Instructions for

Receiving, Installing, Operating and Maintaining
Dry Type, VPI Transformers

Hammond Power Solutions

CONTENTS

However, the supplier assumes no responsibility for its use or misuse and warns the reader to exercise caution in the installation and maintenance of the products described herein.

These instructions do not propose to cover all details or variations in equipment, nor to provide for every contingency to be met in connection with installation, operation or maintenance.
Should further information be desired, or particular problems arise which are not covered, please contact the factory.

PLEASE READ ENTIRE DOCUMENT BEFORE FOLLOWING ANY PART OF IT

1 - SAFETY INDICATIONS

SAFETY PRECAUTIONS

Do not lift or move a transformer without proper equipment and experienced personnel.

Do not off-load the transformer until a full inspection has been completed.

Use terminals only for electrical connections and flexible connectors are recommended.

Connections should only be in accordance with nameplate diagram or connection drawings.

Make sure all power is disconnected before attempting any work on a transformer.

Make certain all ground connections are complete and tightened before energizing the transformer.

Do not attempt to change any taps - primary or secondary, while the transformer is energized.

Do not change connections when a transformer is energized.

Do not tamper with control panels, interlocks or control circuits.

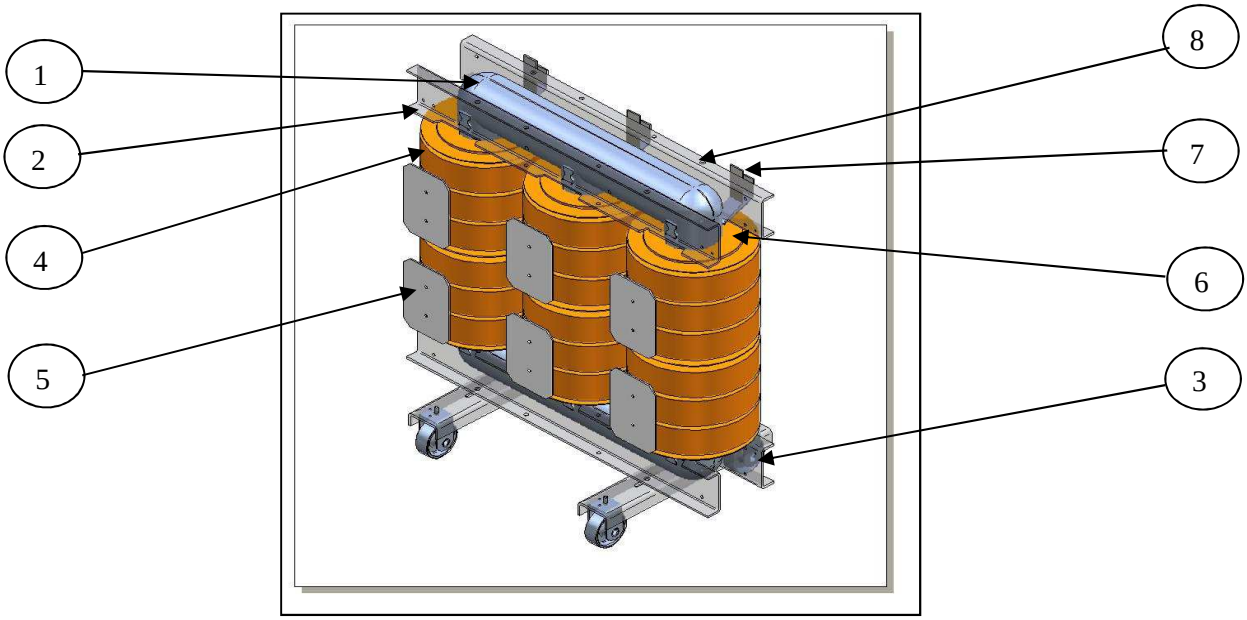
Do not adjust or remove any accessories or cover plates while the transformer is energized.

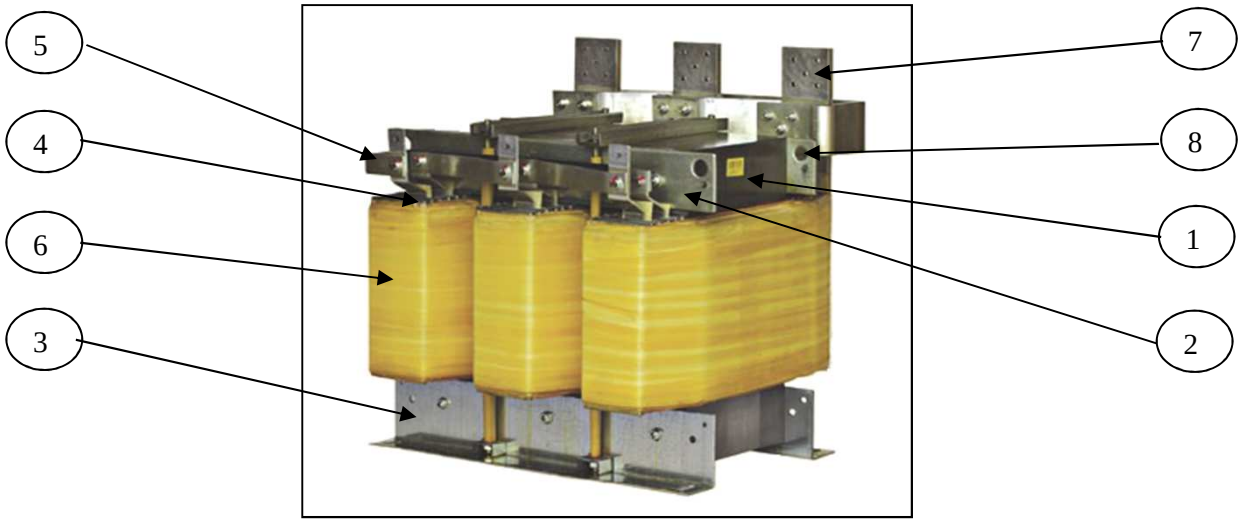
2 - GENERAL INFORMATION

HPS S.p.A. electrical transformers and reactors are manufactured to provide optimum performance for lifetime of uninterrupted service.

Careful attention to the following instructions is recommended for safe and reliable operation.

As with any electrical device, transformers and reactors must be installed according to the requirements of international IEC code or other codes on request.





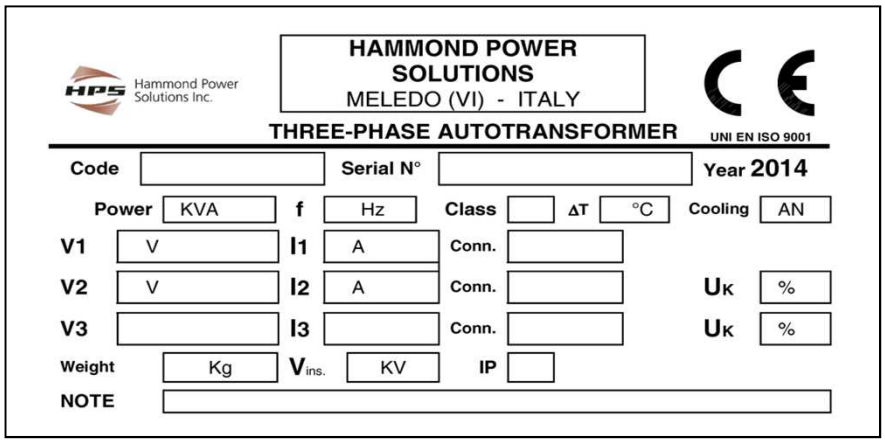
1 - Laminated steel core
2 - Top fixing clamp
3 - Bottom fixing clamp
4 - HV winding
5 - HV connection
6 - LV winding
7 - LV connection
8 - Lifting eye bolts

3 - RATING PLATE

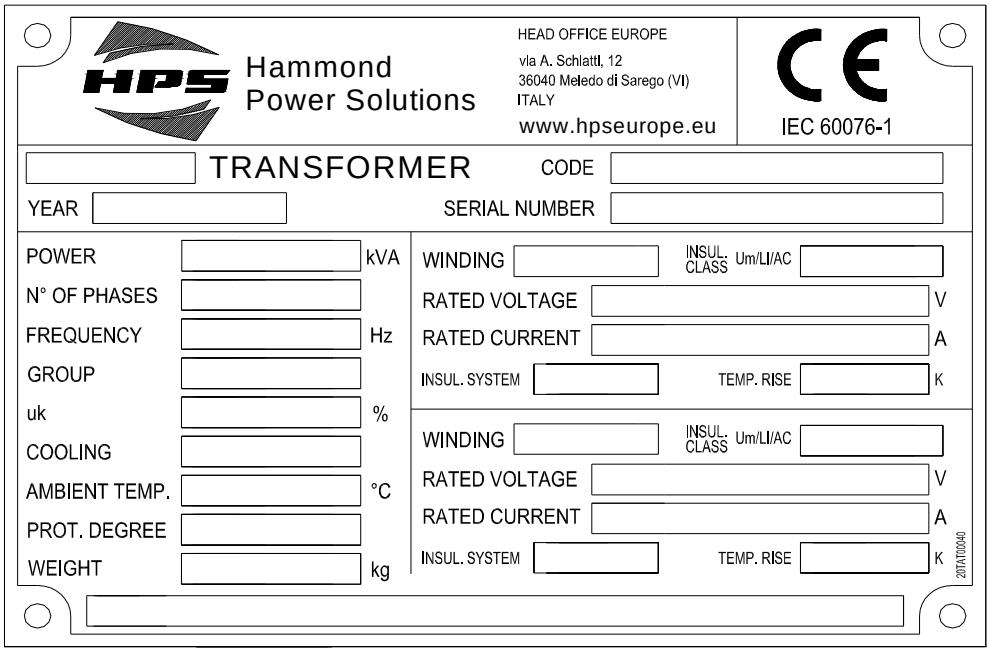
Every transformer produced by HPS S.p.A. has a label that shows the rating value of the transformer.

Two types of labels are available:

A - Paper label for < 400kVA power transformers



B - Steel label for >400kVA power transformer and transformer with steel enclosure



3.1 - Check the condition for correct operation of the transformer

Before the installation of the transformer check the nameplate for the values below on the label:

- ☐ Connection of the terminals
- ☐ Ambient temperature where the transformer is installed
- ☐ Rated power
- ☐ Rated voltages
- ☐ Rated input and output current
- ☐ Notes

4 - RECEIVING, STORAGE AND TRANSPORT

4.1 - Inspection and acceptance

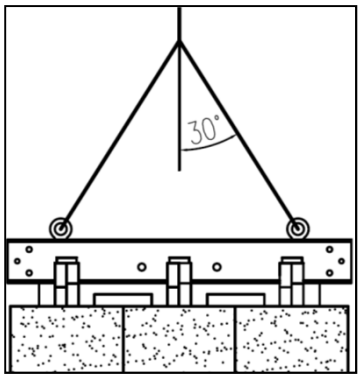
It is very important that you thoroughly inspect each unit prior to its acceptance and removal from the carrier's vehicle.

For your convenience, below is a representative checklist area which should be checked prior to acceptance from the freight carrier:
If applicable, is there any damage to enclosure parts like packaging or metallic box
☐ Does the nameplate serial number agree with the packing list and Bill of Lading identification?
☐ Does the unit show any damage due to mishandling? Check for LV bars, HV connections, broken insulators, cracks in the HV windings, dirt or humidity, protective enclosure damage, foreign objects between the windings, etc.
Are the accessories damaged in any way?
☐ Winding temperature indicator (if applicable)
☐ Fan motors and blades (if applicable)
☐ Dampeners with its shipping protection bolt

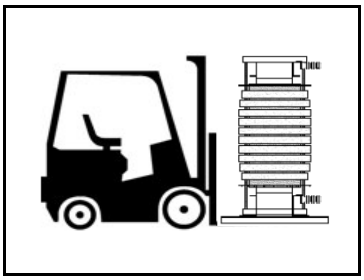
If damage is detected or shortages are noticed, write a brief description on the Bill of lading and contact HPS S.p.A. by fax or by registered mail within the time declared in the conditions of supply from receipt of the transformer.

4.2 - Lifting the transformer

All the HPS S.p.A. transformers and reactors must be lifted only by the method shown below:

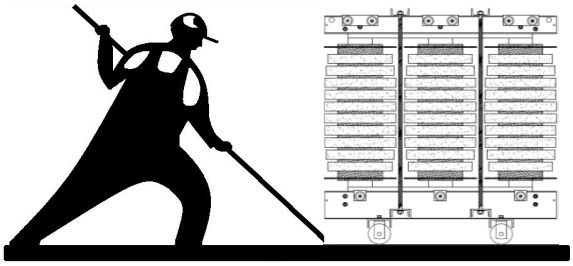


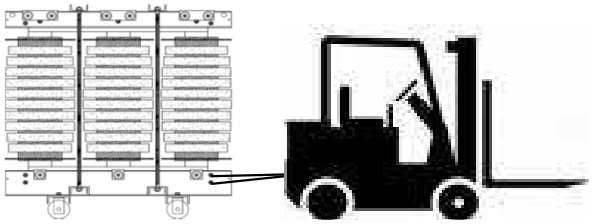
WARNING
Use all the eye bolts or lifting holes available in the upper side of the transformer. Do not allow the angle between the lift cables to exceed 30+30 = 60 degrees



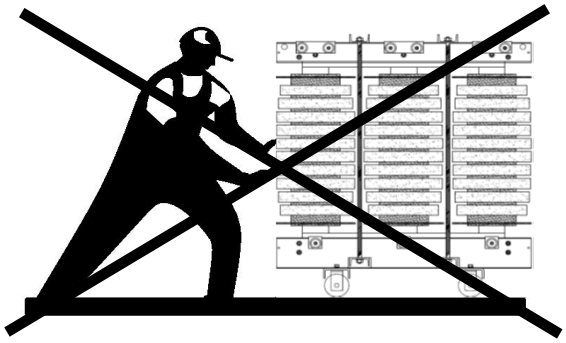
WARNING
Handle the transformer only in upright position Care during lifting to prevent tipping over of the transformer

4.3 - Moving the transformer (only if wheels provided)



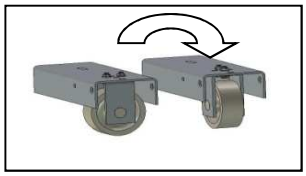


Never try to move the transformer by pushing or pulling on the windings



Move the transformer, whether alone or enclosed in an integral sheet metal box, by leverage against lower clamps or by means of its towing holes only.

The unit can move in two directions only, depending on how the rollers are oriented.



4.4 - Storage

If not installed immediately, the transformers must be kept in the original packaging.

Characteristics of the storage place:

- Free from metallic particles and corrosive gasses and vapors.
- Dry to prevent moisture.
- Free from dust and dirt.
- Flat surface.
- Temperature should not be lower than –25°C.

5 - INSTALLATION

Characteristic of installation place:

- Clean and flat surface.
- Clean and dry air free from dust.
- Without any risk due to the presence of flammable or explosive substances.
- Free from corrosive gasses and vapors
- Free from moisture.
- Max altitude: 1000 m

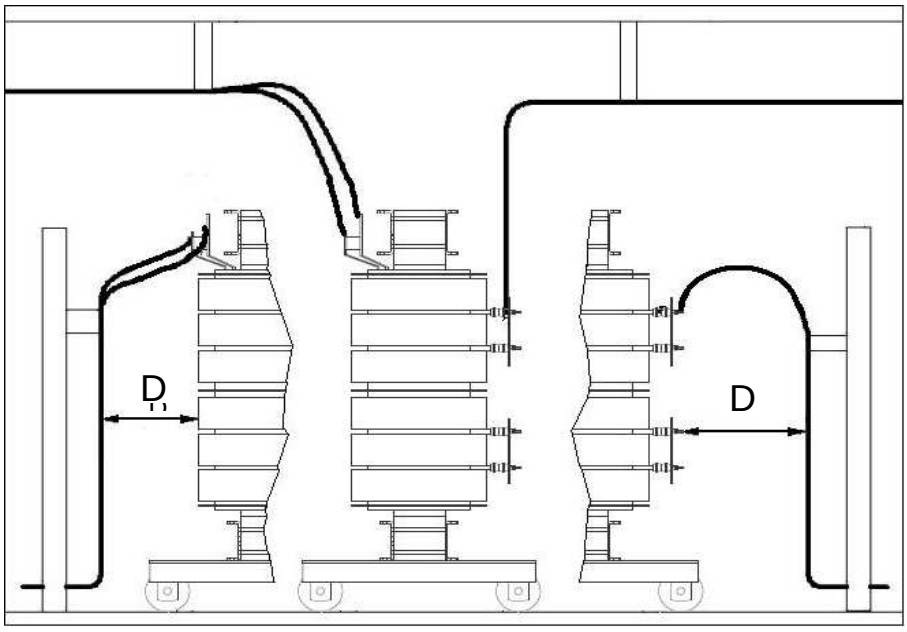
The standards require that the transformers be accesible for inspection and located accordingly.
However, transformers should not be located in areas where stored items are likely to interfere with either natural air convention or the capability to have them inspected.
Passage ways or other areas where people could be exposed to live parts during inspection should also be avoided.

5.1 - Installation guide

The following picture offers some examples of both upper and lower connections.

The connecting cable or busbar must always be:

- Fixed in a solid structure to not have mechanical forces on the transformer connections
- The distances shown in the table below:



CEI EN 60076-3	
kV	D (mm)
≤ 1,1	≥ 0
≤ 3,6	≥ 60
≤ 7,2	≥ 90
≤ 12	≥ 110
≤ 17,5	≥ 170
≤ 24	≥ 210

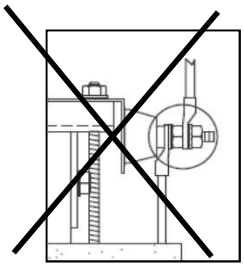
5.2 - Connections

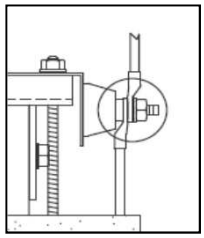
All connections should be made without placing undue stress on terminals. Connectors should be securerly fastened in place and adequately supported with allowances for expansion and contraction.

Connection with cables

The cable connection should be done with tinned-copper cable terminals. For high current, connect one or more cables per hole.
The bolts used for connection are usually brass bolt directly connected to the end of winding.
Do not replace the brass bolts with bolts of a different material: it could alter the connection.

Incorrect wiring



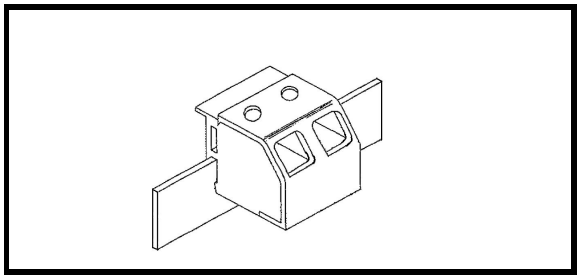


Correct wiring

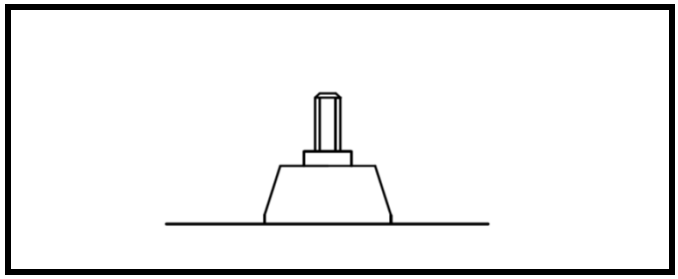
Connection with busbar

When connecting the aluminium bars to copper bars, causing a direct connection between copper and aluminium, it is necessary to use CUPAL intermediate plates

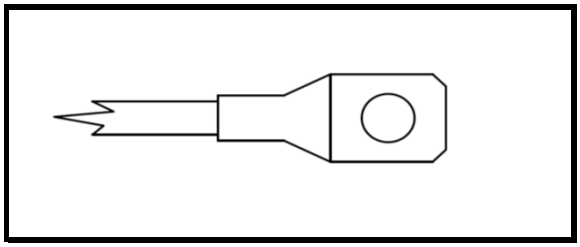
HPS S.p.A. electrical transformer can be designed with many types of connections, depending on the current value and the customer request.



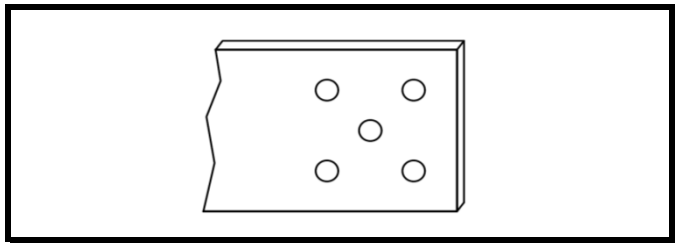
Low current clamps



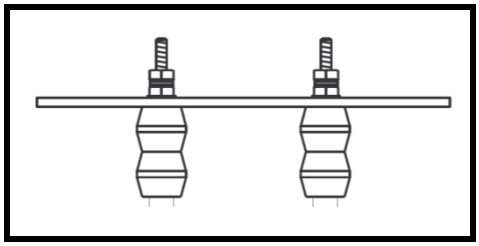
High current clamps



Lug connection



Busbar connection



Bolted connection

5.3 - Tightening torque for electrical and mechanical connections

Block and/or tighten both the electric and mechanical connections in accordance with the following values

When making cable connections or changing taps, always use two wrenches for tightening or loosening bolted connections to prevent distortion or damage.

	Electrical connection		Mechanical connection	
	[Nm]		[Nm]	[mm]
Screw / Bolt	Steel	Brass		
M 6	10 - 15	5 - 10	20	10
M 8	30 - 40	10 - 15	35	13
M 10	50 - 60	20 - 30	45	17
M 12	60 - 70	40 - 50	60	19
M 14	90 - 100	60 - 70	100	22
M 16	120 - 130	80 - 90	150	24
M 18	-	-	200	27
M 20	-	-	270	30
M 22	-	-	360	32
M 24	-	-	460	36

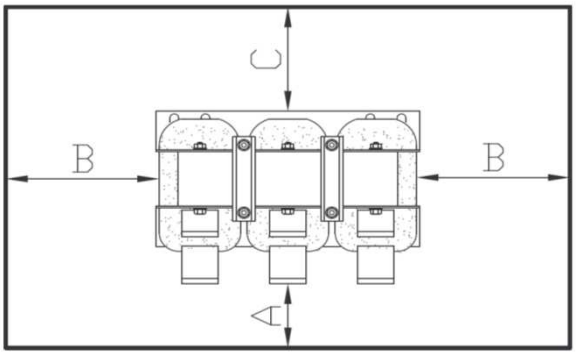
5.4 - Positioning

The IP00 transformers do not assure contact insulation.
It is absolutely forbidden to touch the coils while the transformer is energized.

Distance between a wall to the transformer without enclosure.

CEI EN 60076-3

kV	A (mm)	B (mm)	C (mm)
≤ 1,1	≥ 20	≥ 20	(*)
≤ 3,6	≥ 60	≥ 40	(*)
≤ 7,2	≥ 90	≥ 40	(*)
≤ 12	≥ 110	≥ 60	(*)
≤ 17,5	≥ 170	≥ 80	(*)
≤ 24	≥ 210	≥ 120	(*)
≤ 36	≥ 280	≥ 200	(*)

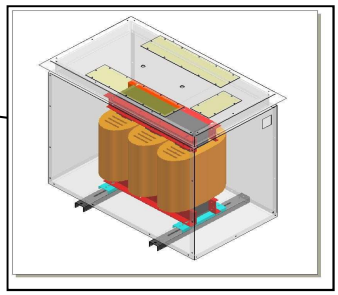


(*) If the connections are:
- only on side A than: C = B
- on the side A and side C than: C = A

Distance between a wall to the transformer with enclosure

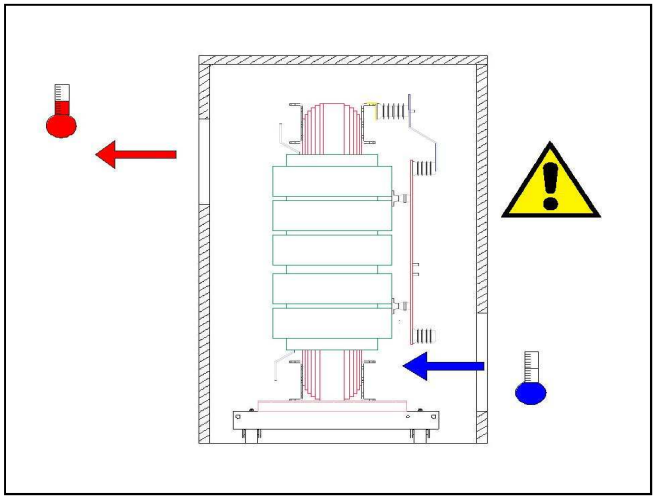
- For ventilation: the correct air flow on the enclosure must be guaranteed (see 5.5)
- For accessibility: the space to disassemble a lateral panel of the enclosure must be guaranteed

Lateral side panel



5.5 - Ventilation

Dry-type general purpose transformer are cooled by free circulation of surrounding air.
The air has to enter at the bottom, flow upward over the core and coil surfaces, and exit through the openings near the top.
The transformers will carry full-rated loads continuously when the surrounding air does not exceed what is written on the label



Characteristics of cooling air:

- ☐ Dry
- ☐ Clean
- ☐ Free from dust
- ☐ Free from acid vapor and gasses
- ☐ Free from metallic particles

As air should flow on cooling surfaces, and inlet and exhaust openings should be correctly dimensioned. Should the air flow be inadequate, the transformer would experience anomalous heating, which could cause the thermal protection system to trip.

Flow of air needed from the transformer that have been guaranteed

3,5 ÷ 4 m³ of air per minute every one kW of total losses

These values must be guaranteed for the box installation.
If these values can't be respected, install a fan assembly

Example:
Transformer 500KVA 400V-400V

No load losses	0,993	kW	
On load losses (at 120°C)	6,914	kW	
Total losses (at 120°C)	7,907	kW	
Minimun flow of air needed	7,907 x 4 =	**32**	m³ per minute of air needed

5.6 - Overvoltages

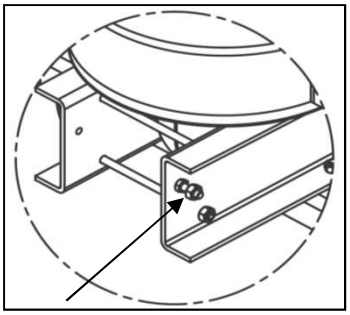
In the case that the transformer is exposed to over-voltages or over-load due to atmospheric events, the operation of circuit breakers or other causes, appropriate surge arrestors, fuses or circuit breakers for the insulation level are necessary.

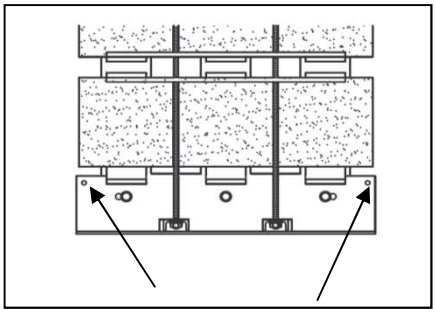
6 - COMMISSIONING

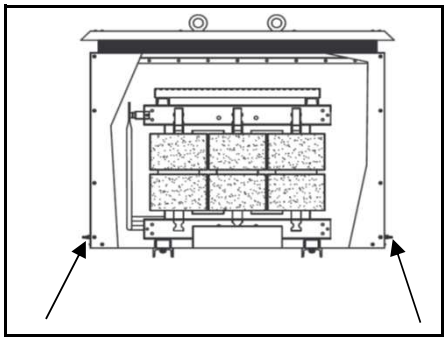
Final activities and inspection prior to energization

6.1 - Earth Connection

Earth cables have to be designed according to the fault current calculation.







6.2 - Cleaning

If the transformer has been stored for a long period, clean it thoroughly.
Clean the HV and LV windings from dust deposits, dirt and condensation. Use a vacuum cleaner to avoid dispersion of dirt and dust on the transformer. Do not use liquid cleaners.

6.3 - Electrical inspection check list

- ☐ All external connections have been made properly (Phasing of connections to terminals, etc.)
- ☐ All connections are tight and secure.
- ☐ All accessory circuits are operational.
- ☐ All tap connections are properly positioned.
- ☐ The neutral and ground connections have been properly made.
- ☐ Fans (if supplied) are operational.
- ☐ Proper clearance is maintained from high voltage and low voltage bus to terminal equipment.
- ☐ All windings are free from un-intended grounds.

6.4 - Mechanical inspection check list

- ☐ There is no dust, dirt or foreign material on the core and coils.
- ☐ There is no visible moisture on or inside the core and coils or enclosure.
- ☐ All plastic wrappings are removed from the core and coils.
- ☐ All shipping members have been removed.
- ☐ There are no obstructions in or near the openings for ventilation.

6.5 - Energizing

After checking the installation and ensuring that no object/tool has been left on the transformer, it is possible to close the circuit breaker. After energizing the transformer from the supply, close the circuit breaker, applying the load on the transformer.
Fuses and circuit breakers have been chosen with timed opening time to prevent unwanted openings, especially in the energizing of the transformer (I inrush = 20x I rated for 0,3 s).

6.6 - Sound level

The audible sound produced by transformers is due to energizing of the core by the alternating voltage applied to the windings.
This creates vibrations whose fundamental frequency is twice the frequency of applied voltage.
The audible sound will be present even under no load conditions.

Average sound level for transformers without metallic enclosure (reference CEI 14-12):

Power [KVA]	**Average sound level** [dB]
0 - 100	59
101 - 160	62
161 - 250	65
251 - 400	67
301 - 500	68
401 - 630	70
631 - 1000	73
1001 - 1600	76
1601 - 2500	81
>2500	Not classified

The decibel values referenced here represent average values obtained in a sound laboratory per industry standard test procedures.

Decibel values obtained in field-testing are unreliable and can be as much as 10 to 15 dB higher than actual test lab values due to a variety of circumstances beyond the control of the transformer manufacturer.

In most cases, transformers returned for noise actually meet the standard values when re-tested in a laboratory.

Causes of sound increase:

- Higher than rated voltage being applied to transformer windings. Must be measured with true RMS meter to see harmonics.

- Breaking dampeners (if provided) or shipping braces not removed.

- Flexible conductors not mounted.

- Transformer enclosure panels not properly tightened.

- Improper location of transformer: mount the transformer as far away as possible from corners, wall or ceilings.

- Transformer installed on suspended floors.

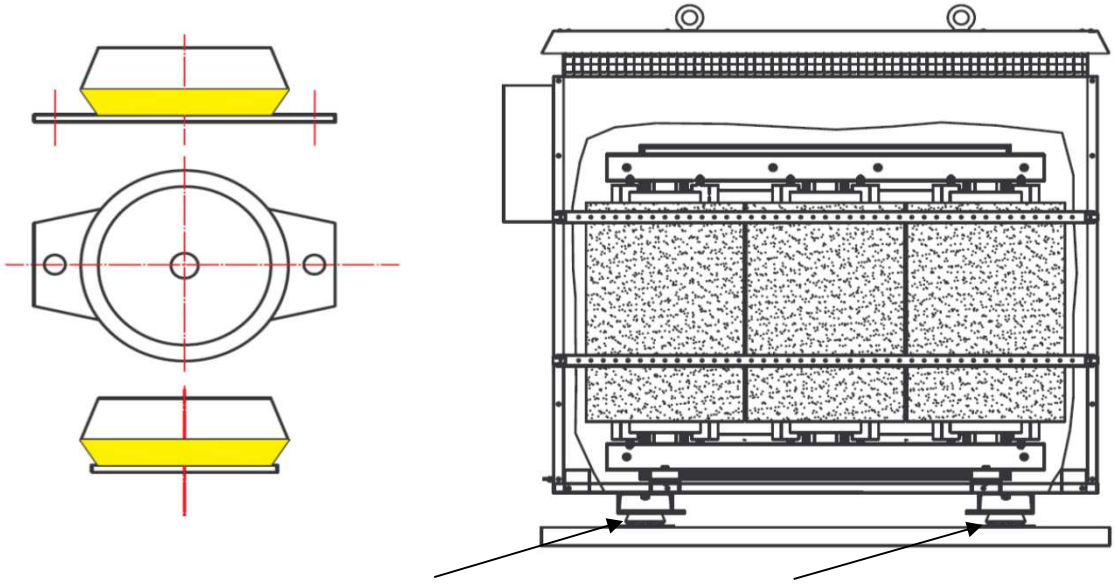
- Current or voltage harmonics that are not declared.

- Transformers installed in close proximity to each other.

6.7 - Anti-vibration mountings

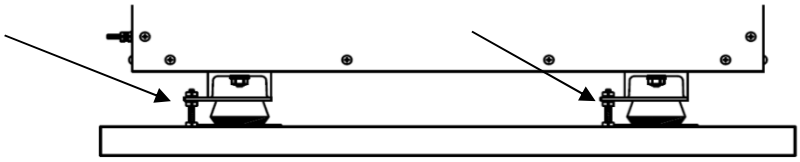
For specific installation, if required, to have the highest noise reduction, the transformers can be installed with anti-vibration mountings.

The used anti-vibrating supports have been manufactured by vulcanizing rubber to the metal for obtaining the maximum result during the period of use in the various field applications with cut or compression stress.
The internal and external metallic parts in steel are zinc-plated to protect the rubber from the Ozone, UV rays, or oil which damage the rubber.



WARNING

- After the definitive positioning of the transformer, remove the protective screws;



- Do not increase the weight of the transformers because the anti-vibration mountings are chosen for the original weight:

- The antivibration mountings have to be positioned on a horrizontal surface during the shipment and the final position. Check if all the anti vibration mountings of the transformer have the same vertical deformation.

7 - MAINTENANCE

Under normal operating conditions and environments, HPS S.p.A. transformers do not require maintenance.

However, periodic care and inspection is a good practice, particularly if the unit is exposed to extreme environmental conditions.

7.1 - Suggested maintenance and control activities

Item	*CONTROL*	*FREQUENCY*	*INSTRUMENT TO BE USED*	*ACTIVITY*
1	Function of the temperature sensors. PT100 / PTC	Yearly / when needed	Tester	Electrical continuity
2	Monitoring device	Monthly / after exceptional events	-	Function check according to manufacturers instructions
3	Cleaning of dust, dirt, possible foreign materials on the windings	Every 6 months / when the transformer is de-energized	Clean, dry compressed air, max pressure 3 bar. Dry wiping rags	The ventilation gaps between the windings must be completely clean and open
4	Moisture on the windings	After a period not in use with no applied voltage	Oven / method of heating in short circuit	Drying at 80°C
5	Tightening of the bolts for delta/star	Yearly / when needed	Torque wrench	Tightening torque according to paragraph 5.3
6	Insulation between windings and earth	After a period not in use with no applied voltage	Mega-ohmmeter (Megger) with voltage more than 1000 V	LV against earth: min 2 Mohm HV against earth: min 1 Mohm per rated kV HV against LV: min 1 Mohm per rated kV Should the value be lower, contact HPS S.p.A.
7	Correct matching core, windings	After exceptional events (shock or a short circuit, etc.)	Steel tape rule or similar	Geometric matching of the windings

7.2 - Guide for trouble-shooting

SYMPTOM	*CAUSES*	*CHECKINGS AND ACTIONS*		
Electric circuit				
Windings overheating	Continuous overload; wrong external connections; poor ventilation; high air temperature; damaged or improperly directed fan blades; high harmonic or unbalanced loads.	Rated characteristic Ventilation Transformer connection	See See See	3.1 5.5 5.2 - 5.3
Reduced or zero voltage	Loose primary connections	Transformer connection	See	5.2 - 5.3
Excessive secondary voltage	High input voltage; Improper primary connections.	Rated characteristic	See	3.1
Unbalanced secondary voltages	Overload; connections not identical tap positions; neutral ungrounded.	Rated characteristic	See	3.1
Insulation failure	Continuous overloads; dirty accumulations on coils; mechanical damage in handling; lighting or switching surges.	Rated characteristic Cleaning Handly Overvoltage	See See See See	3.1 7.1 4.2 - 4.3 5.6
Breakers or fuses opening	Breaker or fuse with no delayed opening; short circuits; overload	Rated characteristic Protection device	See See	3.1 6.5
Excessive cable heating	Improperly bolted connection; incorrect cable size for load; incorrect cable routing.	Transformer connection Ventilation	See See	5.2 - 5.3 5.5
Magnetic core				
Vibration and noise	Low frequency of voltage input; high input voltage; core clamps loosened in shipment/handling; improper tap connection; installation on suspended floors or close to reflective wall; connection with no flexible conductors	Rated characteristic Mechanical connection Sound level causes	See See See	3.1 5.3 6.6
Overheating	High input voltage; improper loads; harmonics; dirty core.	Rated characteristic Maintenance	See See	3.1 7.1
High no load current	Low frequency; high input voltage.	Rated characteristic	See	3.1
Dielectric materials				
Smoke	Excessive varnish could burning clear on first start-up that may cause smoke. This is not a problem for the transformer but if the smoke don't stop, an insulation failure could be occurs.			
Burned insulation	Lighting surge; switching/line disturbance; excess dirt or dust on coils.	Overvoltage Maintenance	See See	5.6 7.1
Overheating	Clogged air dust or inadequate ventilation.	Ventilation	See	5.5

7.3 - Customer Care

For more information or spare parts, please do not hesitate to contact our customer service.
Call +39 0444 822000 or send an e-mail to: info@hpseurope.eu

Do not forget the registration number of your transformer.

7.4 - Warranty

HPS S.p.A. makes no warranties, express or implied, whether of merchantability, fitness for a particular purpose, performance otherwise, except as follows:

HPS S.p.A.'s obbligation under this warranty shall be limited to repair or replacement of parts proven within the warranty period to have been defective the time of shipment.

Upon discovery of any such defects, the purchaser shall promptly notify HPS S.p.A. thereof and, if requested by HPS S.p.A. return the defective parts to HPS S.p.A.

The purchaser shall be responible for all expense of removal, freight and reinstallation in connection with repairs or replacement of defective parts.

In no event will HPS S.p.A., be responsible for or reimburse purchaser for repairs or replacements made by others. In no event and under no circumstances shall HPS S.p.A. be liable for loss of anticipated profits or for interruption of operations for any special, incidental or consequential damages whatsoever.

CONSULT FACTORY FOR SPECIAL CONDITION AND APPLICATIONS

HAMMOND POWER SOLUTIONS S.p.A.

Via Angelo Schiatti 12
36040 Meledo di Sarego (VI) Italy
tel: +39 0444 822000
fax: +39 0444 822010

Service department e-mail: info@hpseurope.eu
www.hpseurope.eu