General Instructions

miniSUB

UNDERGROUND COMPACT TRANSFORMER SUBSTATION

IG-131-GB
version 03

02.01.2012
CAUTION!

When MV equipment is operating, certain components are live, other parts may be in movement and some may reach high temperatures. Therefore, the use of this equipment poses electrical, mechanical and thermal risks.

In order to ensure an acceptable level of protection for people and property, and in compliance with applicable environmental recommendations, Ormazabal designs and manufactures its products according to the principle of integrated safety, based on the following criteria:

- **Elimination of hazards wherever possible.**
- **Where elimination of hazards is neither technically nor economically feasible, appropriate protection functions are incorporated in the equipment.**
- **Communication about remaining risks to facilitate the design of operating procedures which prevent such risks, training for the personnel in charge of the equipment, and the use of suitable personal protection equipment.**
- **Use of recyclable materials and establishment of procedures for the disposal of equipment and components so that once the end of their useful lives is reached, they are duly processed in accordance, as far as possible, with the environmental restrictions established by the competent authorities.**

Consequently, the equipment to which the present manual refers complies with the requirements of section 11.2 of the forthcoming IEC standard 62271-1. It must therefore only be operated by appropriately qualified and supervised personnel, in accordance with the requirements of standard EN 50110-1 on the safety of electrical installations and standard EN 50110-2 on activities in or near electrical installations. Personnel must be fully familiar with the instructions and warnings contained in this manual and in other recommendations of a more general nature which are applicable to the situation according to current legislation.

The above must be carefully observed, as the correct and safe operation of this equipment depends not only on its design but also on general circumstances which are in general beyond the control and responsibility of the manufacturer. More specifically:

- **The equipment must be handled and transported appropriately from the factory to the place of installation.**
- **All intermediate storage should occur in conditions which do not alter or damage the characteristics of the equipment or its essential components.**
- **Service conditions must be compatible with the equipment rating.**
- **The equipment must be operated strictly in accordance with the instructions given in the manual, and the applicable operating and safety principles must be clearly understood.**
- **Maintenance should be performed properly, taking into account the actual service and environmental conditions in the place of installation.**

The manufacturer declines all liability for any significant indirect damages resulting from violation of the guarantee, under any jurisdiction, including loss of income, stoppages and costs resulting from repair or replacement of parts.

**Guarantee**

The manufacturer guarantees this product against any defect in materials and operation during the contractual period. In the event that defects are detected, the manufacturer may opt either to repair or replace the equipment. Improper handling of this equipment and its repair by the user shall constitute a violation of the guarantee.

**Registered Trademarks and Copyrights**

All registered trademarks cited in this document are the property of their respective owners. The intellectual property of this manual belongs to the manufacturer.

In view of the constant evolution in standards and design, the characteristics of the elements contained in this manual are subject to change without prior notification.

These characteristics, as well as the availability of components, are subject to confirmation by Ormazabal’s Technical - Commercial Department.
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**1. DESCRIPTION AND MAIN CHARACTERISTICS**

Ormazabal's miniSUB is a walk-in type coverless underground compact Transformer Substation designed in accordance with the EN 61330 standard for use in public Medium-Voltage (MV) electrical distribution networks of up to 24 kV.

![Figure 1.1: Main components of the miniSUB Transformer Substation](image)

There are 2 of miniSUB:

- **miniSUB-H**: the ventilation grilles are horizontal.
- **miniSUB-V**: natural ventilation is through 2 turrets/ducts located on the cover.

![Figure 1.2: miniSUB-H](image)

![Figure 1.3: miniSUB-V](image)

The miniSUB Transformer Substation is made up of 2 main parts:

- Prefabricated concrete enclosure.
- **MB** switchgear of up to 630 kVA / 24 kV.
1.1. PREFabricated Enclosure

In turn made up of:

1. Prefabricated monoblock concrete construction.
2. Removable cover.
3. Personnel access cover with an opening measuring of 1940 x 1000 mm. The door can be opened or closed by one operator. The cover includes a security protection barrier for pedestrians and a lock once open. In turn, when in place, it provides correct ventilation for the miniSUB.
4. Access ladder with non-slip rungs and extendible handrails above level 0.
5. 2 ventilation grilles on the cover for air inlet / outlet in miniSUB-H and 2 vertical ventilation turrets in miniSUB-V.
6. 12 holes with cable inlet / outlet bushing (4 for MV and 8 for LV).
7. Oil collection pit.
8. Document holder for documentation relating to miniSUB.

Figure 1.4: miniSUB
1.2. MB SWITCHGEAR

Attached to the inside of the enclosure is the basic module MB\textsuperscript{[1]} made up of the following elements:

1. Supporting frame with hoisting system.
2. CGMCOSMOS-2LP compact MV switchgear with full SF\textsubscript{6} insulation.
3. LV switchgear: Low-Voltage board (LVB) with auxiliary services box (lighting and power outlet).
4. Fully oil-filled, MV/LV distribution transformer unit -630, 400 or 250 kVA / 24 kV.
5. Direct MV and LV cable interconnections.
7. Lighting.
8. Auxiliary services.

\textsuperscript{[1]} The operating instructions related to the basic module MB are described in Ormazabal's General Instruction document IG-130 supplied with the equipment.

\textbf{Figure 1.5: MB basic module}
1.3. DIMENSIONS AND WEIGHTS

- miniSUB-H (Horizontal Ventilation)

<table>
<thead>
<tr>
<th>Dimensions [mm]</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>4550</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>2350</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>2460</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight [kg]</th>
<th>Transformer 250 kVA</th>
<th>Transformer 400 kVA</th>
<th>Transformer 630 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>11300</td>
<td>16000</td>
<td>16800</td>
</tr>
<tr>
<td>Cover</td>
<td>3000</td>
<td>16400</td>
<td>16800</td>
</tr>
<tr>
<td>Switchgear</td>
<td>1700</td>
<td>2100</td>
<td>2500</td>
</tr>
<tr>
<td>Total</td>
<td>16000</td>
<td>16400</td>
<td>16800</td>
</tr>
</tbody>
</table>

**Figure 1.6: Dimensions of miniSUB-H**
• miniSUB-V (Vertical Ventilation)

<table>
<thead>
<tr>
<th>Dimensions [mm]</th>
<th>Body</th>
<th>Ventilation Turrets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>3460</td>
<td>1000</td>
</tr>
<tr>
<td>Height</td>
<td>2350</td>
<td>485</td>
</tr>
<tr>
<td>Depth</td>
<td>2460</td>
<td>675</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight [kg]</th>
<th>Transformer 250 kVA</th>
<th>Transformer 400 kVA</th>
<th>Transformer 630 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>10100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover</td>
<td>2700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switchgear</td>
<td>1700</td>
<td>2100</td>
<td>2500</td>
</tr>
<tr>
<td>Total</td>
<td>14500</td>
<td>14900</td>
<td>15300</td>
</tr>
</tbody>
</table>

Figure 1.7: Dimensions of miniSUB-V
2. TRANSPORT

2.1. ACCESS
The site must be visited in advance to check if vehicles can have access and if there is sufficient space available for the unloading operation.

2.2. TRANSPORT
2.2.1. Land Transport
The miniSUB-V and miniSUB-H can be transported by low-loader truck, boom truck or normal truck.

![Figure 2.1: miniSUB land transport](image)

Lashing must involve ropes, which are hooked into the DEHA moorings of the building to ensure stability during transportation. To avoid any movement of the roof in relation to the body, slings should be attached above the cover.

The basic module MB is supplied bolted to the miniSUB floor for transportation.
2.2.2. Sea Transport

Transport must be in open flat-rack, reinforced floor containers.

Measures must be taken to prevent water from entering the container during transportation. The miniSUB-V turrets must be protected by a band of elastic plastic wrapped around them. The miniSUB-H ventilation outlets must be similarly covered to ensure a correct seal.

Once positioned inside the container, attach a 100 x 100 x 10 mm and 100 mm long square to each corner of the enclosure. These must be welded to the floor of the container in order to avoid any movement during transportation. Finally, attach 2 slings crossways over the enclosure.

![Figure 2.2: Slings for sea transport](image)

2.3. PLANNING

On the location sketch or drawing, mark out the spaces available for the crane and the transport truck.

Pay special attention to the position of the crane to ensure the support jacks are not too close to the excavation, which could lead to collapse. The support jacks shall be more than 2.50 m from the excavation.
3. INSTALLATION

3.1. LOCATION

The exact site of the substation must be defined, indicating alignment levels and the height to the reference points, finish of the surrounding area, rainwater outlets (in the case of miniSUB-H) and the position of the cable inlets and outlets.

Sites where miniSUB acts as a sump for the surrounding ground and, in general, any site where rushing water is concentrated must be avoided.

3.2. HANDLING

To correctly handle miniSUB, a suitable lifting beam, slings and hooks must be used to ensure the greatest possible balance during hoisting, as shown in the following figures:

Correct coupling

![Correct coupling diagram](https://via.placeholder.com/150)

Figure 3.1: Proper attachment of DEHA hooks
Hooking and approximate dimensions

3.3. PREPARING THE GROUND

3.3.1. Excavation dimensions

The measurements indicated in the following figures must be respected for correct installation:

- miniSUB-H

Figure 3.2: Attaching outer DEHA

Figure 3.3: miniSUB-H Transformer Substation excavation diagram
3.3.2. Base Concreting

To ensure a correct level, reinforcement of the base of the miniSUB and distribution of electrical earthing, the base of the excavation must be concreted as indicated in Figure 4.7, leaving 4 earthing connections visible on the surface for connection to the general earth. The concreting must be 150 mm thick. The mesh must be made of 150 x 150 mm squares with a bar diameter of 8 mm.

Approximately 50 mm must be respected for subsequent levelling and settling sand filling.

3.4. LEVELLING PROCESS

The final level 0 must be defined in advanced before this operation and those of subsequent sections can be performed.

3.4.1. Recommended Levelling Equipment

The following parts are recommended as levelling equipment:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Recommended Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spirit level</td>
</tr>
<tr>
<td>1</td>
<td>Square-end spade</td>
</tr>
<tr>
<td>8</td>
<td>Levelling tools: Nomenclature 394 243 22</td>
</tr>
<tr>
<td>1</td>
<td>4 m ladder</td>
</tr>
</tbody>
</table>

⚠️ CAUTION

Level correctly to prevent the miniSUB base from breaking, which would lead to the entry of water.
3.4.2. Attachment and Filling Process

The installation operation consists of positioning the miniSUB in the excavation made for this purpose and of connecting the LV and MV cables, along with the external earthing network.

To ensure the miniSUB is correctly attached to the ground, fill the excavation immediately after the levelling and installation process. If this is not done and the excavation fills with water, the enclosure will float because it weighs less than the weight of the volume of water moving it.

Filling must be done so that the 2 sides with no cable inlets are covered, compacting the soil in layers.

3.5. MV AND LV CABLE ACCESS AND SEALING

The unit has 12 holes for cable inlets and outlets: 4 for MV and 7 for LV and earth. The average level of the holes is located between – 0.6 and – 0.8 m. The holes are sealed with bushing on delivery.

![Figure 3.5: Cable inlet / outlet position](image)
Proceed as follows to correctly seal the bushing lugs:

a) Select the most suitable inlet. For easier identification, each lug has the corresponding diameter printed on it.

b) Cut the corresponding lugs according to the cable diameter\(^2\).

The following table indicates the diameters of the most common cables:

<table>
<thead>
<tr>
<th>MV cables 12 / 20 kV (HEPRZ1)</th>
<th>LV cables 0.6 / 1 kV (RV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-section [mm(^2)]</td>
<td>Diameter [mm]</td>
</tr>
<tr>
<td>240</td>
<td>39.7</td>
</tr>
<tr>
<td>150</td>
<td>35.6</td>
</tr>
<tr>
<td>95</td>
<td>16.8</td>
</tr>
</tbody>
</table>

This table provides the cross-section and lug diameters for MV and LV cables. The table consists of two columns for MV cables and two columns for LV cables.

\(^2\) See Figure 3.4

\(^3\) 50 mm\(^2\) insulated earthing cable always to be used when run outdoors.

CAUTION
Should the bushing be accidentally cut in the wrong place, contact Ormazabal's Technical - Commercial department.

![Diagram of bushing elements](image)

**Figure 3.6: Bushing elements**
3.6. EARTH CONNECTION

The protective or metal part earthing connection built into the basic module MB and hidden behind the lower LVB cover is connected to the protective earth disconnection box fitted on the lower side wall of miniSUB using a line of 50 mm² cross-section care copper cable.

The metal reinforcement of the enclosure body is connected directly to the protective disconnection box.

The operational earthing line connects the LVB neutral busbar to its disconnection box fitted inside miniSUB. The connection is made using 0.6 / 1 kV RV-type, 50 mm² cross-section insulated copper cable.

Both Earth connections are independent.

CAUTION

Both earthing circuits are independent. The neutral flatbar on the LVB is not connected to the protective earth (metal parts) connection flatbar.

The Transformer Substation project must include a section corresponding to the earthing installation (check the Utility’s standard project) as well as a justification of its size.

The copper braided wire cross-section, the terminations' contact surface and tightening torques must be suitable for a fault current delimited by network protections. It is recommended that an external protective earthing network of bare copper wire be used with a minimum cross-section of 50 mm².

Adequate earthing measures around the Transformer Substation must be provided to prevent dangerous touch and step voltages.

The tightening torque recommended for electrical connections in the earthing network is set according to the following table.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Tightening Torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.8 Steel</td>
</tr>
<tr>
<td>M10</td>
<td>32</td>
</tr>
<tr>
<td>M12</td>
<td>56</td>
</tr>
</tbody>
</table>

The cover reinforcement is electrically connected to the body of the Transformer Substation by means of a 50 mm² inner copper braid.
3.7. EARTHING RING

The use of one earthing ring around miniSUB is recommended.

Follow the instructions below for the installation of the protective earth connection electrode:

Connect 1 perimeter ring at the bottom of the excavation at a distance of approx. 0.4 m from the miniSUB concrete enclosure perimeter. This perimeter ring must be connected to the base plate at the bottom of the excavation to at least 2 connection points. Furthermore, these points must be connected to at least 2 underground earthing rods.

Another perimeter ring at a distance of 1 m. from the miniSUB perimeter, at - 0.8 m from level 0.

Both rings must be connected together using bare copper wire and the assembly of these two rings must be connected to the protective earthing point of the miniSUB.

Use of 50 mm² cross-section bare copper cable is recommended for the protective earthing circuit.

Figure 3.7: Recommended earthing ring
4. SEQUENCE OF OPERATIONS

4.1. SEQUENCE OF ACCESS TO miniSUB

1. Open the access door to miniSUB
   - Stand on the access door.
   - Use the ORMAZABAL “G” type wrench to turn the two square-head lock bolts located on the access door anti-clockwise until they are loose.
   - Stand away from the access door.
   - Pull gently on the door to open it.

**CAUTION**
- If the ambient temperature is above 20 °C, the access door may start opening without any force having to be applied.
- At low temperatures below 5 °C, greater force may be required to help the door to open.
• Lock the access door using the safety brace located on the side opposite the access ladder (this must be carried out at level 0).

![Figure 4.3: Location of the safety brace](image)

2. Pull out the perimeter protection fence.

The purpose of this three-sheet protection fence is to close off the perimeter of the hole in the operating cover to prevent pedestrians from falling into it.

The protection fences must be pulled out from outside the miniSUB and at level 0.

• Start with the protection fence furthest away from the access ladder (1), pulling it upwards until the latch at the bottom of the protection fence becomes locked in the fixture in the frame guide.
• Repeat the same operation with the centre protection fence (2) and then with the protection fence closest to the ladder (3).

![Figure 4.4: Pulling out the perimeter protection fence](image)  
![Figure 4.5: Perimeter protection fence in protection fence](image)
3. Prepare to access the inside of the miniSUB.

- Pull the two handrails on the access ladder upwards.

![Figure 4.6: Pulling out the handrails](image)

- Access the inside of the miniSUB by carefully climbing down the ladder.

**CAUTION**

Before accessing the Transformer Substation, operators must have all of the appropriate personal protective equipment available.

- Use the chain between the handrails to avoid accidental entry to the miniSUB.

![Figure 4.7: Close off entry using the chain](image)

4.2. miniSUB EXITING AND CLOSURE SEQUENCE

1. Inside the miniSUB, unlock the three protection fences, starting with the one furthest away from the access ladder:
   - Unhook its corresponding latch.
   - Allow the protection fence to slide fully downwards.
   - Repeat the same operation with the centre protection fence and then with the protection fence closest to the ladder.
2. Exit the miniSUB up the ladder.
3. Once outside, lower the handrails on the ladder.
4. Before closing the door to the miniSUB, check that there is no dirt or foreign bodies in the frame of the cover.
5. Remove the safety brace locking the miniSUB door from level 0.
6. Close the access door, holding onto it until it is shut
7. Stand on the access door to lock it by turning the two square-head bolts clockwise using the ORMAZABAL “G” type wrench until they are tight.

4.3. COMMISSIONING

Once miniSUB is installed, make the input and output connections to the MV cubicle line functions and the LV cable connections.

Check that the transformer MV is suitable for the installation project. This information is printed on the transformer nameplate and in the test protocol.

Before commissioning the Transformer Substation, check that the transformer tap changer is in the position corresponding to its maximum rated voltage and that it is locked. In the case of a multi-voltage transformer in MV, check that the rated voltage of the transformer corresponds to the service voltage of the mains.

⚠️ CAUTION
The tap changers must always be actuated without voltage in the circuit.

Commission the functional unit of the CGMCOSMOS-2LP cubicle with the transformer at no-load (LVB fuse-holder bases open).

When commissioning the Transformer Substation, check the operating voltage from the LV side (fuse-holder bases). Where it does not match the value established, proceed as follows[^4]:

1. Power down the CGMCOSMOS-2LP cubicle functional unit. Open all of the fuse-holder bases on the LVB.
2. Check that the CGMCOSMOS-2LP functional unit and the LVB are de-energised.
3. Then earth the CGMCOSMOS-2LP functional unit. The LV bushings on the transformer are also earthed.
4. Unlock the transformer tap changer to adapt it to the required power voltage by turning the switch back one position.

Check the service voltage on the LVB when the no-load transformer functional unit is connected to the MV mains. Measure the voltage on the low-voltage board to check the correct connection and position of the regulation tap changer. If the service voltage is incorrect, follow the steps given until the service voltage on the LVB is appropriate.

[^4]: For the commissioning and switching of the different functional units, see Ormazabal’s IG-130 General Instructions document.
5. MAINTENANCE

Once the miniSUB is installed, clean the groove in the entrance cover using a non-abrasive bristle brush. When cleaning the groove, be particularly careful when cleaning the 2 bolts holding down the miniSUB cover. This operation must be repeated whenever maintenance work is performed.

The prefabricated enclosure as such does not require any maintenance. It may occasionally require the lubricating of locks and the checking of the ventilation grilles. There must be no blockages in the ventilation grilles or turrets of the prefabricated enclosure.

To perform maintenance work on the different functional units of the miniSUB switchgear, see Ormazabal's IG-130 General instruction document.

5.1. REPLACING THE SWITCHGEAR

Proceed as follows the replace the basic module MB:\[5\]:

1. Remove the seal from the cover using a putty knife.

   Tool: putty knife

   ![Figure 5.1: Cover Seal](image)

2. Open the access cover to the miniSUB and disconnect the protective earthing cable that connects the cover to the enclosure.

   Tool: 17 mm spanner

   ![Figure 5.2: Earthing braid between cover and enclosure](image)

[\[5\]](Before replacing the basic module MB, see Ormazabal's IG-130 General Instructions document.)
3. Thread the eyebolts onto the cover (supplied in a plastic bag) and hoist the cover.

![Figure 5.3: Threading the eyebolts](image)

4. Check the correct condition of the rubber and its seal located on the area where the cover lies on the body. Replace if worn.

5. Disconnect the MV and LV cables. Loosen the bolts attaching the unit to the supports and the disconnector box protective earthing line. Wind up the protective earthing line cable and attach it with a plastic tie to the inside of the LVB. Disconnect the service earthing line from the LVB neutral.
6. Remove the basic module MB by hooking the hoisting slings\(^6\) onto the holes in the plates located on the sides of the MB assembly. Use a lifting beam measuring 1700 mm in length and with a minimum load capacity of 2500 kg.

7. Remove the transportation plugs from the new MB unit and place it inside the miniSUB using the same hoisting system as that used to remove the unit.

*Tool*: 17mm spanner

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\(^6\) Minimum load capacity of each sling: 1500 kg
8. To commission the unit, follow the above instructions in reverse order.

9. Once the cover has been attached and connected to its earth connector, remove the lifting eyebolts from the cover and seal the outside of the cover to the enclosure. This should be sealed with polyurethane sealant, preferably grey polyurethane sealant.

Tool: polyurethane foam with suitable applicator

CAUTION

Maximum weight of the basic module MB: 2500 kg.

Dimensions in mm.

Figure 5.7: Supporting points of the basic module MB on miniSUB

Figure 5.8: Sealing the cover
6. ADDITIONAL INFORMATION

6.1. OIL COLLECTION DEVICE

Ormazabal's miniSUB is fitted with a liquid collection pit in the event of accidental spillage in the transformer. The collection pit is made up of a floor of the concrete body, 3 side walls and one partition separating it from the cable trench. This area, reserved for storing dielectric liquid in the event of spillage, is located in the transformer area (floor plan) and has a capacity of 600 l.

6.2. ACCESSORIES INCLUDED

1. First aid sign.
2. Electrical warning sign.
3. Document holder with information on the TS.
4. Lever for actuating the MV switchgear.
5. Insulated key for turning the LVB disconnector.
6. Cable installation process in bushing.

6.3. TRANSFORMER SUBSTATION SUPPORTS

The enclosure is fitted with additional support points for the installation of other switchgear assemblies, as indicated in Figure 5.7.
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version 02.4
29.07.2009

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UNDERGROUND COMPACT
PREFABRICATED TRANSFORMER SUBSTATION
IG-131-GB
version 03
05.10.2011

TECHNICAL - COMMERCIAL DEPARTMENT:

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