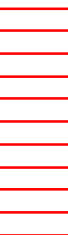




Installation and maintenance instructions for liquid-filled distribution transformers





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1. Generally applicable conditions

We are delighted that you have purchased a Pauwels transformer. It was manufactured using the latest techniques, tested in full and subjected to a thorough final inspection before delivery. In spite of these precautions difficulties may still arise during transportation, installation or operation. This is why we advise you to read the following points carefully.

A transformer is an electrical appliance and should therefore be handled according to the applicable national safety instructions.

Remark: If you opted for a transformer tank with radiators, other directions partly apply. Consult us about these.

1.1. Warranty conditions

The transformer comes with a factory warranty against construction defects that applies for 12 months after being put into operation, with a maximum of 18 months after leaving the factory. Any deviations from this must be established contractually. The warranty is limited to the repair or possible replacement of the transformer and this repair or replacement does not extend the original warranty. If difficulties should arise during the warranty period and afterwards, the service department of Pauwels Trafo Belgium N.V. can be contacted. They will provide you with the necessary assistance.

In case of any interpretation disputes, the 'General terms and conditions of Sale' of Pauwels Trafo Belgium N.V. shall take precedence over these directions and the 'Special agreements' shall take precedence over the 'General terms and conditions of sale'.

1.2. Transportation

Distribution transformers are shipped "ready for installation", which means filled with the insulating liquid and with accessories fitted or supplied separately.

1.2.1. Transportation by lorry

The transformers must be tightly secured at the top and bottom on the lorry. At the bottom by nailing down the base for the rollers or carriage. Fixed rollers should be clamped. At the top the transformer must be tightly secured via the lifting lugs or via special transport clamping lugs. If securing straps are used, make sure they do not pull on the lips or lip reinforcements. If the transformer is fitted with an expansion tank and a silica gel breather, see paragraph 1.2.2. about hermetic sealing.

1.2.2. Transportation by rail or sea

Transformers are usually packed in strong crates, boxes or containers. When packed in crates, the transformer's lifting lugs can be used to lift the entire equipment. Under no circumstances may moisture be allowed to penetrate into the transformer. For hermetically sealed transformers – both those with gas cushions and those with integral filling – this is not a problem. The liquid cannot come into contact with the surrounding air. For transformers with an expansion tank the infiltration of air during transportation and storage is prevented by:

- either placing a gasket in the de-aerator (breather) (**which must be removed before the transformer is energised**)
- or replacing the silica gel air breather with a blind flange that prevents the infiltration of air. In that case the air breather is supplied separately. Assembly instructions are included with the air breather.

1.2.3. Moving distribution transformers

In order to move a transformer the following accessories are required, depending on its size and the directions:

- a set of rollers, the wheels of which can be moved very simply in a longitudinal or diagonal direction
- lifting lugs on the main cover
- reinforcement of the bottom of the transformer tank allowing transportation by lift truck
- if necessary, upon special request, jacking bosses and/or (fixed or detachable) lifting lugs on the roller base or carriage.

Attention: A transformer must never be lifted at the lower side of the cooler fins. Never use the bushings (high voltage (HV) or low voltage (LV) insulators) to guide the transformer when moving it. Nor should the fins or fin reinforcements (round bar on top and bottom of the fins) be pulled on.

The clamping lugs are not to be used to manipulate the transformer; they must be used exclusively to secure the transformer during transport.



1.2.4. Acceptance procedure

Upon arrival of a transformer and its accessories everything should be closely inspected.

The following points should be checked:

- is there any damage to the crate or box?
- is there any rust or is the paint on the transformer or its accessories damaged?
- are the transformer tank or accessories damaged?
- are there any leaks?
- if the liquid level is visible: is it high enough?
- is the delivery complete? Check the number of transformers, the number of boxes of accessories and check that all accessories are fitted or present.
- check the information on the nameplate.

All deviations should be reported immediately to Pauwels Trafo Belgium N.V. If no report has been received within one week of arrival at the client's, we shall assume that the delivery arrived complete and in good condition.

In connection with the transportation insurance, the following procedure is applied in the event of damage:

- a) if no transportation by sea preceded transportation by land and you did not receive an insurance certificate:
 - ❑ declare the transport company liable by means of a comment on the delivery note and a registered letter
 - ❑ do what is necessary to limit the damage and to avoid additional damage
 - ❑ inform Pauwels Trafo Belgium N.V.
- b) if transportation by sea preceded transportation by land and/or you received an insurance certificate:
 - ❑ follow the instructions on the back of the insurance certificate carefully. Especially do not sign a "clean" proof of receipt, but record your reservations on these documents.
 - ❑ inform Pauwels Trafo Belgium N.V.
- c) in case of transportation by rail: have the authorised bodies at the station the delivery was collected from draw up a report.
This acceptance procedure must be repeated after each transportation stage, so that the origin of the damage can be established.

1.3. Storage of transformers

1.3.1. Preparation and checking of transformers before storage

- If an air breather is provided, it must be fitted and filled with dry (orange) silica gel. Fill the oil lock and fit it under the air breather. The liquid level is checked and, if necessary, liquid is added. For more information about this, see chapter 4 "Maintenance".
- Any damage to the paint is touched up. Contact Pauwels Trafo Belgium N.V. for the correct procedure.
- The transport protection (test button lock) is removed from transformers with a Buchholz relay.
- If an explosion vent is fitted, this is removed.

Storage is limited to 1 to 2 weeks. If it lasts longer than this, the expansion tank and, if provided, the air breather must be installed and the transformer must be filled or topped up with the liquid provided. Storage should preferably occur in a dry, ventilated area, unless the transformer is protected by a condensation-free cover.

1.3.2. Monitoring and checking of transformers during storage

Preferably only fully assembled, liquid-filled transformers are stored for a long period of time. The following checks must be carried out during storage:

- checking of the air breather, if fitted. The colour of the silica gel must be orange, the level of the oil lock must be checked.
- the transformer must be checked for leaks.
- check that there is no damage to the paint and that there is no rust.

If any defects are established, they should either be remedied immediately or Pauwels Trafo Belgium N.V. should be informed as quickly as possible.



1.3.3. Storage after taken out of operation

Before the transformer is stored, a full check as described in the “Acceptance procedure” paragraph should occur.

Responsibility for correct storage lies with the client.

Points to which attention should be paid:

- the possibility for the liquid to expand must be guaranteed.
- contact of the liquid with the air must be avoided.
- the transformer must always be stored filled with liquid.



2. Installing and connecting liquid-filled distribution transformers

During installation the following rules must be followed in order to ensure that the transformer operates correctly:

2.1. Installation

- a) The local regulations for installing liquid-filled transformers in buildings, on a pole, in a cabinet or in the open air must be followed to the letter in relation to, among others, fire safety, protection against leaking (sump or oil-catchment tank), accessibility, electrical regulations,...
- b) The place where the transformer is set up must be adequately ventilated in order to enable dissipation of the heat given off by the transformer. We are at your disposal to do relevant calculations and to explain the precautions to be taken. For distribution transformers set up in buildings or steel sheet substations this means that there must be a regular supply of fresh air from outside, that there is adequate ventilation and enough free space above the transformer.
- c) Oil sample plug, tap changer and any other operating and protection equipment must be easily accessible. Monitoring apparatus such as thermometers must be clearly visible and/or readable.
- d) Setting up the transformer completely parallel with a wall is not advisable as this can increase the noise. Anti-vibration pads under the wheels can reduce the transfer of the noise vibrations to the ground.
- e) The area in which the transformer is placed must be inaccessible to pets, birds, rodents, ...

We once again remind you that lifting the transformer by taking it under the cooling fins is absolutely forbidden. This will create leaks.

2.2. Connections

- a) Electrical and other connections.
Always ensure that connection of the cables and busbars to the bushings occurs without any tensile force being exerted on the bushings that can lead to leaking by the seals or cracks in the bushings.
A flexible connection is recommended in all cases. In this way, expansion of the conductors due to temperature differences cannot lead to leaks or cracks.



Torque values to be used:

- HV connection to brass bushing stem M12 – spanner size 19: 15-20 Nm
- LV connection to flag connector with
 - M10 bolts – spanner size 17: 25-35 Nm
 - M12 bolts – spanner size 19: 40-60 Nm
 - M16 bolts – spanner size 24: 100-150Nm
- Check torque for tightening flag connector on bushing
 - M10 bolts – spanner size 17: 25-35 Nm
 - M12 bolts – spanner size 19: 40-60 Nm

Other recommended torque values: see table in Annex 2.

When using plug connections on the HV, the manufacturer's directions should be followed completely.

Ensure that all connections have large, solid and clean contact surfaces. When making contacts between different materials, precautions should be taken to avoid electrolytic couples.

These connections can be made using cable lugs, flat busbars or adapted clamps. Each feeder conductor must have a sufficiently large section.

Whenever the transformer's HV and LV bushings are worked on, it must be ensured that the lower nut on the bushing remains in position. This ensures that the transformer remains sealed.

Use 2 spanners when tightening the other nuts on the bushing to prevent the bushing from twisting.

2.3. Earthing

The transformer tank must be connected to the HV earthing system. Therefore earthing bolts are fixed onto the cover, the roller carriage or the base of the transformer tank. The electrical resistance of the earthing terminal is usually specified by the power supply company. Ensure that the connection point is kept clean.

3. Putting into operation

After setting up and connecting the transformer the following steps must be carried out sequentially to put it into operation:

3.1. External check:

- ❑ Check that the various transport protection measures have been removed: Buchholz test button lock, air-breather plugs, seal in filler cap of expansion tank, polystyrene blocks in cooling fins, ...
- ❑ Check the ambient temperature and ventilation of the premises.
- ❑ Check for leaks, rust and damage; (check that the drain plug does not leak, that the sampling plug and any filter press valves are completely closed).
- ❑ Check the setting up and operation of the various accessories; dial plates of measuring apparatus and the colour of the silica gel in the air-breather, if present, must be visible and readable at a safe distance from the live parts.
- ❑ Check the colour of the silica gel (if applicable); the colour of the silica gel in the air-breather, if present, must be orange. If it is colourless, the silica gel must be dried or replaced.
- ❑ Check the liquid level via the oil level indicator (if applicable).
N.B.: Never fill a hermetically sealed transformer yourself as there may be overpressure or underpressure in the transformer tank.
- ❑ Check whether bushings, apparatus and control units are dirty. These must be clean; if they are not, they must be cleaned.
- ❑ Open HV and LV air-filled cable boxes:
check for condensation, water penetration and leaks.
- ❑ Check the compound level in the HV cable junction box (if applicable).
- ❑ Tighten all bushings and electrical connections, including those in the boxes, using a torque spanner; see chapter 2.2. "Connections".
- ❑ Check that the transformer is properly earthed.
- ❑ Remove all foreign objects from the conductors, from the cover and from the cable boxes. If the transformer is located in a distribution station or substation, all foreign objects must be removed from this area.
- ❑ If LV and/or HV are reconnectable, check that the connecting strips or change-over switches are in the correct position to form the required switch group and voltage.



3.2. Electrical measurements before putting into operation:

All transformers that leave the factory have been submitted to the routine tests and measurements in accordance with IEC 60076, a test certificate is drawn up and given to the buyer.

To electrically test the transformer again after transportation, setting up or installation, Pauwels Trafo Belgium N.V. specifies the following tests:

- a) An insulation test using a 2500 or 5000 Volt “Megger” (see Annex 1).
- b) A continuity test of the connections and windings.
- c) Checking of the auxiliary devices and accessories (correct operation, setting and checking of the contacts, cabling, checking of test equipment).

Attention: Never pressurise transformers to check the pressure valve and pressure relay.

3.3. Energising

Energising should be carried out by an authorised person and the locally applicable safety instructions should be followed closely.

Conditions for energising

The transformer should be initially energised without load and with the tap changer in the position equivalent to the rated no-load voltage. Measure the voltages between the LV phases themselves and to the earth. For safety reasons we strongly advise against measuring directly on the LV transformer terminals. If one or more of these voltages deviate from the rated no-load voltage, it can be adjusted (see procedure below). The transformer is left with no load for a few hours. During this period the temperature and liquid level – if visible – are checked regularly.

- The transformer may now run under load. A gradually increasing load with intermediate checks is advisable.
- Adjusting the low voltage.
If the voltage on the LV side both at no load and under load deviates from the rated value and this must be adjusted, the procedure is as follows:
 - de-energise the transformer at the HV and LV side and earth it properly;
 - unbolt the tap changer by lifting the knob;
 - change the tap changer to the desired position;
 - release the knob until the spring presses it down again and thus re-locks the tap changer.



Low voltage too high (must be decreased)

If the applied high voltage is higher than the rated transformer high voltage, this results in the low voltage being too high.

In this case the HV tap changer knob should be put in a position that corresponds to a high voltage that is higher than the rated high voltage (see nameplate).
The tap changer must be set at a lower position number.

Low voltage too low (must be increased)

If the applied high voltage is lower than the rated transformer high voltage this results in the low voltage being too low.

In this case the HV tap changer knob should be put in a position that corresponds to a high voltage that is lower than the rated high voltage (see nameplate).
The tap changer must be set at a higher position number.

Increasing low voltage (higher tap changer knob position number compared with reference value)

Decreasing low voltage (lower tap changer knob position number compared with reference value)

Example (see nameplate)

	Position no. tap changer	HV Volt	LV Volt	
	1	15,500		
	2	15,250		
Nom. pos.	3	15,000	400	Rated voltage
	4	14,750		
	5	14,500		



3.4. Parallel operation

When running in parallel, the transformers must satisfy the relevant regulations and conditions (including IEC 60076-1 and IEC 60076-8 Chapter 4). These are the following:

- a) Transformers must have the same clock-hour number. The winding connections may be different;
- b) Impedance voltages must be the same (a tolerance of maximum 10% is allowed);
- c) Rated voltages must be equal (both HV and LV); (see also item 'i' below)
- d) when continuously running in parallel, the power rating ratio must not exceed 3:1.

The information for the above conditions can be found on the nameplate.

Before switching to parallel operation, the following procedure must be followed:

- a) Connect the corresponding HV terminals;
- b) Connect the corresponding LV terminals;
- c) Execute a (preferably) common earthing on the transformer tanks;
- d) Connect the LV neutrals;
- e) Connect the transformers to the supply system at the HV side. The LV main switches must remain open;
- f) Check for any difference in voltage between the corresponding LV phases. The voltmeter should show no readings. If, however, there is a difference in voltage, the cause should be traced and remedied.
- g) If there is no difference in voltage between the corresponding LV terminals, the main lower voltage busbars may be energised at the LV side;
- h) Parallel operation of/with dual LV transformers (so-called seven bushing transformers) is advised against;
- i) If the tap changers are put out of their rated positions, make sure that the set HV values correspond (see nameplate).



If the above conditions are not satisfied, circulation currents can occur which can lead to damage to the transformer. For brief parallel operation (when switching over) this may be permitted. Consult IEC 60076-8.

We cannot be held liable for damage to transformers or electrical installations caused by wrong connections.



4. Maintenance

Hermetically sealed distribution transformers are basically maintenance free. Transformers with an expansion tank require little maintenance.

4.1. Annual external check

This maintenance check can be carried out while the transformer remains energised. Attention: keep a safe distance from energised (live) parts.

This type of maintenance comprises the following:

- ❑ Assessing the various noises coming from the transformer.
- ❑ Checking the ambient temperature and ventilation of the premises.
- ❑ Checking for leaks, rust and damage.
- ❑ Checking for dirt on the bushings, apparatus and control units.
- ❑ Checking the colour of the silica gel (if applicable).
- ❑ Checking the liquid level via the oil level gauge (if present).
- ❑ Checking the liquid temperature (if thermometer present); checking local temperature rises due to contact resistances on HV and LV connections (infrared temperature measurement, discolorations, ...).
- ❑ Checking the operation of the pressure relief valve (if present).

4.2. Two-yearly maintenance

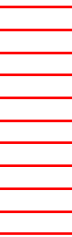
This type of maintenance should be carried out while the transformer is de-energised and earthed at the HV and LV sides. Do not forget to also switch off the auxiliary voltage for the accessories!

Two-yearly maintenance comprises the following:

- ❑ Performing the annual external check (see 4.1.).
- ❑ Remedying the comments from the yearly external inspection.
- ❑ Checking the compound level in the HV cable junction box (if applicable).
- ❑ Opening the HV and LV air cable boxes (if applicable), checking for condensation and water penetration.
- ❑ Checking the auxiliary devices and accessories (correct operation, setting and checking of the contacts, cabling, checking of test equipment).
- ❑ Checking the correct operation of the tap changer. The tap changer is tested whilst the transformer is de-energised by switching the tap changer into various positions and by measuring whether there is continuity in the internal connections.



We advise transformer users to adjust the above maintenance frequency if the transformers are located in severe climatological conditions and if the operating conditions allow or require a different frequency.





5. Liquid sampling and analyses

Analysis of the sample of cooling liquid enables us to determine the condition of the transformer liquid and can also give an indication of the condition of the windings, (tap changer) switch and internal connections.

Various liquid tests and analyses can be performed upon request.

Sampling should best be left up to qualified personnel.

The sampling procedure, described in standards IEC 60475 and IEC 60567, must be followed strictly.

After a sample of the liquid has been taken, the level must be checked and, if necessary, it must be adjusted by authorised personnel from Pauwels Trafo Belgium N.V..

Pauwels Trafo Belgium N.V. advises a 5-yearly liquid analysis for hermetically sealed transformer and a 2-yearly liquid analysis for transformers with an expansion tank. This can be adjusted if the results obtained indicate the necessity of this or if operating conditions allow or require it.

N.B.: never add silicone oil to mineral oil or mineral oil to silicone oil!



6. After Sales Service of Pauwels Trafo Belgium N.V.

For specialised work we advise you to use the After Sales Service department of Pauwels Trafo Belgium N.V. They have the qualified personnel and the necessary equipment to do this perfectly.

Included in specialised work are, among others:

- replacement of bushings, appliances and monitoring equipment
- opening the transformers (transformer can be under overpressure or underpressure!)
- handling and replacing the cooling liquid
- sealing off transformer tank leaks
- carrying out electrical measurements and their interpretation
- interpretation of analyses of liquid samples.

End of life span

The transformer is constructed in such a way that the different components can easily be recycled at the end of its life span.

However, the components can only be recycled after the cooling liquid has been drained. The latter should be done with great care.

The indicative relation between the different transformer materials is the following:

- | | |
|---|-----|
| <input type="checkbox"/> oil | 25% |
| <input type="checkbox"/> core material | 35% |
| <input type="checkbox"/> winding material (copper and/or aluminium) | 15% |
| <input type="checkbox"/> steel | 20% |
| <input type="checkbox"/> insulation material | 5% |

The insulation material is to be regarded as non-toxic waste.
The transformer does not contain any PCBs nor asbestos.

During office hours the After Sales Service can be reached on the following telephone and fax numbers:

- phone + 32 15 283 410 / 283 412 / 283 414
- fax + 32 15 200 129 / 283 300

Outside office hours, in the event of emergencies, this service is available via the general telephone number of Pauwels Trafo Belgium N.V.: + 32 15 283 333



7. Accessories

At the customer's request the transformers can be fitted with a large variety of apparatus and control equipment.

More information on this (description, operation, ...) can be found on the PK sheets which are available upon request.

<u>Documentation:</u>	(list not complete)	
Valves/taps	Oil drain/sampling tap A22 DIN 42551	PK 3835
	Sampling valve NW 15	PK 3812
Temperature	Dial thermometer 2 contacts	PK 3544
	Dial thermometer without contacts	PK 3849
	Distance thermometer 2 contacts	PK 3546
	Thermostat 2 contacts	PK 3611
	Thermostat 1 contact	PK 3612
Liquid level gauges	Magnetic oil level 1 1/2"	PK 3519
	Level gauge expansion tank DIN 42555	PK 3511
	Oil level gauge PTI	PK 3514
	Oil level indicator 1" (floating type)	PK 3527
Pressure	Pressure relief valve 1"	PK3735
	Pressure relief relay 2 contacts	PK3733
Expansion tank	Buchholz relay BG 25, 2 contacts	PK3710
	Air dryer DIN 42567 A	PK3750
		PK3751
	Vent/filling opening of expansion tank	DIN 42553
Other	DGPT 2	PK 3760
	Hermetik Schutz	PK 3520
Bushings	DIN bushings 1 kV DIN 42530	PK 3410
	DIN bushings 3 kV DIN 42539	
	DIN bushings 10-30 kV /250 A DIN 42531	
Connectors for terminal studs	DIN 43675	
Current carrying connections up to 1600 Amp	DIN 46200	
Plug-in bushings	EN 50180	



8. Standards

For more information on transformers in general you can have a look at the following IEC and CENELEC standards:

IEC 60076 Power Transformers

- IEC 60076-1 : General
- IEC 60076-2 : Temperature rise
- IEC 60076-3 : Insulation levels, dielectric tests and external clearances in air
- IEC 60076-5 : Ability to withstand short-circuit
- IEC 60076-8 : Application guide (used to be IEC 606)
- IEC 60076-10: Determination of sound levels (used to be IEC 551)

IEC 60354 Loading guide for oil-immersed power transformers

IEC 60616 Terminal & tapping markings for power transformers

IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear

IEC 60422 Supervision and maintenance guide for mineral insulating oils in electrical equipment.

IEC 60475 Method of sampling liquid dielectrics

IEC 60567 Guide for the sampling of gases and of oil from oil-filled electrical equipment and for the analysis of free and dissolved gases

IEC 60599 Mineral oil-impregnated electrical equipment in service - Guide to the interpretation of dissolved and free gasses analysis

IEC 60836 Specifications for silicone liquids for electrical purposes

IEC 60944 Guide for the maintenance of silicone transformer liquids

EN 60076 Identical to IEC 60076

EN 50180 Bushings above 1kV up to 36kV and from 250A to 3150A for liquid-filled transformers

HD 398 Identical to IEC 60076

HD 428 Three-phase oil-immersed distribution transformers 50Hz, from 50 to 2500kVA with highest voltage for equipment not exceeding 36kV

HD 596 Bushings up to 1kV and from 250A to 5kA for liquid-filled transformers



Annex 1: Insulation resistance measurement (Megger test)

The Megger test measures the insulation resistance between the windings themselves and between the windings and the earth. Any short-circuit to the earth or low insulation resistance due to the presence of water in oil and windings or because of a high tangent delta of the oil can be detected in this way.

The following points should be observed when carrying out this measurement:

- ❑ completely remove HV and LV connections/couplings
- ❑ clean the bushings
- ❑ carry out the measurement in dry conditions (no rain, fog, snow,...)
- ❑ carry out the measurement by measuring directly from the transformer terminals
- ❑ after each measurement the transformer should be discharged (extremely dangerous capacitive voltage!)
- ❑ the transformer tank must be correctly connected to the earth

Measuring procedure:

3 measurements are carried out, preferably with an electronic megger.

For use and settings of the measuring device and to read (**) the scale values: consult the appropriate manual.

1. HV to earth with 5000 or 2500 Volt (*)
2. LV to earth with 2500 Volt (*)
3. HV to LV with 5000 or 2500 Volt (*)

(*) The voltage applied during megger testing must never exceed the test voltage of the transformer.

(**)value should be read when the meter needle is stable.

Measurement may be carried out on any HV and LV phase as the three phases are interconnected internally.

If the values measured are less than **10 MOhm / kV**, the cause must be established.

For example: for a transformer with a rated high voltage of 15 kV the values must be minimum $10 \times 15 = 150$ MOhm (also for the low voltage).



Annex 2: Recommended torque values in Nm for various connections

Thread size	M6	M8	M10	M12	M16	M20	M30	M42	M48
Spanner size	10	13	17	19	24	30	46	65	75
A) Bushing insulators									
Low voltage (LV) DIN 42530									
				250A		630A	1000A	2000A	3150A
1. Fixing of bushing terminal stud:									
cork gasket				10-15Nm		25-55Nm	65-150Nm	100-300Nm	150-500Nm
buna gasket				7-10Nm		17-37Nm	44-100Nm	67-200Nm	100-334Nm
2. Connection between nuts				15-20Nm		70-100Nm	250-350Nm		
3. Fixing of flag connector to terminal stud (bolt and nut in stainless steel)			25-35Nm	40-60Nm					
4. Bolts to flag connector surface			25-35Nm	40-60Nm	100-150Nm				
High Voltage (HV) DIN 42531									
1. Fixing of top of terminal stud (terminal stud and nuts in brass)				10-15Nm					
2. Connection to terminal stud (terminal stud and nuts in brass)				15-20Nm					
3. Fixing of base (stud and nut in stainless steel)									
cork gasket			10-20Nm	20-35Nm					
buna gasket			10-15Nm	15-25Nm					
Plug-in bushing									
cork gasket			10-20Nm						
buna gasket			10-15Nm						
B.) LV connecting busbar									
Interconnection (pin and nut in 8.8 steel)			45-60Nm	65-85Nm	95-130Nm				
C.) Cover / frame									
Bolt and nut in stainless steel (pitch = 60mm) = cork gasket		20-25Nm		40-60Nm					
(pitch = 90mm) = buna gasket		20-25Nm		40-60Nm					
D) Busbar bushings									
Fixing on cover		8-15Nm							
Top piece onto bottom piece	5,4-6Nm								

Max. Value: applied torque

Min. Value: checking torque

(If the torque that you measure is lower than Min. Value → re-apply Max. torque Value)



Checking recommended torque values is required

- when setting up/installing the transformer
- when connecting the transformer to the HV / LV connectors
- when carrying out maintenance work

We recommend to re-apply Max. torque Value 4 weeks after replacement of the seals.