

MEDIUM VOLTAGE PRODUCTS

TDO 6, TJO 6, TJO 7, VOG-24, VOL-24, VOL-40.5

Instruction for installation,
use and maintenance

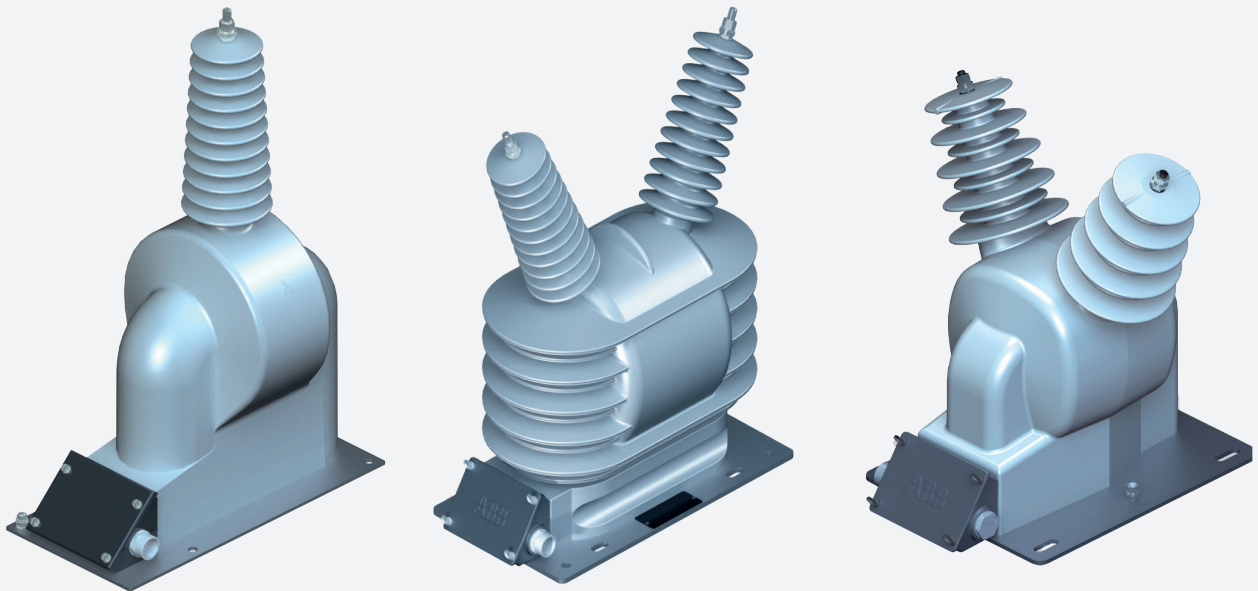


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Instructions for Installation, Use and Maintenance for Voltage Transformers

This installation, use and maintenance guide is valid for TDO 6, TJO 6, TJO 7, VOG-24, VOL-24, VOL-40.5 voltage transformers operating in outdoor conditions.

1. General Description

The voltage transformers are designed to supply measurement and protection circuits in high voltage power networks with admissible voltage up to 40.5 kV and frequency 50 Hz or 60 Hz.

The instruction includes the following types of voltage transformers:

- TJO 6, TJO 7, VOG-24 – voltage transformers single-pole,
- TDO 6, VOL-24, VOL-40.5 – voltage transformers double-pole.
- CBS products modifications - voltage transformers alternatives to standard designs available for TJO 7, VOG-24 and VOL-24

Design versions may differ depending on:

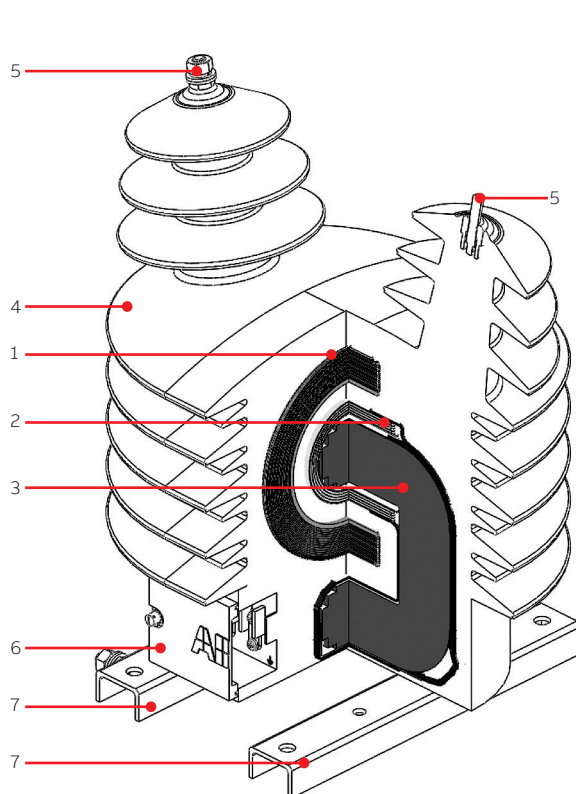
- dimensions,
- rated primary voltage (insulation level),
- secondary voltage,
- rated power in given accuracy class,
- thermal burden.

Examples of voltage transformers standard design (TDO 6, TJO 7 type) are shown in the Figure No. 1 and 2.

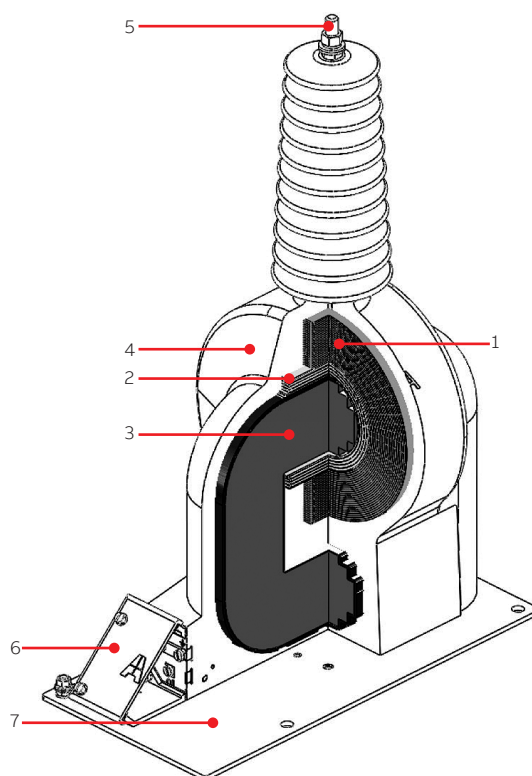
CBS modification is represented by clamp type primary terminal, special baseplate, junction box including secondary terminals and on side label with primary voltage marking.

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01
An example of the construction of a doublepole transformer (based on transformer TDO 6)

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02
An example of the construction of a singlepole transformer (based on transformer TJO 7)
1 – Primary winding
2 – Secondary Winding
3 – Magnetic core
4 – Epoxy resin housing, insulation
5 – Terminal primary winding
6 – Terminal box of the terminals secondary windings
7 – Baseplate with earthing terminal



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01

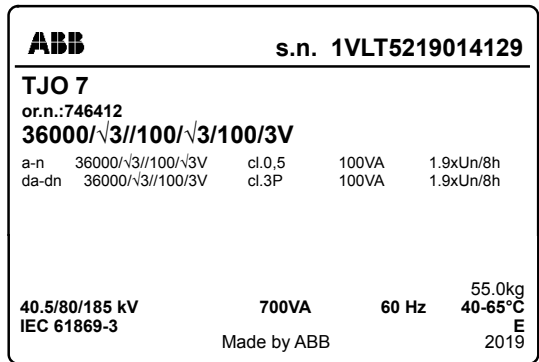


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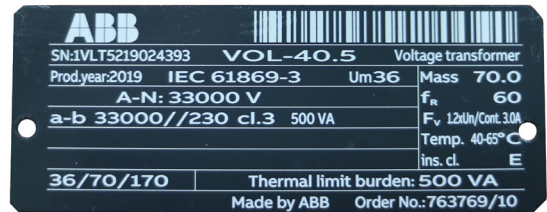
2. Service Conditions

The voltage transformers should be mounted in outdoor conditions where the ambient air may be polluted by dust, smoke, corrosive cases, vapours or salt. The voltage transformers are designed for standard ambient temperature between -40°C and +40°C and altitude lower than 1000 m above the sea level. The average value of the ambient temperature, measured over a period of 24 hours, should not exceed 35°C.

The transformers may be used also in higher or lower ambient temperatures and higher altitudes when agreed between the manufacturer and purchaser



03



04

03
Example of VT's rating plate (TJO 7 type).

04
Example of VT's rating plate (VOL-40.5).

3. Technical Details

The technical details for each individual voltage transformer are indicated on the rating plate fastened on the voltage transformer. Parameter values indicated on the rating plate must not be exceeded

s.n. 1VLT5219014129	Serial number
TJO 7	Transformer type code
60 [Hz]	Rated frequency
36000:√3 / 100:√3 /100:3 [V]	Rated voltage ratio
a-n	Terminal marking for first secondary winding
da-dn	Terminal marking for auxiliary secondary winding (for open delta connection)
100 VA, 100 VA	Rated power
0,5, 3P	Accuracy classes
40,5/80/185 kV	Highest voltage for equipment / power-frequency withstand voltage / rated lightning-impulse voltage
IEC 61869-3	Standards
2019	Year of production
E	Temperature class
700 VA	Thermal limiting output
1.9/8h	Over voltage factor
40-65°C	Ambient temperature
746412	Order number

Tab. 1. Description markings on the nameplate:

Voltage transformer type	Weight
VOG-24	app. 39 kg
VOL-24	app. 43 kg
VOL-40.5	app. 70 kg
TJO 7	app. 55 kg
TJO 6	app. 57 kg
TDO 6	app. 60 kg

Tab. 2. Voltage transformers weight

4. Instructions for Installation

General information

A voltage transformer is a piece of electrical equipment and its electrical installation shall be done by skilled person only. Observe the provisions of local legislation regarding the minimum age and the competence criteria for personnel working with or in vicinity of electrical installations.

If local legislation is not applicable, the guidelines set forth in EN 50110-1 shall be observed.

Checking voltage transformers upon arrival

Inspection shall be made upon arrival of voltage transformer for any signs of damage or tampering incurred during shipment..

Attention: Make sure that voltage transformer parameters indicated on the rating plate comply with the parameters specified on the order!

If:

- there are any damages in the shipment,
- voltage transformer has been damaged,
- or voltage transformer ratings do not comply with order specification,

notify the carrier and contact the voltage transformer manufacturer. Keep the written record of damages until complaint resolution.

Preparations before installation of voltage transformers

Perform a visual inspection of the voltage transformer prior to installation paying particular attention to the following points:

- cast resin (enclosure) is in good condition,
- voltage transformer terminals and surfaces of housing and base are clean and without visible mechanical damages,
- there are no signs of moisture on the voltage transformer; in case of visible signs of moisture, the voltage transformer must be dried,
- voltage transformer ratings comply with technical specification of connection.

Prior to installation of the voltage transformer perform the following measurements:

a) measurement of insulation resistance of primary winding:

- insulation resistance of unearthed transformer (with two insulated primary terminals) shall not be lower than 1000 MΩ, use 2,5 kV coil megaohmmeter to measure the resistance between short-circuited terminals of primary winding and base,

- insulation resistance of earthed transformer (with one insulated primary terminal) shall not be lower than 200 MΩ. Use 1 kV coil megaohmmeter to measure the resistance between short-circuited terminals of primary winding and base.

Attention: Prior to measurements of insulation resistance for earthed transformer (with one insulated primary terminal) remove an earthing screw from “N” terminal in terminal strip and remember to reattach it after completing measurements.

b) measurement of insulation resistance of secondary windings:

- insulation resistance of secondary windings insulation shall not be lower than 50 MΩ. Use 1 kV coil megaohmmeter for measurements.

Attention: Prior to measurements of insulation resistance of secondary windings remove earthing screws in one of the terminals of each secondary winding, if screwed in. Reattach these earthing screws and ground one of the terminals according to voltage transformer connection diagrams.

Safety instructions

- Installed voltage transformer shall be always considered as part of interconnected circuit. Never attempt to touch the leads, terminals or other parts of the voltage transformer unless they are known to be properly connected and ground.
- Always ground the metal base of voltage transformer.
- If secondary winding is earthed at several points, only the same terminal of secondary winding may be used for grounding. Check with care if both terminals of the same secondary winding are not grounded by accident. Grounding both terminals of secondary winding can result in damage of voltage transformer over a short period of time. Any claims for resulting transformer damages will be void.
- If auxiliary secondary windings of earthed transformers (single-pole insulated) are connected to open delta, only one node of open delta circuit may be earthed.
- If two unearthed voltage transformers (doublepole insulated) operate in V-connection, only one of the two terminals of secondary winding may be earthed.

- 05
Primary terminals for double-pole insulated VT – TDO 6 – nuts M10.
- 06
Primary terminal for single-pole insulated VT – TJO 6 – nut M10.
- 07
Primary terminal for single-pole insulated VT – TJO 7 – nut M12.
- 08
Primary terminal for single-pole insulated VT – VOG-24 – nut M10.
- 09
Primary terminals for double-pole insulated VT – VOL-24 – nuts M10.
- 10
Primary terminals for double pole insulated VT – VOL-40,5 – nuts M12.
- 11
Clamp type primary terminal for products with CBS modification (TJO 7, VOG-24 and VOL-24)

Mounting

General and detailed information regarding mounting procedure may differ depending on voltage transformer type and version. Follow the technical specifications included in catalogues, dimensional drawings and rating plates for specific voltage transformer type and mounting instructions

Outdoor voltage transformer may be mounted in vertical position only (with terminal of primary winding facing the top). For other mounting positions consult the manufacturer. Fasten the voltage transformer metal baseplate using the four M10 screws with washers or with two metal profiles and M12 screws depending on the version of voltage transformer. An M8 or M12 earthing screw is available on the baseplate for grounding the voltage transformer, depending on version (see dimensional drawing for exact location).

Recommended tightening torque for screws used in voltage transformers except primary connection.

Screw	Tightening torque [Nm]	
	Recommended	Max.
Clamp type primary terminal*	21	23
M6 **	4,6	4,8
M8	8	10
M10	13	18
M12	25	30
M14	45	50
M16	70	75

* related to CBS modification (clamp type primary terminal)

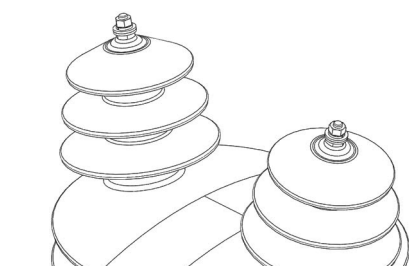
** secondary terminal box (M6)

Tab. 3. Maximum allowed torque for primary terminals screw connections is 20 Nm.

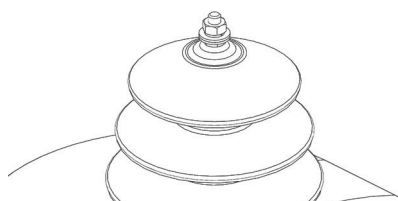
Primary connection

- Terminal screw connections may be tightened with maximum allowed torque of 20 Nm.
- Maximum allowed cantilever strength is 1000 N.

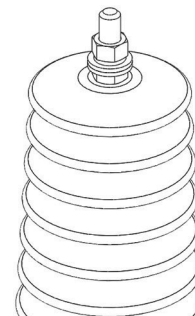
The primary terminals are located on the top surface of voltage transformers (see dimensional drawings).



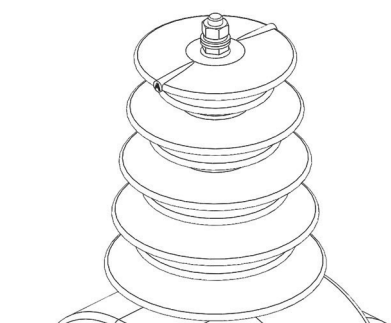
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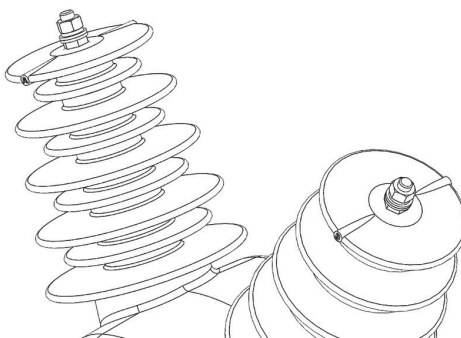
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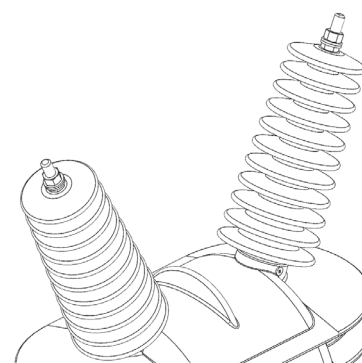
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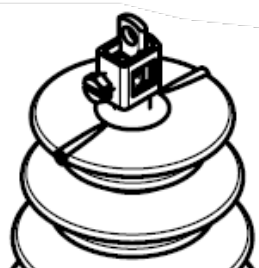
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12
Examples of voltage transformers terminal boxes – TDO 6.

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13
Designation of the secondary windings – TDO 6.

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14
Examples of voltage transformers terminal boxes – TJO 6.

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15
Designation of the secondary windings – TJO 6.

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16
Examples of voltage transformers terminal boxes – TJO 7.

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Designation of the secondary windings – TJO 7.

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Examples of voltage transformers terminal boxes – VOG-24.

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Designation of the secondary windings – VOG-24.

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Examples of voltage transformers terminal boxes – VOL-24.

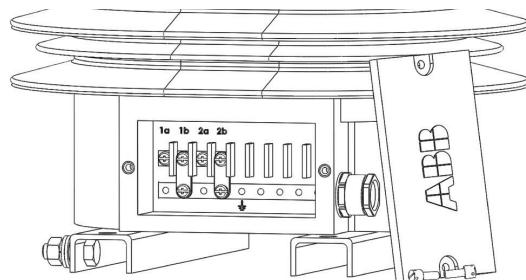
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Designation of the secondary windings – VOL-24.

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Examples of voltage transformers terminal boxes with fuse as option – VOL-40.5.

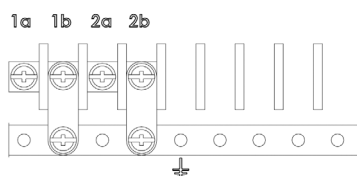
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Label inside of the secondary terminal box indicating each secondary terminal. Available for TJO 6, TJO 7, TDO 6, VOL-24.

Secondary connections

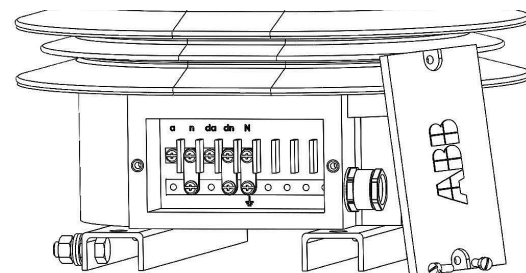
Terminals, terminal screws, nuts and washers are made of brass or stainless steel. The terminal box is provided with one or two PG21 cable gland. The secondary terminals are provided with M6 screws for wiring connections. The cover of the terminal box is provided with lead seal lock. In outdoor voltage transformers degree of IP54 protection for terminal boxes.



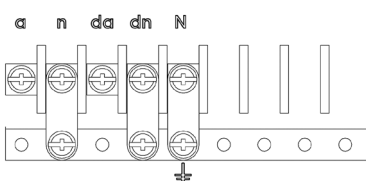
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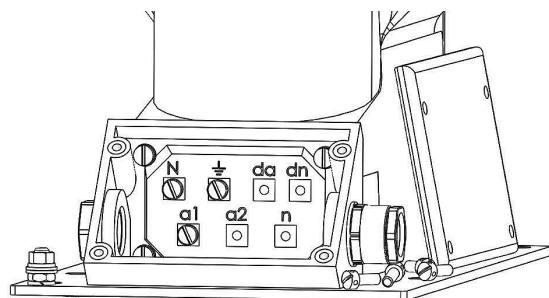
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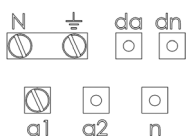
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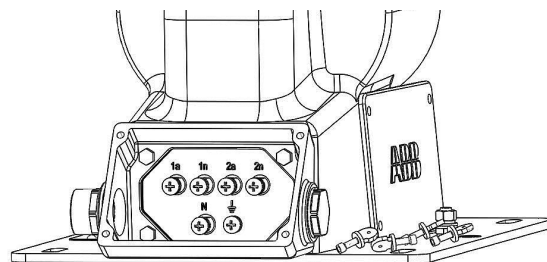
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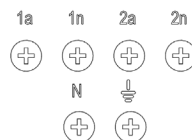
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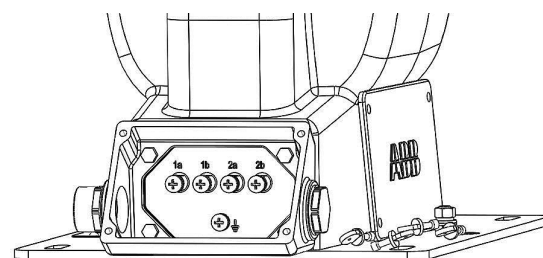
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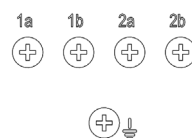
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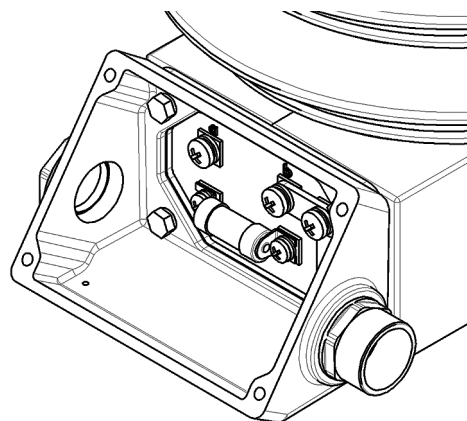
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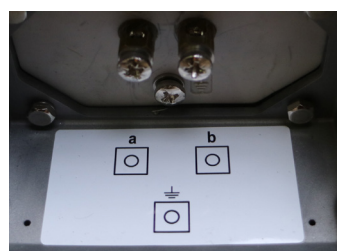
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5. Maintenance and Overviews during Exploitation

Maintenance

Excessive dust or other kind of pollution must be brushed off the transformer. Polluted transformers can be cleaned with spirit, petrol or toluene. Traces of arcs and minor surface damages can be easily removed with sandpaper after which the surface is to be treated by applying a thin layer of silicone paste on it. Instruction for repairing greater surface damages must be requested from the manufacturer.

Overviews during exploitation

Medium voltage instrument transformers in resin insulation are maintenance-free. However, because of work under different environmental conditions during the transformer operation it is advisable to carry out:

- overview of the instrument transformer during operation – only visual control,
- overview of the instrument transformer disconnected from power supply.

Time periods between inspections is regulated by standards, by operation and maintenance manual of switchgears or user requirements.

Overview of the instrument transformer during operation

The review is based on visual control in accordance with the principles of safety. During the inspection should pay attention to:

- condition of resin body,
- condition of primary terminals,
- condition of support structures.

Overview of the instrument transformer disconnected from power supply

The overview should be done every time before restarting. The overview should include:

- cleaning the surface of instrument transformer,
- checking condition of the transformer resinbody surface,
- checking condition of mounting screws and checking the condition of all electrical connections (on primary and secondary terminals and earthing terminals),
- measurement of main insulation resistance,
- measurement of secondary winding insulation resistance.

Attention: Cut off the power supply of transformer before attempting cleaning or repairing operations.

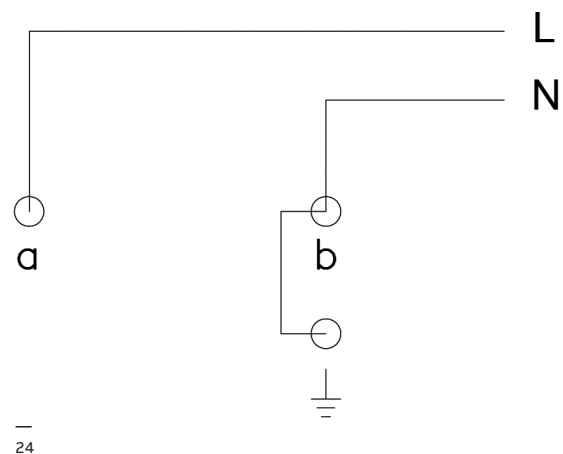
6. Instruction for Use

The main tasks of voltage transformers are:

- to transform voltages from a usually high value to a value easy to handle for relays and instruments, while maintaining appropriate accuracy class, and to power supply to the metering circuit,
- to insulate the metering circuit from the primary high voltage system,
- supply other low voltage devices do not require a high standard of accuracy, such as disconnectors drives

Using voltage transformers for purposes other than described above is forbidden, if not otherwise agreed with its manufacturer.

Attention: For applications that use a power supply transformer, the transformer is recommended to use double-pole voltage transformer. In the case of single-pole voltage transformer secondary side can rise to 190% of rated voltage, which can cause permanent damage to the powered device and the transformer. Using double-pole voltage transformer should be one of the ends secondary winding grounded. An example of such a connection is shown below in figure 23.



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24
An example of connecting the receiver to the secondary terminal winding of the doublepole voltage transformer.

7. Package, Transport and Storage

Admissible temperature range for storage and transport of voltage transformers is -40°C to $+70^{\circ}\text{C}$. Voltage transformers must be protected from exposure to direct sunlight during transport and storage. Voltage transformers shipped for domestic customers are packed in wooden crates or according to customer's specification. Voltage transformers shipped for abroad customers are packed in wooden crates. Voltage transformer should be shipped in position according to symbols and marks indicated on its packing case and protected against weather conditions. They should be stored in dry and clean places, protected from direct exposure to precipitation and solar radiation.

8. Disposal

Materials used in instrument transformers are considered as materials without dangerous environmental impact and materials are not toxic. Disposal of instrument transformers is controlled by national legislation of communal waste.

9. Normative References

Voltage transformers are: designed, tested and manufactured according to international or national standards specified by customers and confirmed by manufacturer. Normative reference for a given voltage transformer is always indicated on the transformer's rating plate.

Standard examples:

IEC 61869-1; IEC 61869-3; GOST 1983-2001.

On requests, voltage transformers may be designed and manufactured in accordance with other revisions of standard or standards specified above upon a prior agreement between manufacturer and purchaser.

10. Voltage Transformer Handling

Voltage transformers should be handled by crane with chains and hooks attached to the lifting eyebolts (see figure 24). Screw the lifting eyebolts through the baseplate/rail and nuts under baseplate/rail properly. Then attach to the crane's hook using chains. This handling method is recommended for the majority of voltage transformers equipped with baseplate and weight exceeding 25 kg, mainly types: TDO 6, TJO 6, TJO 7, VOG-24, VOL-24, VOL-40.5 (see figure 24).

Attention: Load capacity for chains/loops/ crane must be no less than 200 kg. Always make sure that chains/loops are properly and safely attached to the crane's hook and that the voltage transformer is properly secured.

Note: The lifting eyebolts are not part of standard delivery. It can be ordered as Handling kit (1VL4601302V0101) containing 12pcs of lifting eyebolts and 12pcs of nuts.

Attention: Observe the work safety rules during voltage transformer handling operations. Never stay under the suspended loads. Always make sure that the voltage transformer is safely attached to the crane's hook and there is no risk of load falling or tipping over.

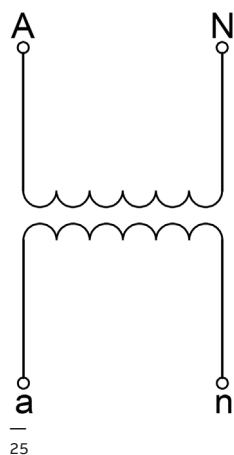


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Example of handling
voltage transformer
VOL-24.

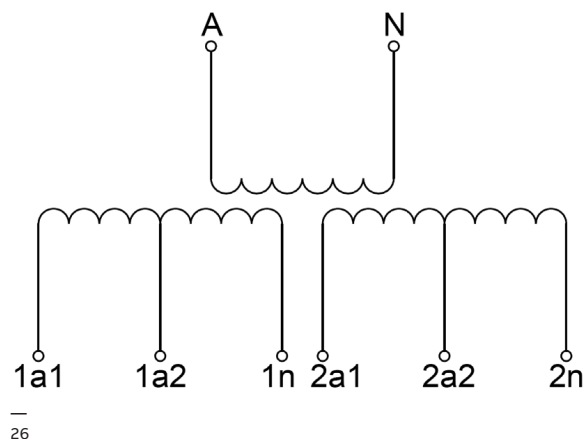
11. Wiring Diagram Examples

Electric schemes

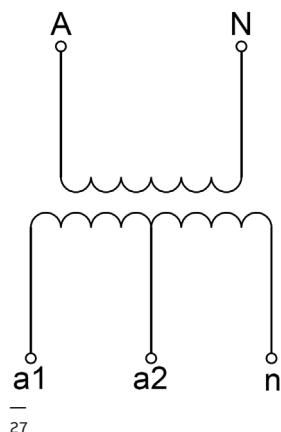
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25
Single-pole insulated
voltage transformer with
one secondary winding



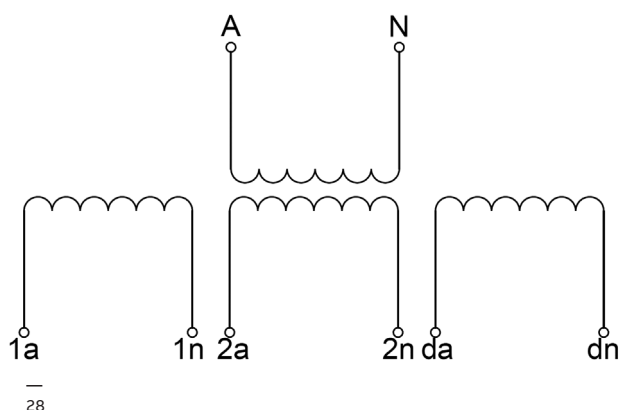
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26
Single-pole insulated
voltage transformer with
two secondary, tapped
windings



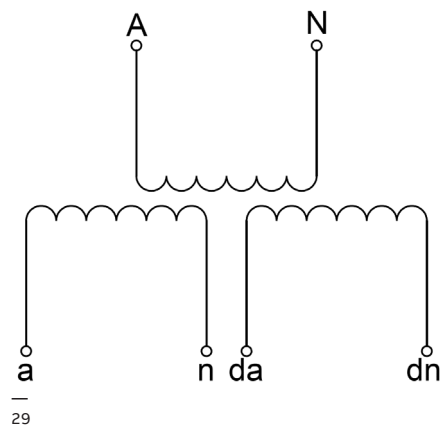
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27
Single-pole insulated
voltage transformer with
one secondary, tapped
winding



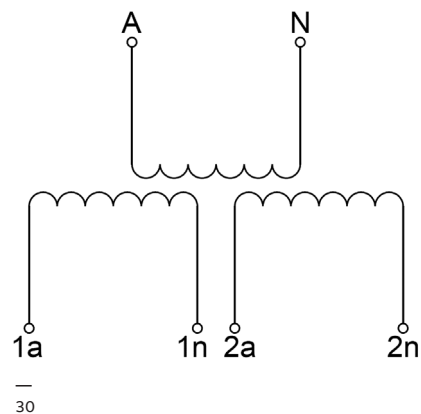
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28
Single-pole insulated
voltage transformer with
two secondary windings
and one auxiliary winding



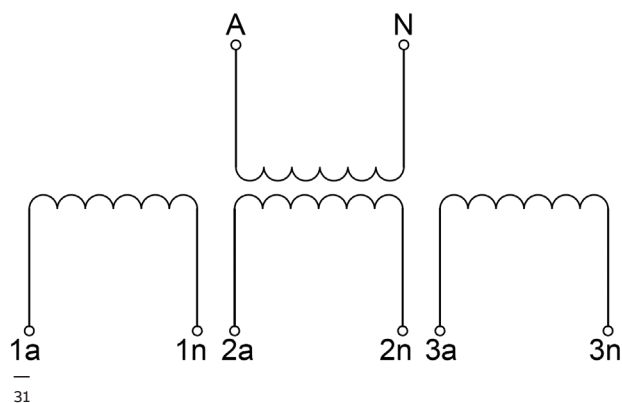
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29
Single-pole insulated
voltage transformer
with one secondary
winding and one
auxiliary winding (for
open delta connection)



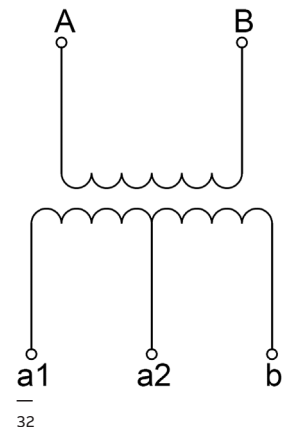
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30
Single-pole insulated
voltage transformer with
two secondary windings



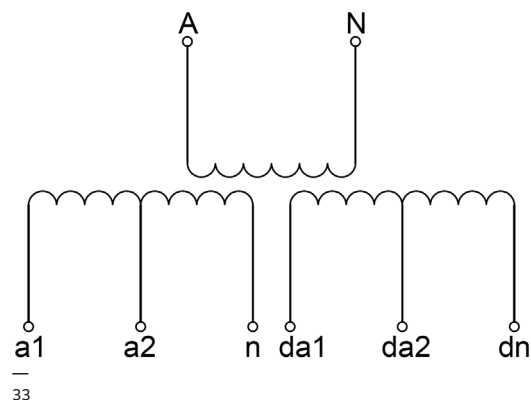
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31
Single-pole insulated
voltage transformer with
three secondary windings



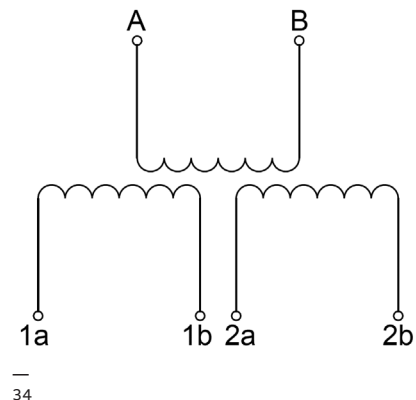
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32
Double-pole insulated
voltage transformer with
one secondary, tapped
winding



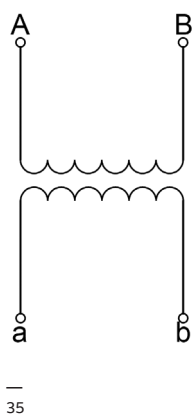
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33
Single-pole insulated
voltage transformer with
two secondary, tapped
windings, one of which
is auxiliary winding (for
open delta connection)



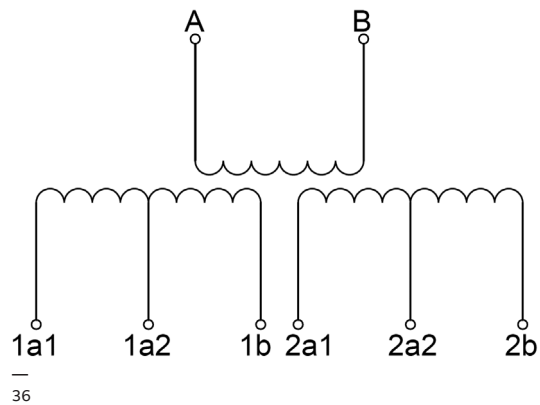
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34
Double-pole insulated
voltage transformer with
two secondary windings



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35
Double-pole insulated
voltage transformer with
one secondary winding



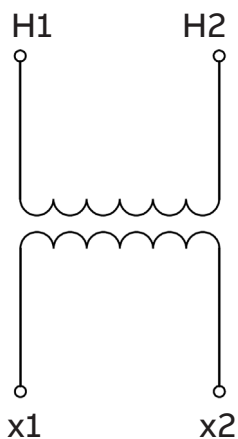
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36
Double-pole insulated
voltage transformer with
two secondary, tapped
windings



11. Wiring Diagram Examples

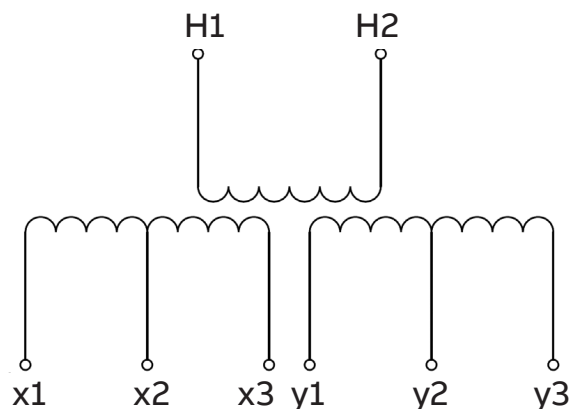
Electric schemes and IEEE terminals marking

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26
Single-pole insulated
voltage transformer with
one secondary winding



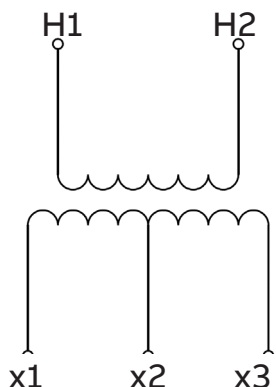
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27
Single-pole insulated
voltage transformer with
two secondary, tapped
windings



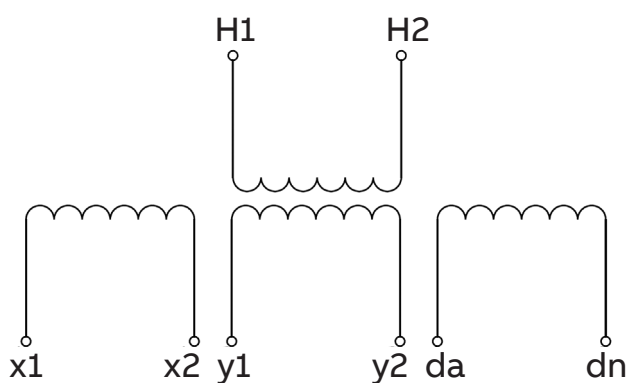
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28
Single-pole insulated
voltage transformer with
one secondary, tapped
winding



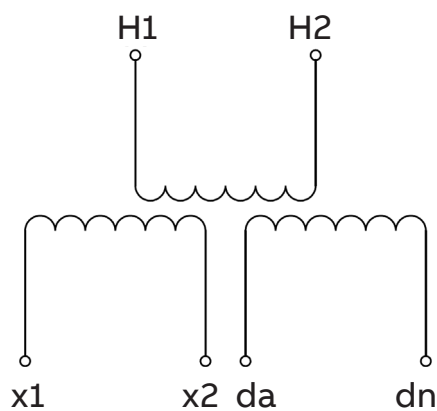
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29
Single-pole insulated
voltage transformer with
two secondary windings
and one auxiliary winding



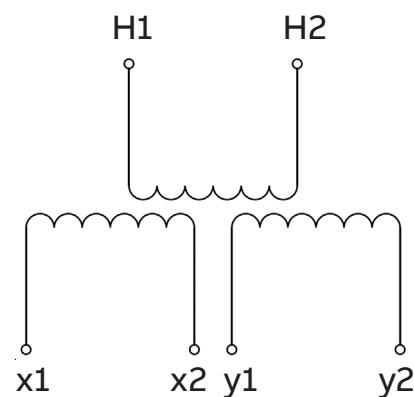
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30
Single-pole insulated
voltage transformer
with one secondary
winding and one
auxiliary winding (for
open delta connection)



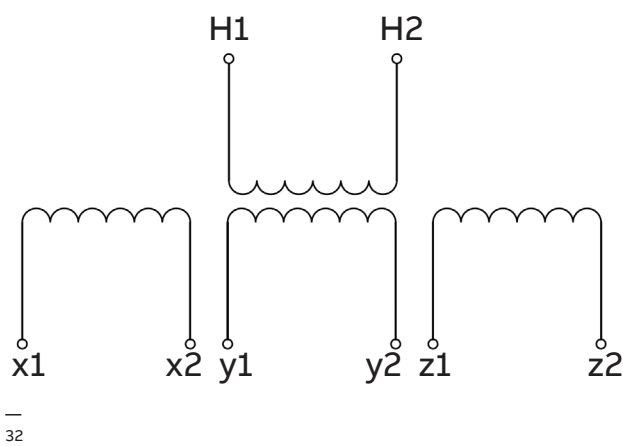
—
30

—
31
Single-pole insulated
voltage transformer with
two secondary windings

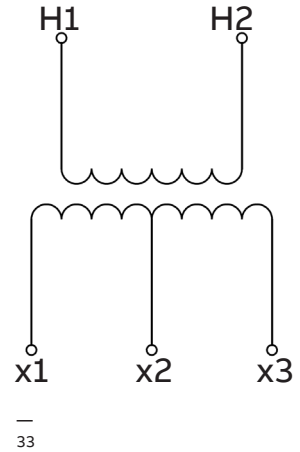


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31

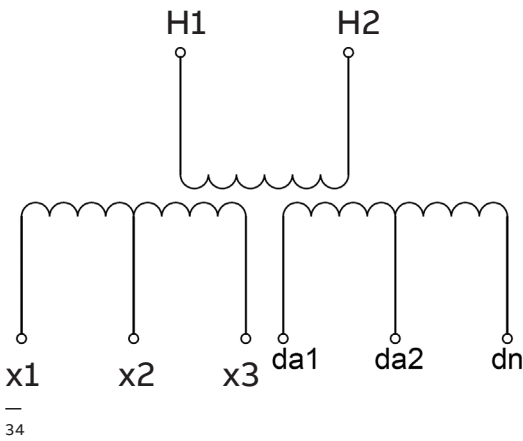
—
32
Single-pole insulated
voltage transformer with
three secondary windings



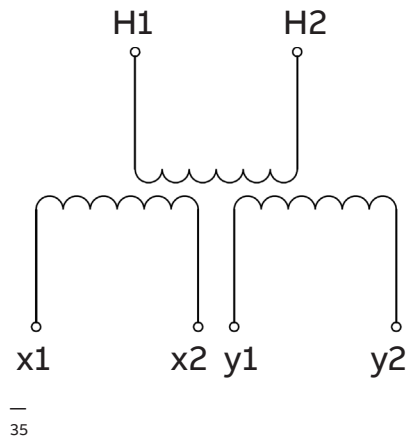
—
33
Double-pole insulated
voltage transformer with
one secondary, tapped
winding



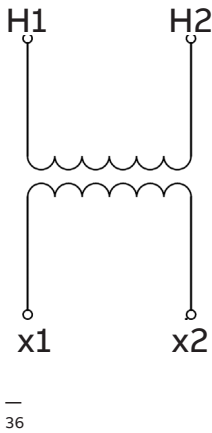
—
34
Single-pole insulated
voltage transformer with
two secondary, tapped
windings, one of which
is auxiliary winding (for
open delta connection)



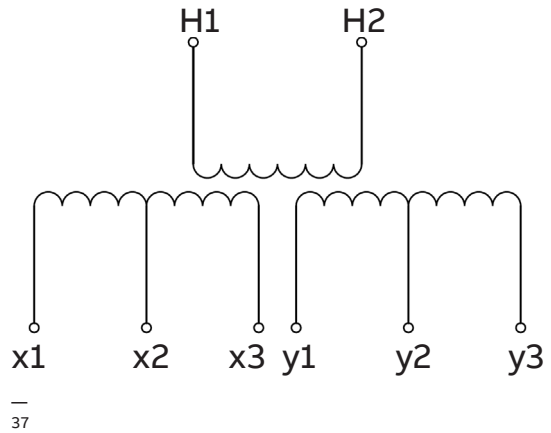
—
35
Double-pole insulated
voltage transformer with
two secondary windings



—
36
Double-pole insulated
voltage transformer with
one secondary winding


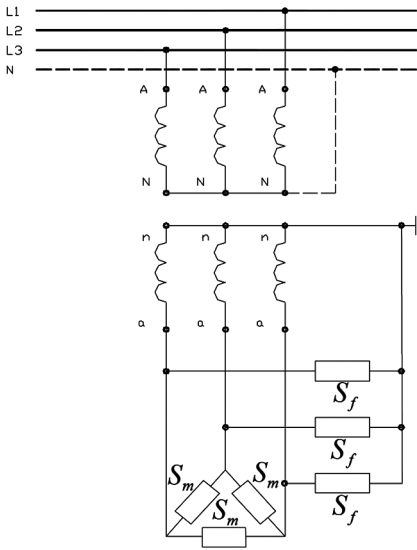

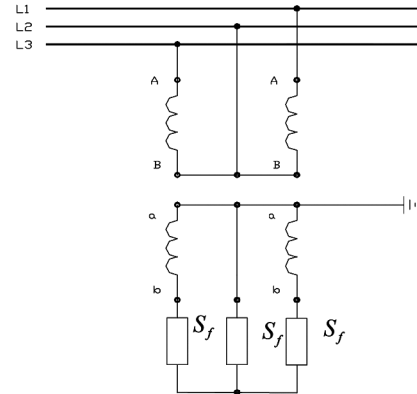

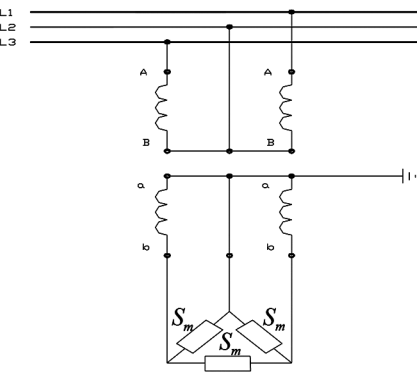

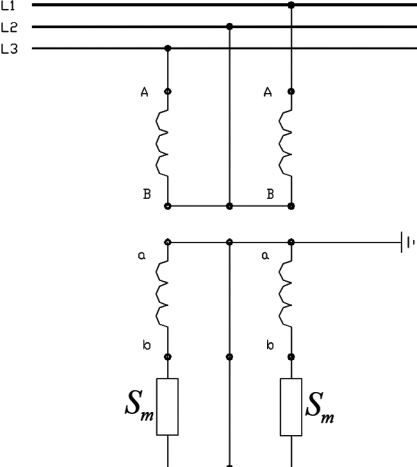


—
37
Double-pole insulated
voltage transformer with
two secondary, tapped
windings



12. Connections of Voltage Transformers – Examples

Connection name	Wiring diagram	Application
With one double-pole transformer		Line voltage measurement. Both poles of the transformer have to be fully insulated.
With one single-pole transformer		Line to ground voltage measurement. One pole of the transformer should be fully insulated.
Star connection with broken delta system		Line to ground voltage and residual voltage measurement. One pole of the transformer should be insulated.
Star connection		Line to line voltage measurement. Connection may have an broken delta system for residual voltage measurement. One pole of the transformer should be insulated.

Connection name	Wiring diagram	Application
<div>Star connection</div> <div></div>	<div></div>	<div>Line to line and line to ground voltage measurement.</div> <div>Connection may have an broken delta for residual voltage measurement.</div> <div>One pole of the transformer should be insulated.</div>
<div></div>	<div></div>	<div>Receivers are connected for line to ground measurement.</div> <div>Both poles of the transformer have to be fully insulated.</div>
<div></div>	<div></div>	<div>Receivers are connected for line to line voltage measurement.</div> <div>Both poles of the transformer have to be fully insulated.</div>
<div></div>	<div></div>	<div>Two receivers are connected for line to line voltage measurement.</div> <div>Both poles of the transformer have to be fully insulated.</div>

13. Appendix 1 - The Procedure to Tighten the Cable Gland

Valid for: TJO 6 and TDO 6 transformers

To seal up the cable gland, it is necessary to use wrench size 32 and hold tight the cable gland. Once wrench size 32 is mounted, put on assembly wrench size 30 on the nut as shown in the picture.

At the same moment when the nut is tightened with wrench size 30 it is necessary to start with counter movement with wrench size 32.

Attention:

It is forbidden to tighten the cable gland with wrench size 32 only.

It is forbidden to tighten the nut with wrench size 30 without providing counter movement as described above.

Both procedures (or any other which does not respect official description) lead to the destruction of the connection between cable gland and secondary terminal cover.

38 Outdoor Instrument
Transformer cable gland
tightening procedure

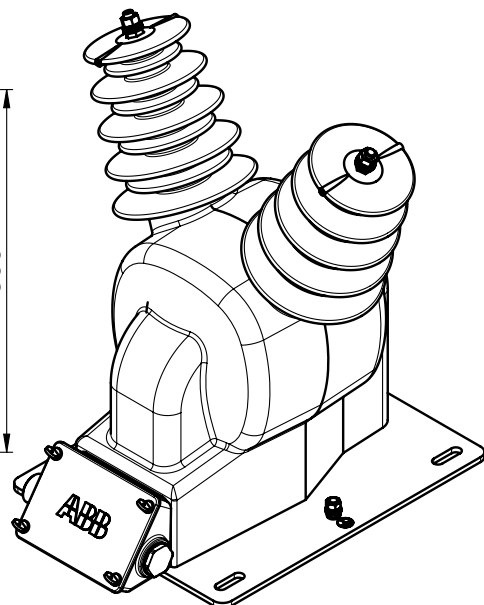
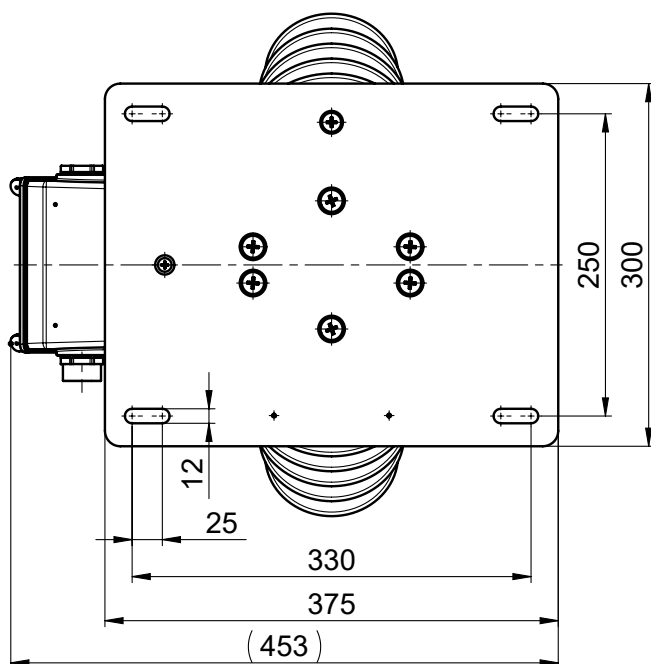
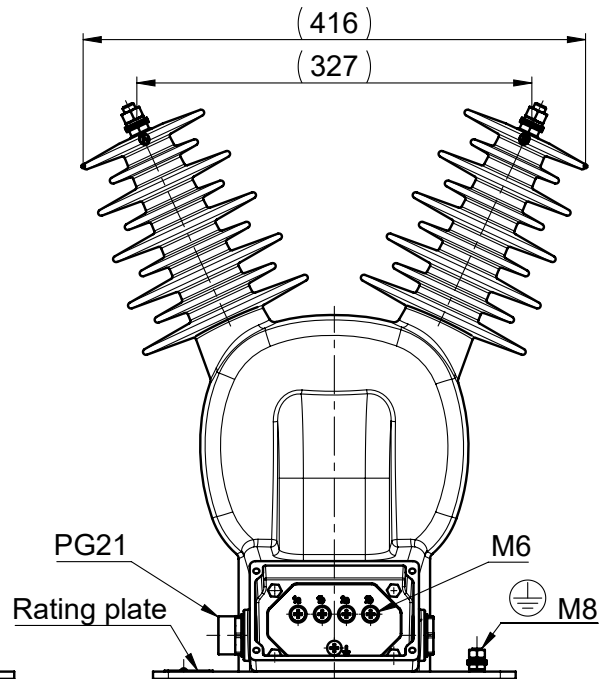
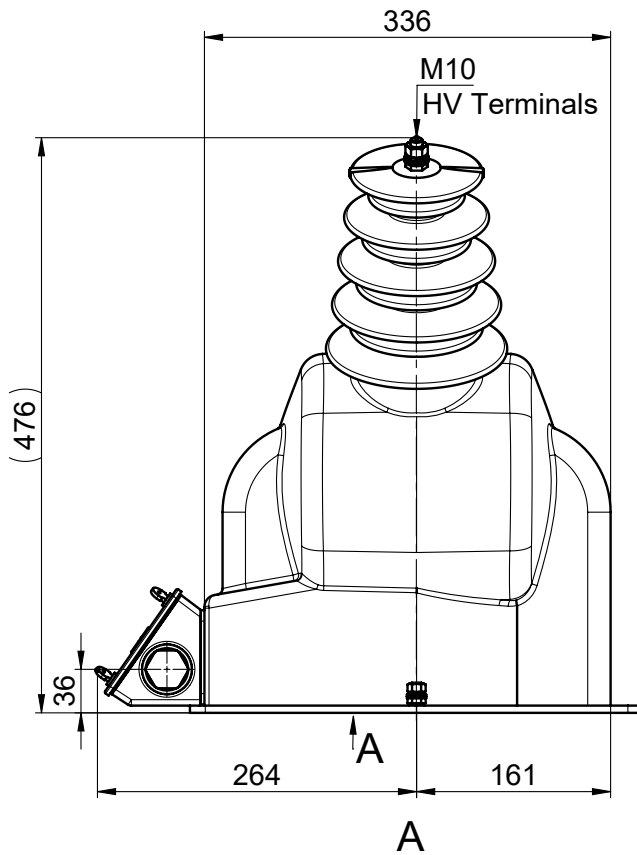


14. Dimensional Drawings

VOL-24

weight: 43 kg
creepage distance: 980 mm
creepage distance A-B: 1500 mm

DO NOT LIFT BY PRIMARY BUSHING!

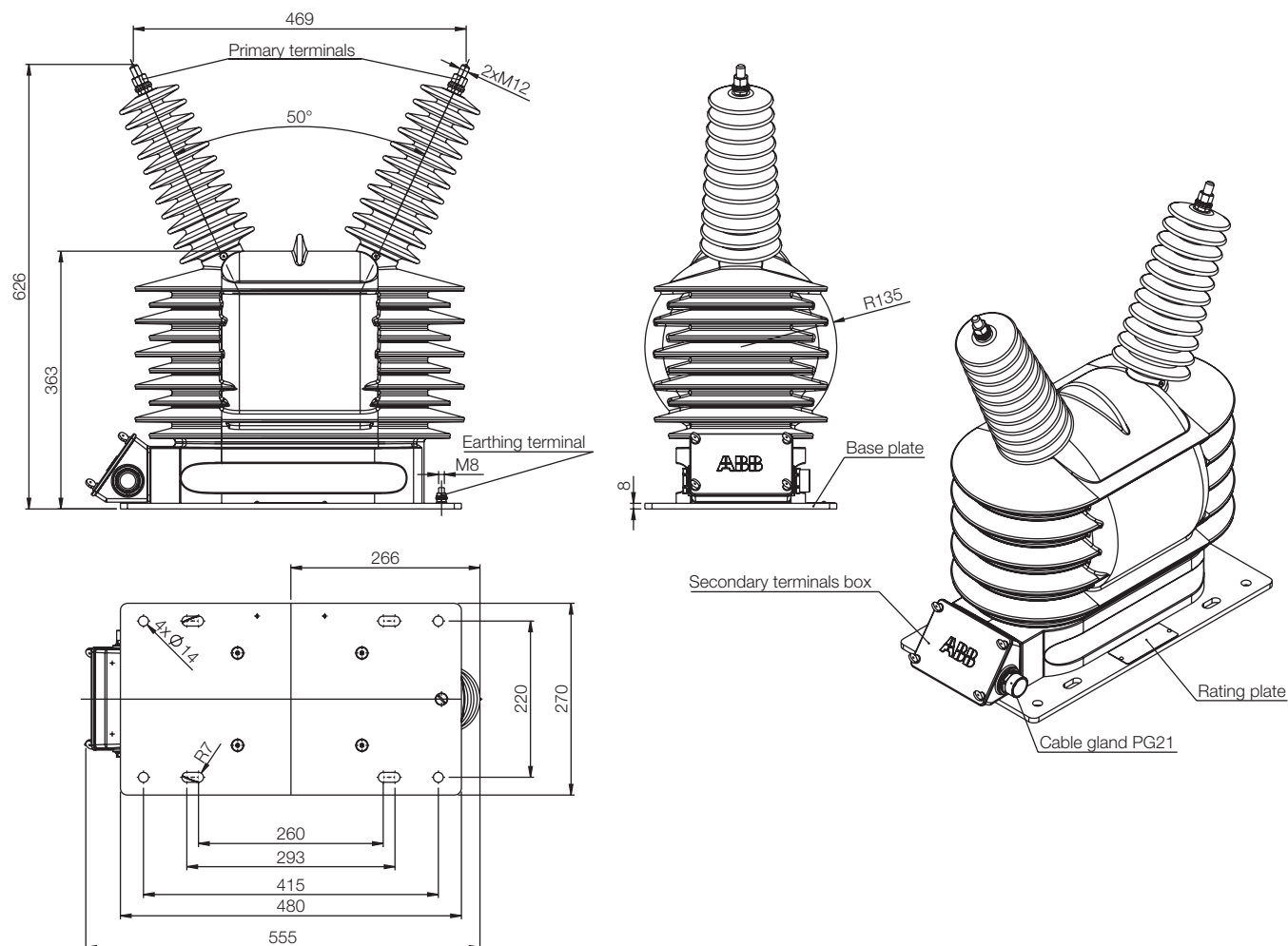


VOL-40.5

2RFA016266 - version with baseplate

weight: appr. 70 kg
creepage distance: 1325 mm

DO NOT LIFT BY PRIMARY BUSHING!

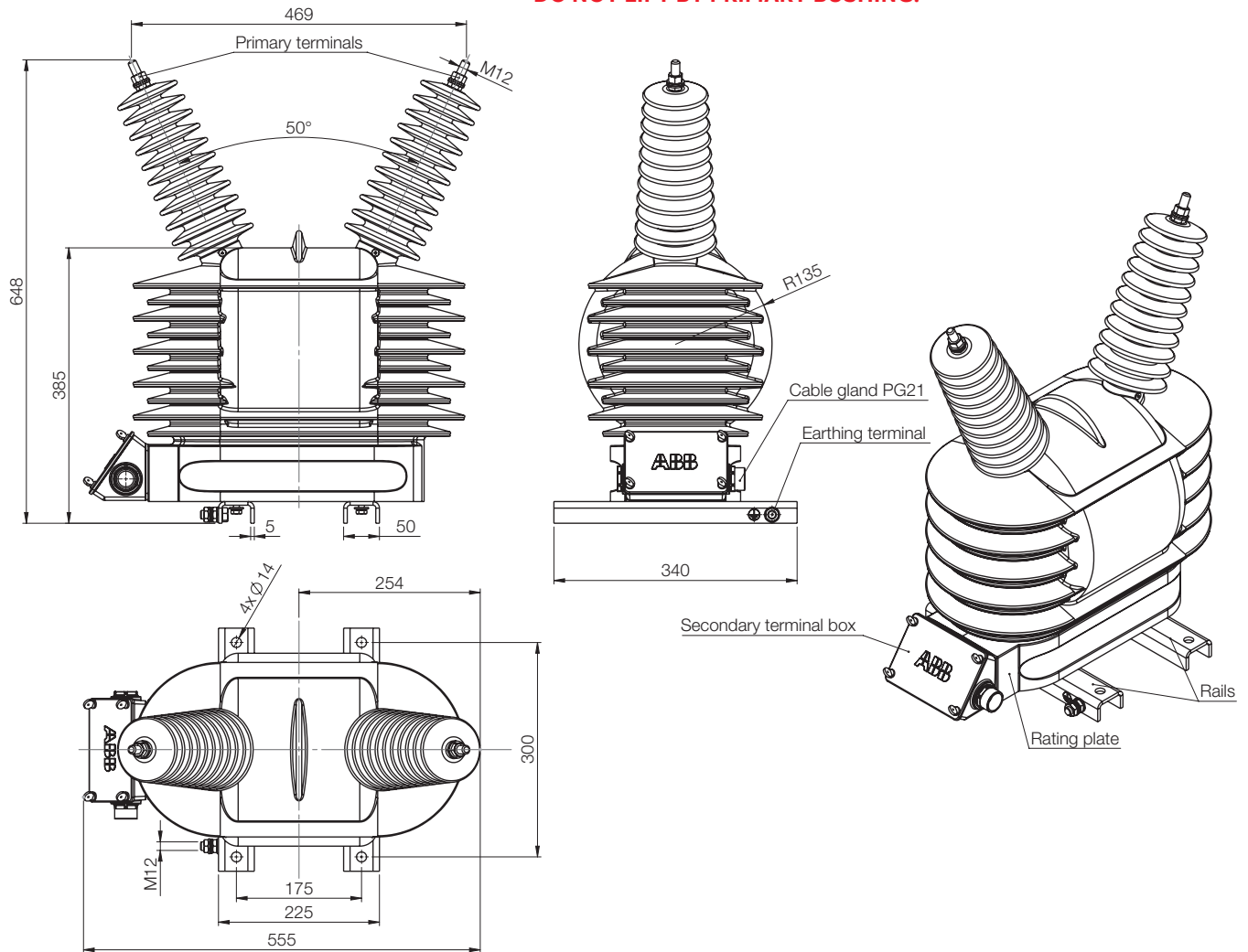


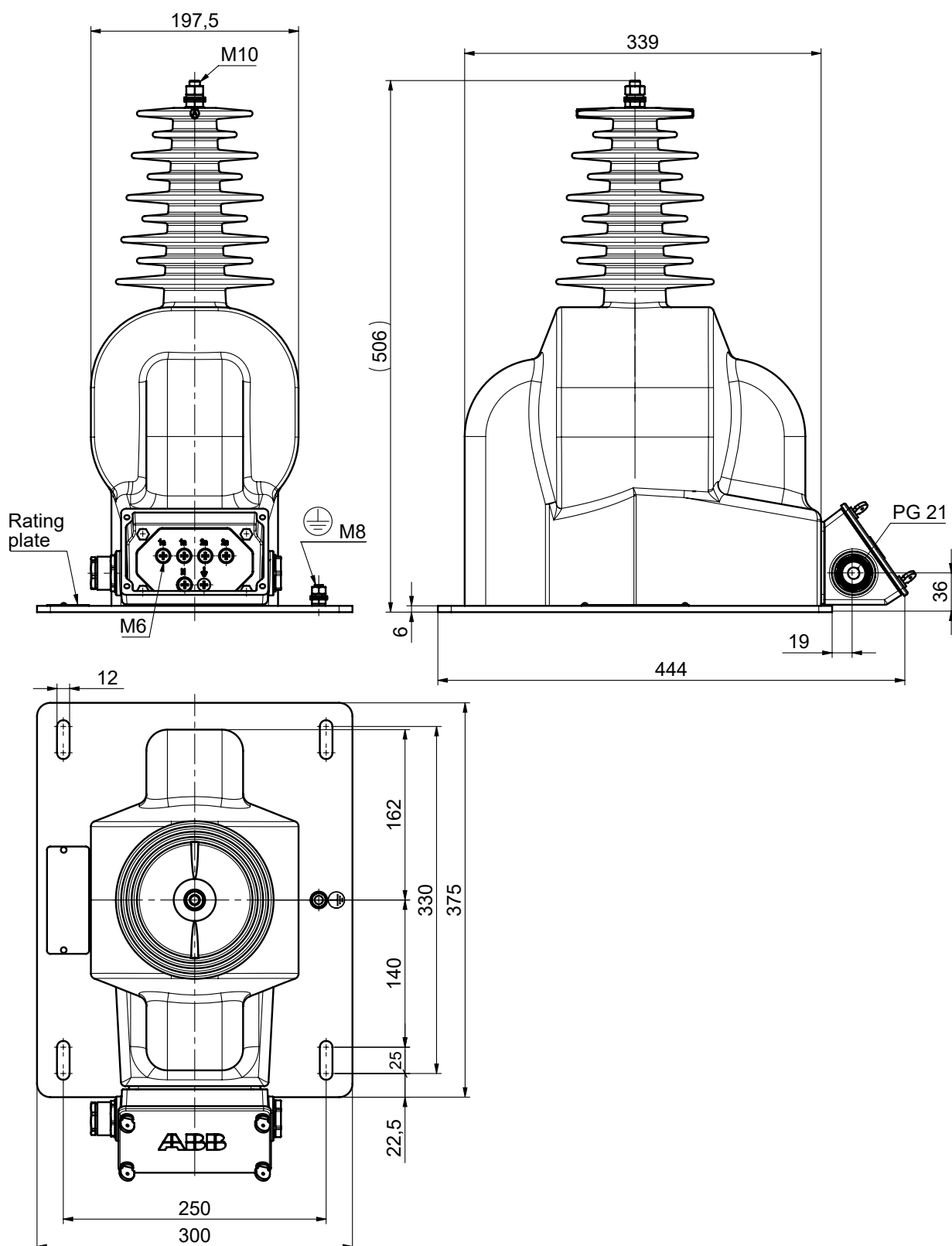
VOL-40.5

2RFA016267 - version with rails

weight: appr. 70 kg
creepage distance: 1325 mm

DO NOT LIFT BY PRIMARY BUSHING!

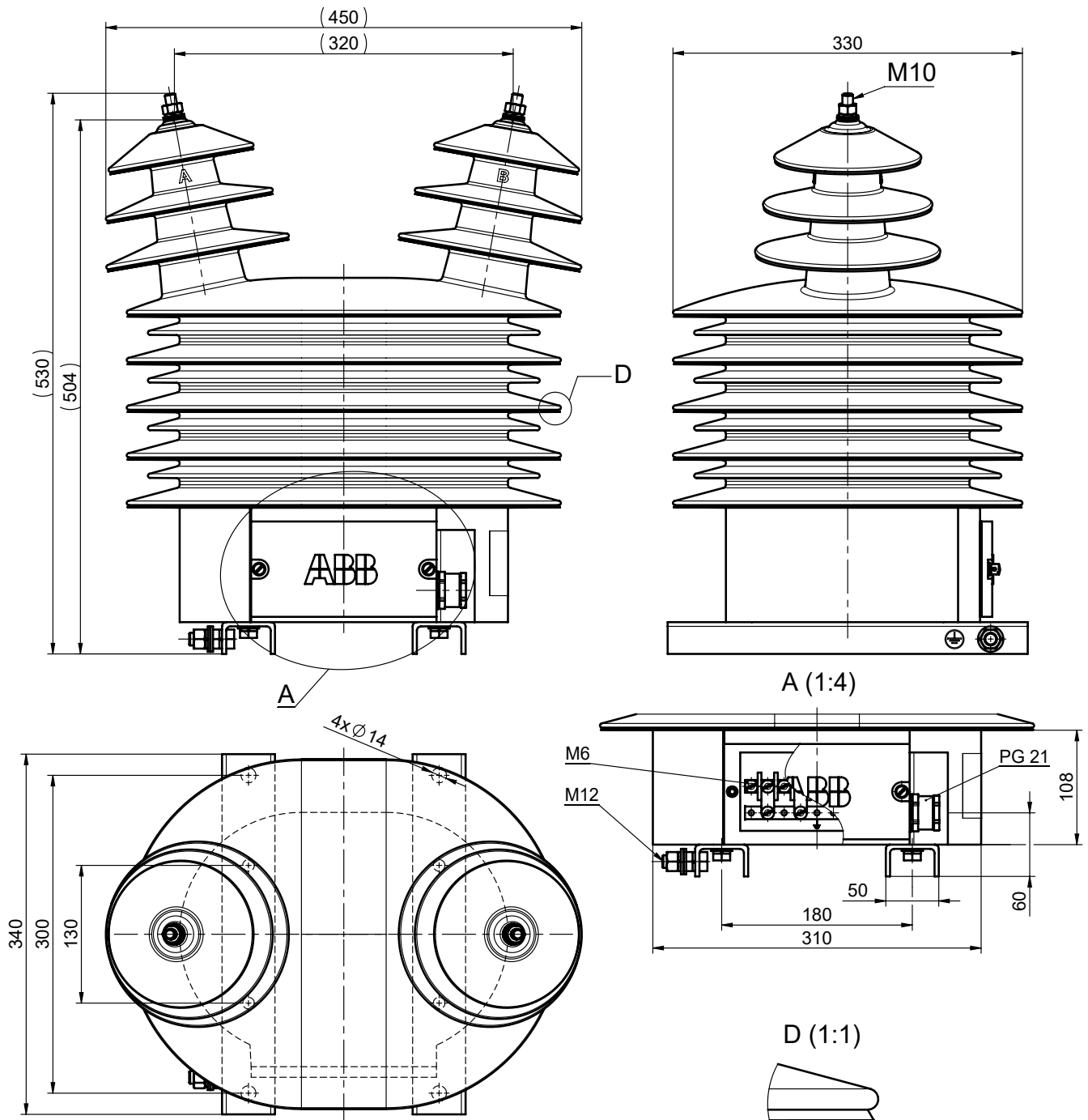


—
VOG-24weight: 39 kg
creepage distance: 1030 mm**DO NOT LIFT BY PRIMARY BUSHING!**

—
TDO 6

weight: 60 kg
creepage distance: 1250 mm
creepage distance A-B: 985 mm

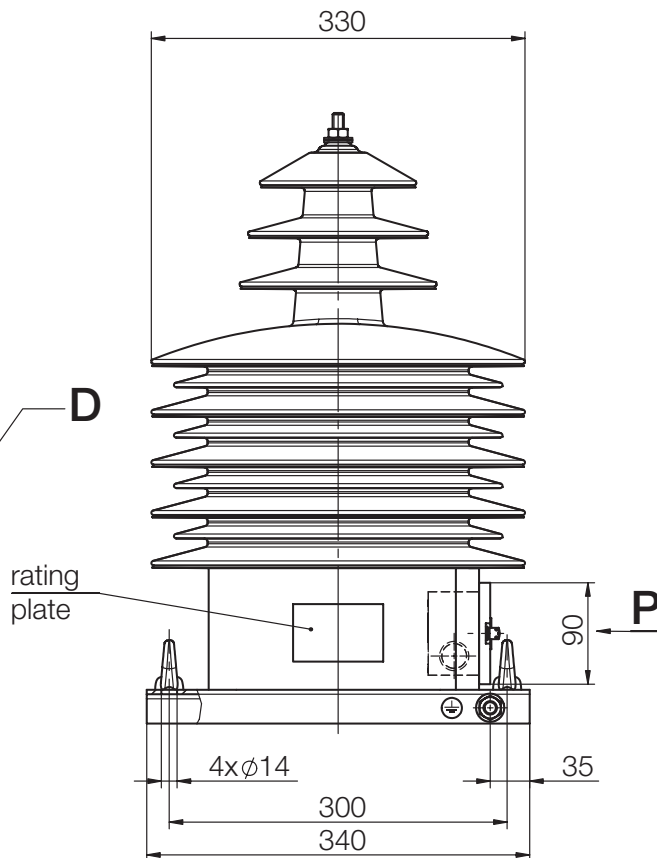
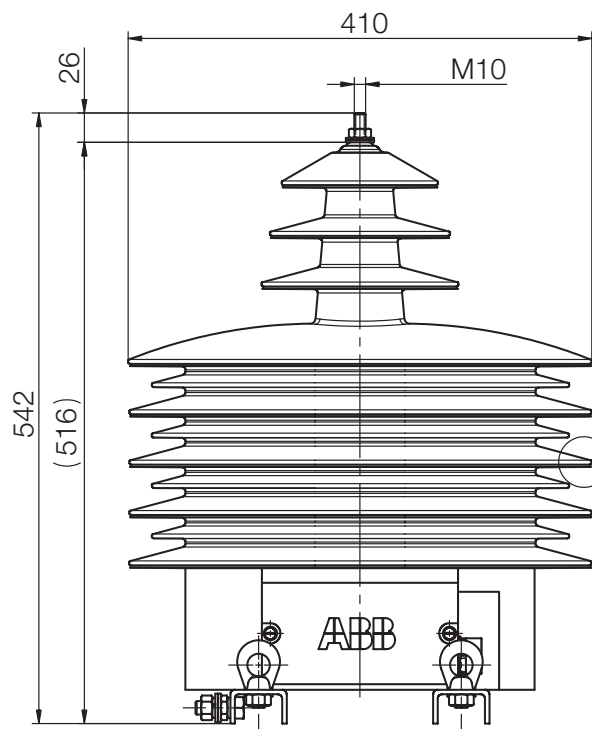
DO NOT LIFT BY PRIMARY BUSHING!



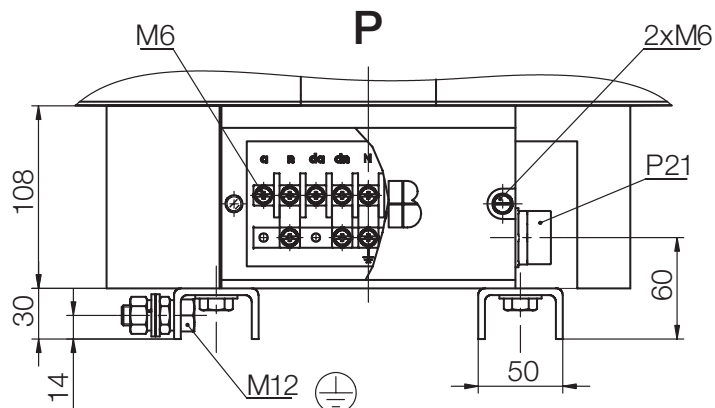
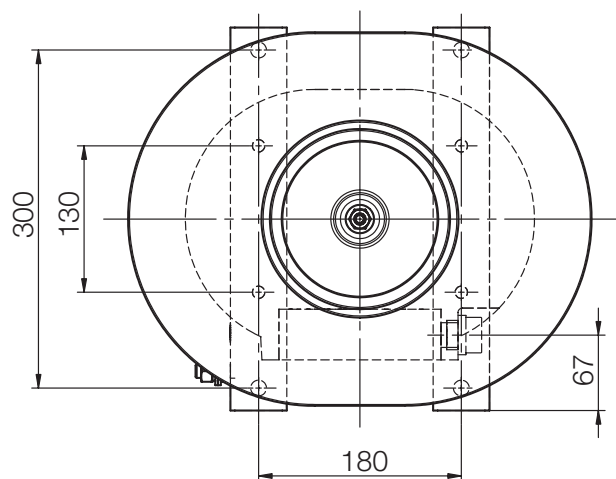
TJO 6

weight: 57 kg
creepage distance: 1250 mm

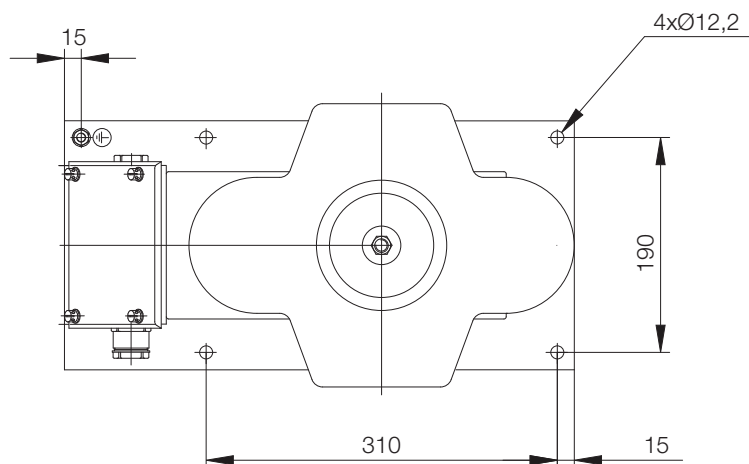
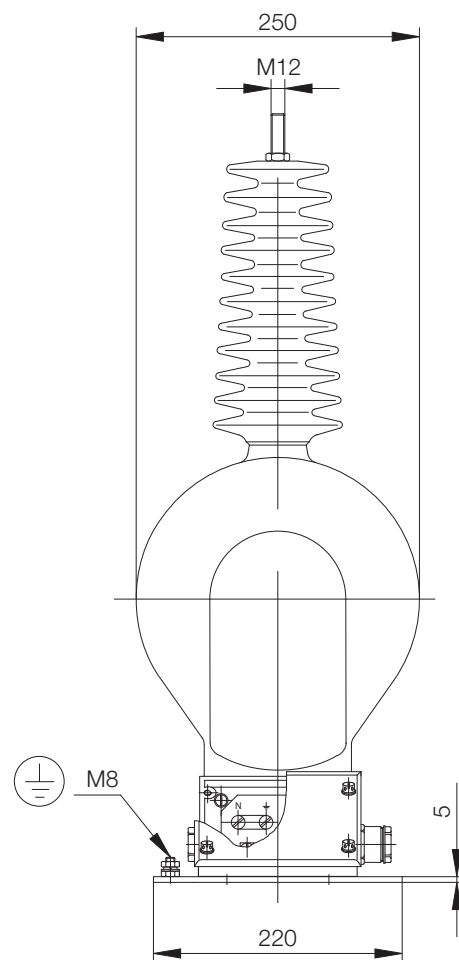
DO NOT LIFT BY PRIMARY BUSHING!



D (1:1)

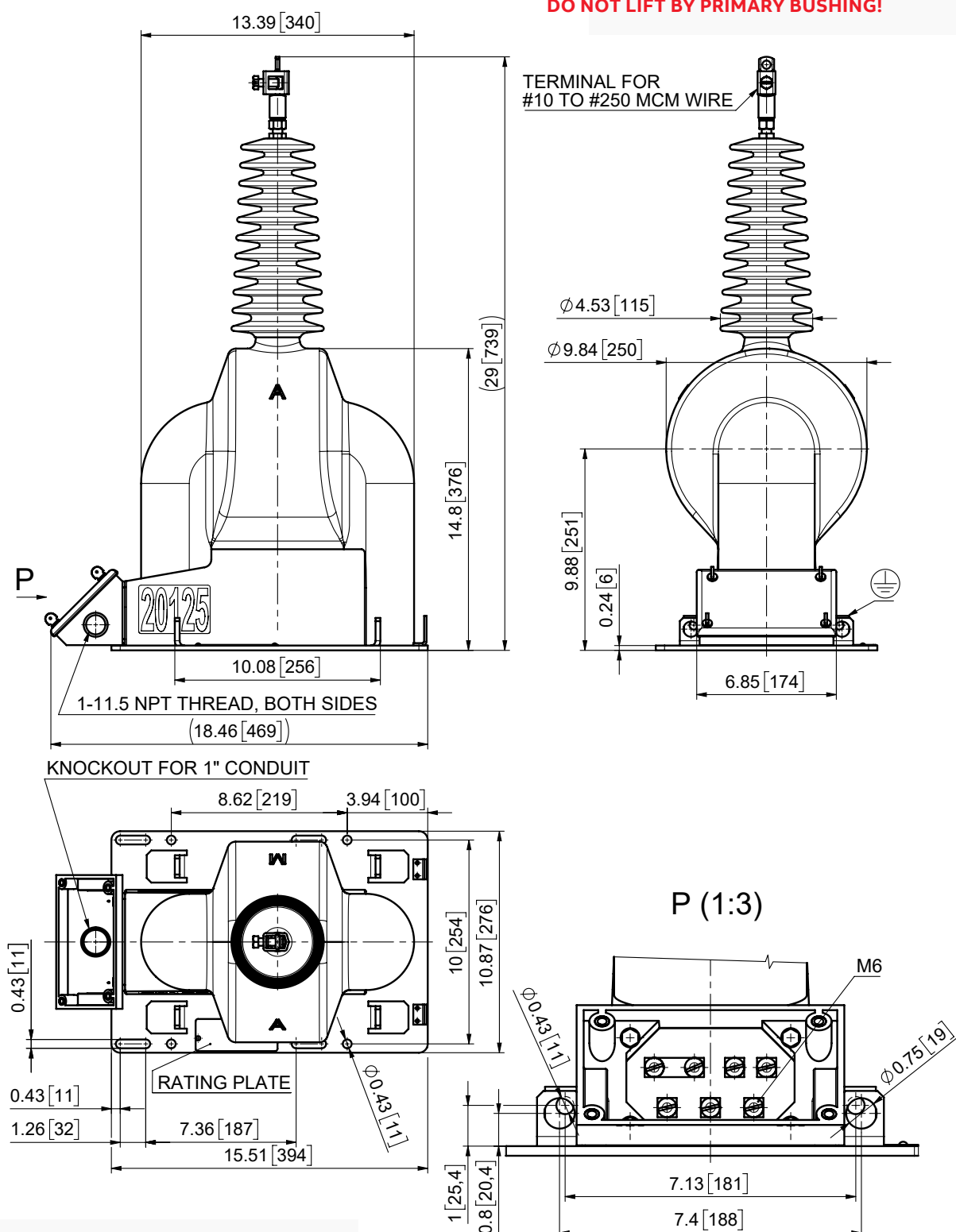


DO NOT LIFT BY PRIMARY BUSHING!



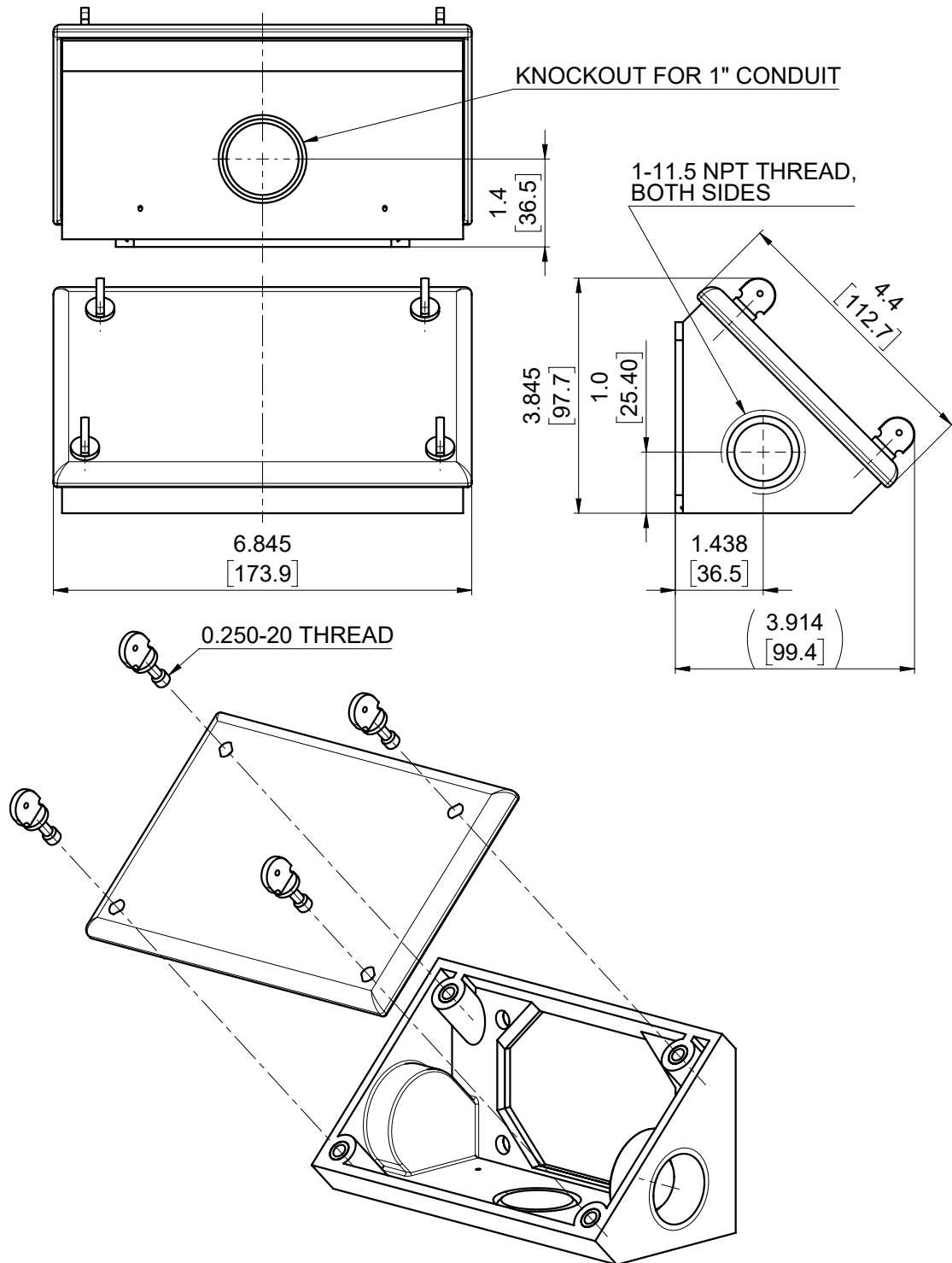
Inches, [mm]

DO NOT LIFT BY PRIMARY BUSHING!



CBS junction box

Inches [mm]

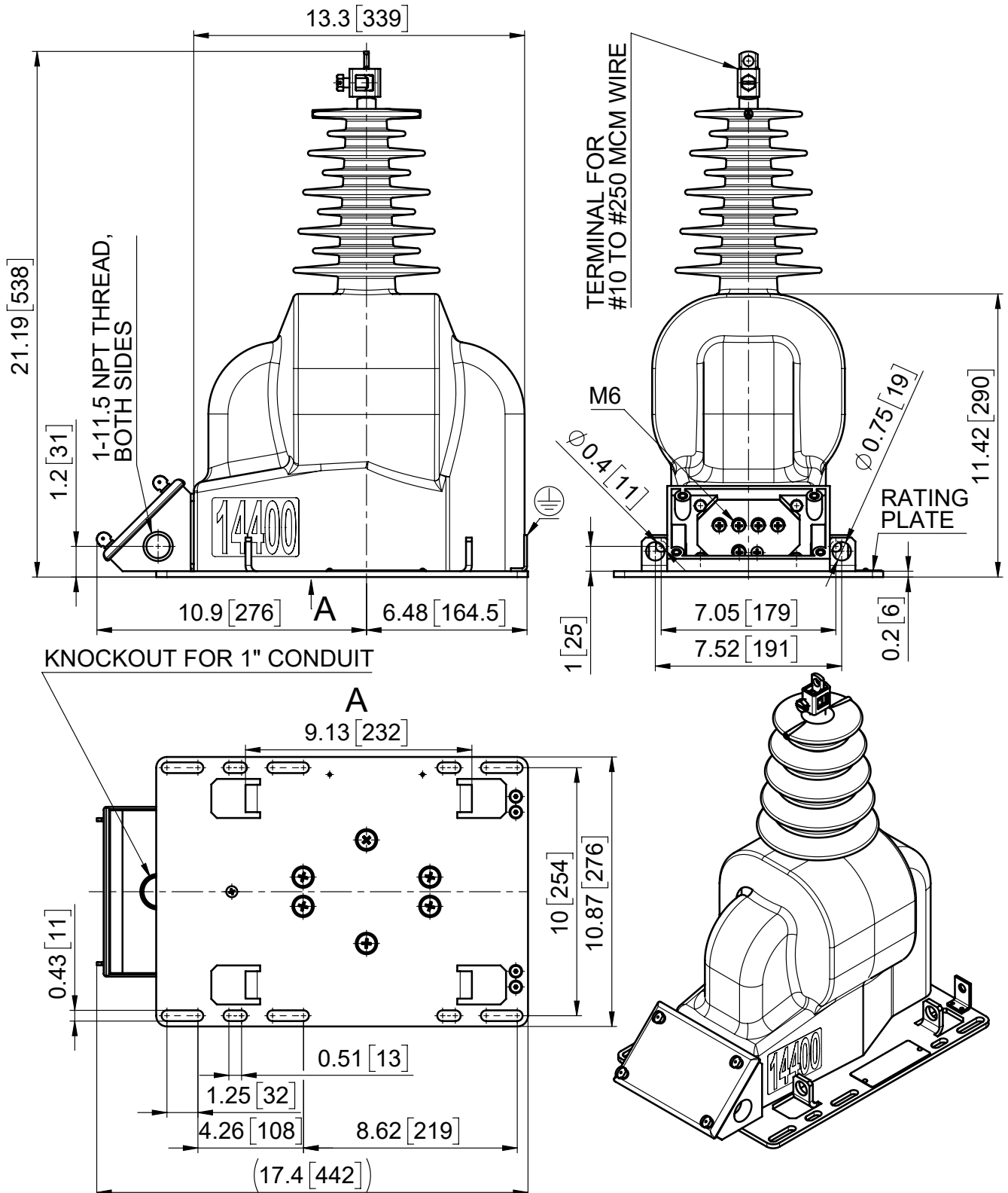


VOG-24, CBS modification

Inches, [mm]

weight: 85.9 lbs [39 kg]
creepage distance: 40.5" [1030 mm]
strike distance: 20.5" [520 mm]

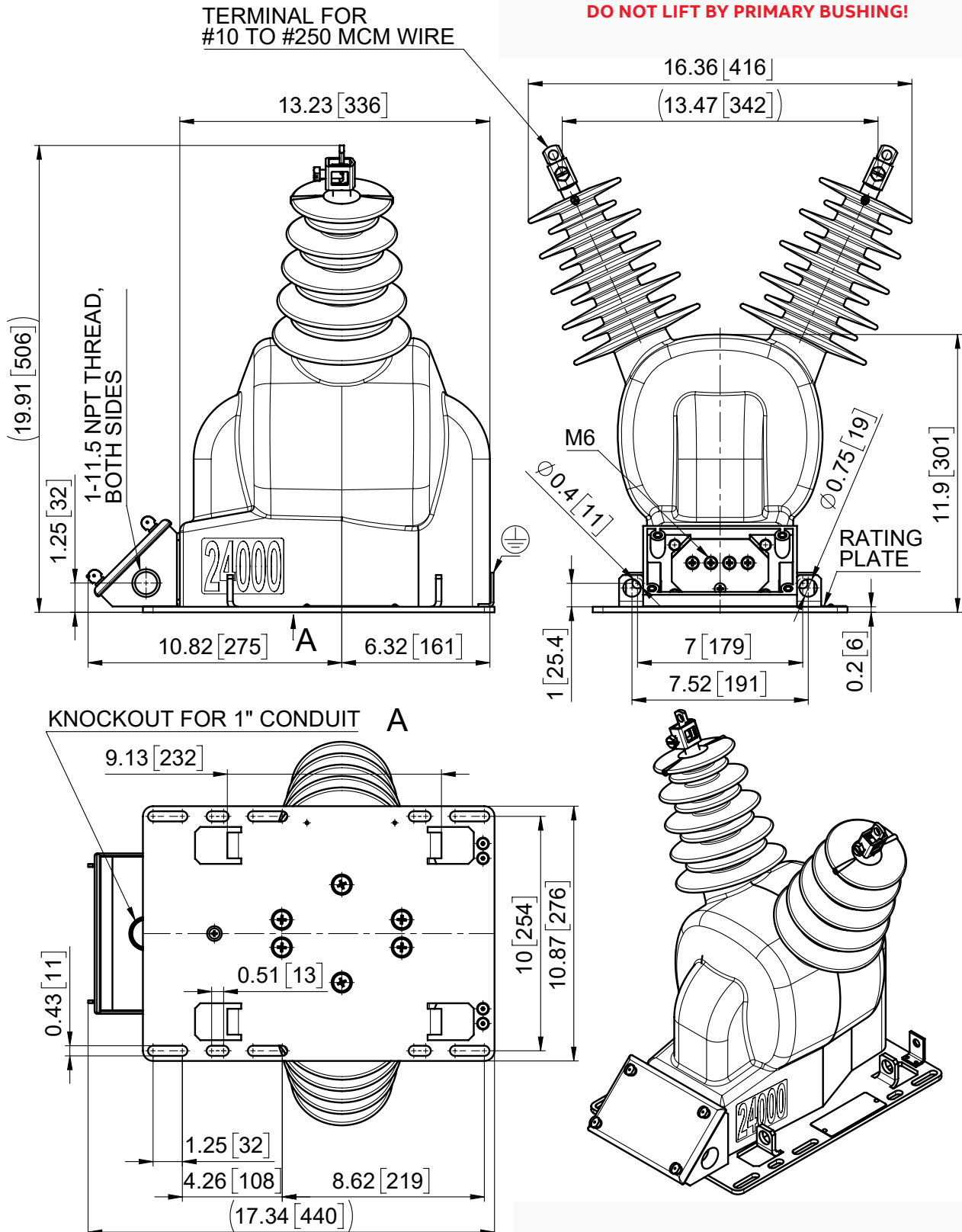
DO NOT LIFT BY PRIMARY BUSHING!



VOL-24, CBS modification

Inches, [mm]

weight: 95 lbs [43 kg]
 creepage distance: 38.6" [980 mm]
 creepage distance A-B: 59.8" [1520 mm]
 strike distance: 18.5" [470 mm]





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