the height. The standard distance between the elements is 10mm ± 9 as shown in the figure below.

Only when all elements are put in place and hang freely, the junctions can be assembled and cast over.

N.B: Be sure to test the insulation resistance and contact resistance before casting each joint.
L.7. SPRING SUPPORT STANDING VERSION LIGHT

- Exploded View

Be aware that the upper and lower shafts (items 3 and 4) have a different purpose. It is very important that these shafts are mounted correctly because the springs must always be subjected to compressive forces caused by the weight of the individual busduct. In case of a standing spring support, the upper shaft (3) will clamp the busduct while the lower shafts (4) will allow the busduct to slide.

- N.B.: The color of the springs shown in the pictures can be different from the springs you find in the box.
ATTENTION!

NEVER unscrew any of the nuts shown on the figure below as the springs are preloaded! Disassembly of the unit is dangerous and proper function of the unit can no longer be guaranteed. The only nuts to be used during the installation are the adaptor nuts and locking nuts.

Please verify the element weight against the weight class of the spring support. You can find the identification sticker as shown in the figure below. Check if the unique code behind every betobar-r element on the material list corresponds with the one you should find on the identification sticker.
Starting from the bottom of the line, put the betobar-r element in place and secure with temporary supports. Each individual betobar-r element must hang completely free, not touching the lower or upper element. As the spring support is preloaded, the distance between the upper betobar-r element and the lower betobar-r element should be approximately 40mm in this stage of the installation. This is shown in the figure below. Hang element in spring support and adjust with the below element before proceeding with the element above.

Keep the fixation point of the spring support, this is where the fixed L-supports are assembled by means of the fixing shaft, above the centre of gravity of the betobar-r element. If not possible, supply (temporary) gliding support to keep the element upright. Leave at least 300mm free of top end and bottom end of the betobar-r element as shown in the figure below to enable the installation of the junction casting box.
Assemble the two half spring supports around the betobar-r element so it can be placed at the correct height. The gliding L-supports (2) can be tightened right away using the shafts (4), washers (6) and nuts (8). Apply 43 Nm torque.
Connect the spring support by means of the shaft (9) and the adaptor nut (10) to the available supporting structure (ceiling or floor) (11). Secure the spring support by means of the washer (12) and the locking nut (13). Apply 43 Nm torque.
Tighten the fixed L-supports (1) by means of the shafts (3), washers (5) and nuts (7). Apply 43 Nm torque.
Transfer the weight of the element to the spring support and check if the element swings freely. **Attention!** The upper element will descend about 30mm. If necessary use the adaptor nut (11) to compensate the height. The standard distance between the elements is 10mm ± 9 as shown in the figure below.

Only when all elements are put in place and hang freely, the junctions can be assembled and cast over.

N.B: Be sure to test the insulation resistance and contact resistance before casting each joint.
Module M: Terminal Connections

M.1. INTRODUCTION

The last step in the installation of a betobar-r electrical power connection is the connection of the complete line with the applications, for example generator, transformer, switch board,… Before making the connection to the applications, the complete line has to be checked and tested.

M.2. MATERIALS REQUIRED

- Materials by installation contractor
  - Torque spanner with set of sockets
  - Set of flat – or ring spanners
M.3. **PROCEDURE**

- Check before connection:
  - Prior to fitting strips and/or flexible links to equipment terminals, the completed lines should be checked and tested in accordance with the instructions: Annex A – Electrical site-test.
  - Check the position of the equipment terminals in relation to the position of betobar-r terminals in accordance with layout/detail drawings. Check whether length and shape of flexible links or strips correspond with terminal positions.
  - Position of equipment and betobar-r terminals should also be checked for correct level differences, square and parallel positions in order to avoid stresses on terminals, flexible links or connection strips. Adjust as required.
  - All contact surfaces are to be absolutely clean and dry.

M.4. **CONNECTION WITH FLEXIBLE LINKS**

- First fix the flexible links (and pressure plates) to the betobar-r terminals with bolts already fitted and in accordance with layout / detail drawings. Then fix flexible links to the equipment terminals. Use only high tensile steel bolts with pressure washers as per DIN 6796.
- Check whether phase/phase, phase/neutral and phase/earth distances are in accordance with local regulations. Give extra attention to bolts, nuts, supports…
- Flexible links should never be fully stretched or fully compressed on installation. If required, adjust the position of the terminal head, so the flexible links is in neutral position.
- If required, fit short circuit bracing strips as represented on detail drawings.
- Tighten bolts class 8.8 with torque spanner setting as follows:

<table>
<thead>
<tr>
<th>Bolt size</th>
<th>M6</th>
<th>M8</th>
<th>M10</th>
<th>M12</th>
<th>M14</th>
<th>M16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque Nm</td>
<td>10,0</td>
<td>23,0</td>
<td>43,0</td>
<td>74,0</td>
<td>117,0</td>
<td>163,0</td>
</tr>
<tr>
<td>Kgm (= da Nm)</td>
<td>1,0</td>
<td>2,3</td>
<td>4,3</td>
<td>7,4</td>
<td>11,7</td>
<td>16,3</td>
</tr>
</tbody>
</table>

- Install the cover(s) of the box with appropriate packing and tighten the bolts with a torque of 10 Nm.
Annex A: Electrical site-tests

A.1. OVERVIEW

The electrical site-tests consists of:

- A junction resistance test
- A line insulation resistance test
- A phase sequence test
- A power frequency withstand test (Optional)

A.2. JUNCTION RESISTANCE TEST

A.2.1. Materials required

Materials delivered by Eta-com:

- 2 junction resistance probes:
  - Probe RB (Figure M. 1)
  - Probe BR (Figure M. 2)

There are 2 interchangeable types of test probes, a type to be placed over the conductor (left in figures M.1 and M.2) and a type to be placed between the conductors (right in figures M.1 and M.2), the latter can also be used St29 and St30 junctions with prolonged insulation plates. The junction resistance values measured with either type are the same.

Depending on the project, one of both types of test probes will be delivered.
Other required equipment:
  - A digital self-contained micro-ohmmeter, having a resolution of 0.1 µΩ or better.

Recommended measuring systems:
- Cropico type D07
- Sonel MM610
- AVO-Biddle type DLRO

In case of supervision by Eta-com, all the required equipment is provided by Eta-com.

A.2.2. User guide

A.2.2.1. Four-wire measurement

- The junction resistances must be checked prior to the casting, in order to ensure contact quality and prevent overheating in service.
- This test is based on a four-wire measurement: a steady current is injected and the resulting voltage drop is used to calculate the resistance.

![Figure M. 3: Four-wire measurement](image-url)
A.2.2.2. Usage of the probes

- The tabs of the probes should be placed in the corresponding holes as per betobar-r type.

![Figure M. 4: 'Over'-type](image1)

![Figure M. 5: 'Between'-type](image2)

A.2.2.3. Straight junction ST26 setup
A.2.2.4. Elbow junction ST27 setup

Figure M. 10: 'Over'-type

Figure M. 11: 'Between'-type
Figure M. 12: 'Over'-type

Figure M. 13: 'Between'-type
A.2.2.5. **Straight vertical junction ST29 setup**

Note: can only be measured with the 'Between'-type

![Diagram of Straight vertical junction ST29 setup]

**Figure M. 14: 'Between'-type**

![Diagram of Straight vertical junction ST29 setup]

**Figure M. 15: 'Between'-type**
A.2.2.6. **Inverse elbow junction ST30 setup**

Note: can only be measured with the ‘Between’-type

Figure M. 16: ‘Between’-type

Figure M. 17: ‘Between’-type
A.2.2.7. LA24 junctions

What sets the LA24 apart from the LA/LB-series is that one phase conductor consists of 2 bars above each other with a space of 5 mm in-between. This implies that for straight junctions the top and bottom conductors must be measured and for elbow junctions, the diagonals must be measured.

2.2.7.1. LA24 straight junctions

Measurement 1:
Measurement 2:

2.2.7.2. LA24 elbow junctions
Measurement 1:

Attention!

Due to the asymmetrical set-up, the colours of the cables of one of the probes needs to be switched! The voltage measurement must always be between the current injection points.

Measurement 2:
A.2.3. Acceptance criteria

- The measured resistance values should not exceed the values indicated in TNG00072 – Junction resistance.

- N.b. the values are only valid for the test probes provided by Eta-com.

- \( R_{\text{max}} \) = maximum resistance value of any single conductor

- The ambient temperature during the tests is to be registered. Only at extreme low or high ambient temperature, some deviation from the resistance values given below may be noticed.

A.2.4. Reporting

- Reporting of these tests is done by means of the test report that can be found in Annex B: Junction resistance test report.
A.3. LINE INSULATION RESISTANCE TEST

- Take the necessary safety precautions
- Clean and dry all creepage paths around bare terminals before the test.
- Application of the test voltage
  - Between all live parts of the main circuit connected and exposed conductive parts (only applicable for LV betobar-r with lost mould).
  - Between each live part of different potential of the main circuit and, the other live parts of different potential and exposed conductive parts connected together.
  - The voltage starts at zero and is gradually raised (during approx. 5 to 10 sec.). This test voltage is then maintained for 1 minute.
- The insulation resistance must be more than $1 \, \text{M} \Omega$ (IEC 61439-1 §11.9)
- Reporting of these tests is done by means of the test report that can be found in Annex C: Line insulation test report.
- Please, consult Eta-com representative in case readings are low or inconsistent.

A.4. PHASE SEQUENCE TEST

- Check if the phase sequence of the connection is in accordance with the layout drawing(s).

A.5. VOLTAGE WITHSTAND TEST (HI-POT TEST)

- This test is optional and carried out if agreed in writing and on demand of the customer.
- Take the necessary safety precautions
- Clean and dry all creepage paths around bare terminals before the test.
- The test is carried out according to IEC 61439-6 par. 11.9.
- Application of the test voltage identical to A.3. Line insulation resistance test.
- Acceptance criteria: the overcurrent relay (100 mA) shall not operate and there shall be no disruptive discharge.

<table>
<thead>
<tr>
<th>Tests Standards</th>
<th>Voltage tests IEC 61439-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types</td>
<td>$U_{\text{max}}$</td>
</tr>
<tr>
<td>LA / LB</td>
<td>1.00</td>
</tr>
</tbody>
</table>

* Routine test (works test) is specified for only 1 sec. However, Eta-com’s works test is extended during 1 minute.

- Reporting of these tests is done by means of the test report that can be found in Annex D: Power frequency withstand test report.
### Annex B: Junction resistance test report

**Project number:**

**Project name:**

**Client:**

**Type betobar-r:**

**Required torque junction** | **Maximum Values**
--- | ---
M10: 43 Nm | ST 26/29:……… μΩ | ST 27/30:…… μΩ

**Line number:**

**Section betobar-r:**

**Phase** | ...... x ......mm² | **Neutral** | ...... x ......mm² | **PE** | ...... x......mm²

**Material betobar-r:**

**Aluminum** | **Copper**

**Us:**

**Volts**

**ac** | **dc**

**Is:**

**Ampère**

**From (equipment no):**

**To (equipment no):**

**Type Micro Ohm tester:**

**Serial no:**

**Calibration valid till :**

*Explanation to execute this test can be found in Annex A: Electrical site-test of the Low Voltage Installation Manual.*

*The maximum values can be found in TNG00072 – Junction resistance*

### Results

**Measured conductor resistance = R (µΩ)**

<table>
<thead>
<tr>
<th>Junction from element no to element no</th>
<th>Type Junction (ST)</th>
<th>Torque (Nm)</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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<th>6</th>
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<td>-</td>
</tr>
</tbody>
</table>

**Remarks project:**

**Test info**  | **Name** | **Company** | **Date** | **Signature**
--- | --- | --- | --- | ---
**Tested by:** | | | | |
**Witness** | | | | |
**Witness** | | | | |

Please send filled-out form to your Eta-com representative.
## Annex C: Line insulation resistance test report

<table>
<thead>
<tr>
<th>Project number:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project name:</td>
<td></td>
</tr>
<tr>
<td>Client:</td>
<td></td>
</tr>
<tr>
<td>Type betobar-r:</td>
<td></td>
</tr>
<tr>
<td>Line number:</td>
<td></td>
</tr>
<tr>
<td>Section betobar-r:</td>
<td></td>
</tr>
<tr>
<td>Material betobar-r:</td>
<td></td>
</tr>
<tr>
<td>Phases</td>
<td>N</td>
</tr>
<tr>
<td>...... x ...... mm²</td>
<td>...... x ...... mm²</td>
</tr>
<tr>
<td>Us:</td>
<td>Volt</td>
</tr>
<tr>
<td>Is:</td>
<td>Ampère</td>
</tr>
<tr>
<td>From (equipment no):</td>
<td></td>
</tr>
<tr>
<td>To (equipment no):</td>
<td></td>
</tr>
<tr>
<td>Resistance measured by:</td>
<td>500 V-dc</td>
</tr>
<tr>
<td>Type isolation tester:</td>
<td></td>
</tr>
<tr>
<td>Serial no:</td>
<td></td>
</tr>
<tr>
<td>Calibration valid till:</td>
<td></td>
</tr>
<tr>
<td>IEC 61439-1 §11.9:</td>
<td></td>
</tr>
<tr>
<td>- test voltage must be ≥ 500 V dc</td>
<td></td>
</tr>
<tr>
<td>- insulation resistance must be ≥ 1000 Ω/V</td>
<td></td>
</tr>
</tbody>
</table>

Explanation to execute this test can be found in Annex A: Electrical site-test of the Low Voltage Installation Manual.

### Results:

<table>
<thead>
<tr>
<th>Test</th>
<th>Phase</th>
<th>Approval for connection to equipment by (name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 – L2L3NPE</td>
<td>MΩ</td>
<td></td>
</tr>
<tr>
<td>L2 – L1L3NPE</td>
<td>MΩ</td>
<td>Line identification attached?</td>
</tr>
<tr>
<td>L3 – L1L2NPE</td>
<td>MΩ</td>
<td>Phase sequences approved?</td>
</tr>
<tr>
<td>N – L1L2L3PE</td>
<td>MΩ</td>
<td>Installation approved?</td>
</tr>
<tr>
<td>PE – L1L2L3N</td>
<td>MΩ</td>
<td></td>
</tr>
</tbody>
</table>

Remarks project:

<table>
<thead>
<tr>
<th>Test info</th>
<th>Name</th>
<th>Company</th>
<th>Date</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested by</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Witness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Witness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Witness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please send filled-out form to your Eta-com representative.
Project number: 
Project name: 
Client: 
Type betobar-r: 
Line number: 
Section betobar-r: 
<table>
<thead>
<tr>
<th>Phase</th>
<th>...... x ......mm²</th>
<th>Neutral</th>
<th>...... x ......mm²</th>
<th>PE</th>
<th>...... x ......mm²</th>
</tr>
</thead>
</table>
Material betobar-r: 
| Aluminum | Copper |
Us: 
| Volt | ac | dc |
Is: 
| Ampère | Test voltage: | ........kV | ........Hz |
From (equipment no): 
To (equipment no): 
Type tester: 
| Serial no: | Calibration valid till: | ........-........-........ |
Explanation to execute this test can be found in Annex A: Electrical site-tests of the Low Voltage Installation Manual.
Test time to execute this test: > 1 minute

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Output current</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 – L2L3NPE =</td>
<td>mA</td>
</tr>
<tr>
<td>L2 – L1L3NPE =</td>
<td>mA</td>
</tr>
<tr>
<td>L3 – L1L2NPE =</td>
<td>mA</td>
</tr>
<tr>
<td>N – L1L2L3PE =</td>
<td>mA</td>
</tr>
<tr>
<td>PE – L1L2L3N =</td>
<td>mA</td>
</tr>
</tbody>
</table>
Output current less than 100 mA
| Yes | No |
Flashover
| Yes | No |
Electrical breakdown
| Yes | No |
Visual damage
| Yes | No |
Ambient temperature
| °C |
Remarks project:

Test info
<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Date</th>
<th>Signature</th>
</tr>
</thead>
</table>
Tested by:
Witness
Witness
Witness

Please send filled-out form to your Eta-com representative
## Annex E: Checklist

**Agent:** Location:

**Customer:** Designation:

**Project:** Drawing(s) no:

### betobar-r type

- \(U_n = \ldots \text{ Volts}\)
- \(I_n = \ldots \text{ Amps}\)
- \(I_s = \ldots \text{ Amps}\)
- \(t_o = \ldots ^\circ C\)
- \(I_{\text{cw}} = \ldots\)
- \(kA_{\text{rms}} = \ldots\)
- \(I_{\text{pk}} = \ldots kA_{\text{peak}}\)
- \(dU = \ldots \%\)

### 1 Receipt goods

<table>
<thead>
<tr>
<th>1.1.</th>
<th>Elements : Quantity - size</th>
<th>5</th>
<th>Terminal boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.</td>
<td>Elements : Insulation resistance</td>
<td>5.1.</td>
<td>Fixing bolts and joint</td>
</tr>
<tr>
<td>1.3.</td>
<td>Accessories : Quantity - size</td>
<td>5.2.</td>
<td>Tightness : - flange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.2.</td>
<td>- cover(s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.2.</td>
<td>- membrane</td>
</tr>
</tbody>
</table>

### 2 Storage conditions

| 2.1. | Temperature 5-45°C sun |
| 2.2. | Moisture |
| 2.3. | Stowing |

### 3 Preparing betobar-r busduct run

| 3.1. | Position equipment |
| 3.2. | Free passage : aperture |
| 3.3. | Outdoor work : protection (weather influences) |
| 3.4. | betobar-r busduct run |
| 3.5. | Position supports |

### 4 Installation supports

| 4.1. | Position |
| 4.2. | Distances |
| 4.3. | Fixing details |
| 4.4. | Alignment supports |
| 4.5. | Elastic supports : alignment |
| 4.6. | Support structures : - flexion |
| 4.7. | TR foundation blocks : - sagging |
| 4.8. | Distances : - to wall/floor |
| 4.9. | Earthing of supports |

### 5 Terminal boxes

| 5.1. | Fixing bolts and joint |
| 5.2. | Tightness : - flange |
| 5.3. | Membrane |
| 5.4. | Drain hole |
| 5.5. | Hot air blower : colour of crystals |
| 5.6. | Cleaning and drying before tests |

### 6 betobar-r elements

| 6.1. | Insulation resistance |
| 6.2. | Alignment : horizontal - vertical |
| 6.2.1) | Spacing junctions (0-20 mm) |
| 6.3. | Distances to wall/floor |
| 6.3. | Distances to other busducts |
| 6.3. | Distances to earthed parts |
| 6.3. | Distances to supports |

### 6.1) Silent blocks - adjustment

| 6.4.1) | Elastic supports : - free movement |
| 6.4.2) | - spring size |
| 6.4.3) | - guidance |
| 6.4.4) | Expansion element : - free movement |
| 6.4.5) | - adjustment |

### 6.4.3) Support structures : - flexion

<p>| 6.5. | Wall bushings |
| 6.5.1) | Fixing on element |
| 6.5.2) | Alignment : squareness |
| 6.5.3) | Fixing on wall or barriers |
| 6.5.4) | Tightness joint : membrane |
| 6.5.5) | Fireproof bushing : - cover sheets |
|       | - rockwool packing |</p>
<table>
<thead>
<tr>
<th>7</th>
<th>Assembly of junctions</th>
<th>8.6. Safety precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.</td>
<td>Alignment conductor ends</td>
<td>- wear gloves</td>
</tr>
<tr>
<td>7.2.</td>
<td>Contact surfaces : clean</td>
<td>8.7. Checks : - adherence elements</td>
</tr>
<tr>
<td>7.3.</td>
<td>Spacing junctions (0-20 mm)</td>
<td>- smoothness surfaces</td>
</tr>
<tr>
<td>7.4.</td>
<td>Junction plates : - thickness SL</td>
<td>- thickness overcasting</td>
</tr>
<tr>
<td></td>
<td>- overlap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- alignment</td>
<td>9 Terminal connections</td>
</tr>
<tr>
<td>7.5.</td>
<td>Distance between phases</td>
<td>9.1. Contact surfaces : clean</td>
</tr>
<tr>
<td></td>
<td>- spring washers</td>
<td>9.3. Flexible connections : - cross section</td>
</tr>
<tr>
<td></td>
<td>- length</td>
<td>- number per conductor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- length</td>
</tr>
<tr>
<td>7.7.</td>
<td>Fixing torque of the bolts</td>
<td>- drillings</td>
</tr>
<tr>
<td>7.8.</td>
<td>Tests : - insulation resistance</td>
<td>- laminated/braided</td>
</tr>
<tr>
<td></td>
<td>- contact resistance</td>
<td>9.4. Strips : - cross section</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number/conductors</td>
</tr>
<tr>
<td>7.9.</td>
<td>Distance between phases</td>
<td>9.5. Short circuit bracing(s)</td>
</tr>
<tr>
<td>8.0.</td>
<td>Material : - quantity</td>
<td>9.6. Fitting cover and joints (after tests)</td>
</tr>
<tr>
<td></td>
<td>- drillsings</td>
<td></td>
</tr>
<tr>
<td>8.1.</td>
<td>Check the shelf life validity</td>
<td>9.7. Flexible connections : - length</td>
</tr>
<tr>
<td></td>
<td>Tools : - moulds – number required</td>
<td>- number/conductors</td>
</tr>
<tr>
<td></td>
<td>- mixer</td>
<td>10 Inspection – electrical tests - check</td>
</tr>
<tr>
<td>8.2.</td>
<td>Storage : dry</td>
<td>10.1. Inspection as above</td>
</tr>
<tr>
<td></td>
<td>- temperature 10-35°C</td>
<td>- insulation resistance</td>
</tr>
<tr>
<td>8.3.</td>
<td>Mould fitting : - clean – dry</td>
<td>10.2. Test</td>
</tr>
<tr>
<td></td>
<td>- demoulding agent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- overlap ends</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- type hardener</td>
<td>10.3. Checks : - service voltage V</td>
</tr>
<tr>
<td>8.4.</td>
<td>Mixing temp. : - type hardener</td>
<td>- full load current A</td>
</tr>
<tr>
<td></td>
<td>- fillers dry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- homogeneous mix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- temperature</td>
<td>- starting current</td>
</tr>
<tr>
<td></td>
<td>- starting time</td>
<td>- voltage drop in % or V</td>
</tr>
<tr>
<td>8.5.</td>
<td>Casting : - temperature</td>
<td>8.6. Safety precautions</td>
</tr>
</tbody>
</table>
| | - filling level | - ambient conditions :
| | - hardening time | - temperature °C |
| | - cleaning | - humidity H₂O |
| | | - others |
| | | - special conditions |

**betobar-r type**

\[
\begin{align*}
U_n &= \ldots \text{Volts} \\
I_n &= \ldots \text{Amps} \\
I_i &= \ldots \text{Amps} \\
I_{\text{low}} &= \ldots \text{kA}_{\text{rms}} \ldots \text{s} \\
I_{pk} &= \ldots \text{kA}_{\text{peak}} \\
dU &= \ldots \% \\
T_o &= \ldots \text{°C} \\
\end{align*}
\]
Annex F: Material Safety Data Sheets

F.1. OVERVIEW

- Below is a list of materials for which a Material Safety Data Sheet is available.
  - Mould release agent
  - Hardener A
  - Hardener B
  - Hardener C
  - Resin
  - Fillers
  - Green pigment
  - Promaseal-S
  - Promat glue K84
  - Rockwool D100

- The Material Safety Data Sheets are available at www.etacomcs.com and on request via ETA-COM Belgium or via your sales representative.

- In case of emergency there’s an Emergency Response Service provided by BIG. **Emergency telephone: +32 (0) 14 58 45 45**