1LKR600002NMA

INSTRUCTIONS MANUAL

Vacuum Cast Coil Dry Type Distribution Transformers

The reliability in your hands.

Dear client:

You have acquired an ABB Power Technology encapsulated dry-type transformer of proven quality that offers the following advantages:

- Good resistance to short-circuits
- Low flammability
- Self-extinguishing
- Unaffected by humidity
- Great thermal inertia
- Minimum partial discharges
- Compact design
- Lower installation costs
- Low maintenance

PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE PUTTING THE TRANSFORMER INTO OPERATION

Pictograms

Various pictograms are used in this documentation of the en-capsulated dry-type transformer, to draw attention to safety requirements or other important information.

Danger

This symbol introduces a prohibition or a rule. Failure to comply can cause bodily injuries, death and/or severe damage to the plant.

Caution

This symbol introduces a warning or a rule. Failure to comply can cause damage to the plant or impair its function.

Attention

This symbol indicates important health and safety advice

CONTENTS

1. DESIGN, MANUFACTURE AND TESTING

The dry-type transformer whose test record sheet is enclosed, is manufactured by ABB Power Technology and has been designed and built to meet the compulsory **Standards** stipulated by the **High Voltage Electro technical Regulations** in force on the date of its manufacture as well as complying with the client's specifications.

In order to check the above, the following tests have been carried out:

1.1 Individual or routine tests

	STANDARDS	
	IEC	**ANSI/IEEE**
Measurements of windings resistances	60076-1	C57 12.91
Transformation ratio measurement and connection checking	60076-1	C57 12.91
Load loss and short-circuit impedance measurements	60076-1	C57 12.91
No load loss and current measurements	60076-1	C57 12.91
Separate source voltage-withstand test	60076-3	C57 12.91
Induced over voltage withstand test	60076-3	C57 12.91
Partial discharges measurements	60076-11	C57 12.91

1.2 Standard and special tests.

Other tests such as standard and special tests can be carried out in the ABB Power Technology test laboratory. These tests are normally carried out to check the quality in design and process changes. They can also be performed on order when requested by our clients.

These tests are:

STANDARDS

	IEC	ANSI/IEEE
Temperature rise test	60076-11	C57 12.91
Lightning impulse test	60076-11	C57 12.91
Sound Level measurement	60076-10	C57 12.91

Some of the special tests that we can carry out at our facilities are:

-Measuring zero-sequence impedance.
-Measuring insulation resistance.
-Measuring of harmonics of the no-load current.
-Measuring of the dissipation factor (tag. δ) of the insulation resistance capacitances.
-Anti-corrosion protection measurement.

These tests are carried out in accordance with the relative IEC, IEEE, ANSI standards and the internal test procedures at the disposal of our clients.

2. CERTIFICATES AND HOMOLOGATION. QUALITY POLICY

2.1 Company register certificate.

On March 11,1999 ABB Ltd.(Korea) was awarded the Company Register certificate ***Nº 10BK00113*** by BVQI which guarantees that our Quality Assurance System satisfies standard **ISO 9001:2000** and is applied throughout the process, from the design and development stages to after-sales service, establishes management criteria and procedures and processes that ensure that our transformers are free of defects. This system also includes suppliers and the application of the knowhow and expertise obtained from research and from the standard and special tests carried out, guaranteeing homogeneity in the design of product components, manufacturing procedures and tests, staff training and the continuous improvement of the whole process.

2.2 Environmental certification.

The environmental certificate ***Nº 271404*** granted by BVQI guarantees that the environmental management system satisfies standard **ISO 14001-2004** and is applied to the design, production, after-sales service and repair phases of transformers, and is developed as expressed by ABB in its environmental policy.

2.3 Accreditation of the tests laboratory.

Accreditation of the tests laboratory for the accomplishment of the routine and type tests defined in this manual and granted by **KOEMA with nº 99-46**, which indicates that the tests laboratory meets.

2.4 Product certifications obtained.

The following product certificates have been obtained by ABB Power Technology:

- The **class F1 "Burning Behavior"** certificate obtained in homologated tests in accordance with IEC 60076-11, dated Dec.2005 in the laboratory of ABB AG.C.E.S.I. **test number: BETB-075**.
- The **class C2 "Climatic"** certificate in accordance with IEC60076-11, dated May 2006, **Report no.: 70670078-HVL 06-1143**.
- The **class E2 "Condensation and humidity"** certificate in accordance with IEC60076-11, dated May 2006, **Report no.: 70670078-HVL 06-1143**.
- It's suitability to endure TYPE TEST including short-circuits according to AS 60076-11-2006 certified by **KNATA in Australia** dated on April 1,2008**. Certificate no.**

102442.(3P 1500/2000KVA 11000/433V 50HZ)

- It's suitability to endure TYPE TEST including short-circuits according to IEC 60076-11 certified by **KERI** dated on March 06,2008**. Certificate no. 2008TS00381.(3P 500KVA 22900/380V 60HZ)**
- It's suitability to endure TYPE TEST including short-circuits according to KS C 4311 / KEMCO 2007-94(2007.07.23) certified by **KERI** dated on October 16,2007**. Certificate no. 2007TC00636.(3P 3000KVA 22900/6600V 60HZ for High Efficiency Transformer)**
- It's suitability to endure TYPE TEST including short-circuits according to IEC 60076-11 certified by **KERI** dated on May 30,2007**. Certificate no. 2007TC00292.(3P 3500KVA 6600/433V 50HZ for ONGC)**
- It's suitability to endure TYPE TEST including short-circuits according to IEC 60076-11 certified by **KEMA** dated on October 12,2006**. Certificate no. 108-06**. **(3P 1600KVA 11000/433V 50HZ)**
- Vibration test Certificate for windmill application made by **VIRLAB, S.A (Spain)**. on October 06,2006. **Certificate no. 261264.(3P 2350KVA 22000/690V 50HZ)**
- It's suitability to endure TYPE TEST including short-circuits according to ES 140-650 755 / IEC 60076-5 certified by **KERI** dated on May 06,2005**. Certificate no. 2005TS02469**.(3P 1500/2000KVA 6900/480V 60HZ)
- It's suitability to endure TYPE TEST including short-circuits according to IEC 60076-5 certified by **ERDA(India)** dated on Feb. 08,2005**. Certificate no. PLV/10/SC/1031**. **(3P 400KVA 11000/433V 50HZ)**
- It's suitability to endure TYPE TEST including short-circuits according to ES 140-650 755 / IEC 60076-5 certified by **KERI** dated on May 06,2005**. Certificate no. 03S0553**.(3P 1000/1333KVA 6900/480V 60HZ)
- It's suitability to endure TYPE TEST including short-circuits according to IEC 60076-5 certified by **KERI** dated on Nov. 04,2003**. Certificate no. 03S1408.(3P 1250KVA 22900/380V 60HZ)**

2.5 Quality policy

QUALITY POLICY

Our most important quality criterion is our customers' satisfaction.

Their requirements will be satisfied by our commitment and by products which fulfill the terms that have been agreed. Each product delivery and each of our actions with regards to our customers should create a recommendation for future business.

We will ensure that all of our employees are sources of quality and productivity by means of:

- Quality improvement programmes which result from the motivation achieved through confidence, respect, participation and recognition.
- Education and training provided to ensure that each employee understands, backs and contributes to the achievement of Total Quality.
- Economically producing quality services and products which fully satisfy customer needs and expectations.

We will ensure that our suppliers are an extension of our business. They will be selected, appraised and acknowledged as suppliers on the basis of their potential value and real contribution towards satisfying the demands of our total quality objective.

We will adhere to standards ISO 9001/2000, which establish the demands for quality assurance in our business and we undertake to comply with the legal, regulation and standard requirements of the customer.

General Manager

ABB Power Technology

Distribution transformers

3. TEST RECORD SHEET

All the information on the tests that the transformer has undergone is recorded on the Test Record Sheet and included with the information accompanying the transformer.

The Record Sheet indicates important data such as the no-load and load losses as well as the impedance voltage, no-load current and the level of partial discharges.

Each transformer manufactured by ABB Power Technology without exception, has its own particular test record which is kept on file for a minimum period of 13 years and is at the disposal of our clients at their request.

4. RELIABILITY AND SAFETY

The transformer leaves the factory free of all defects (as shown by the tests it has undergone) and ready to be put into operation for the whole of its working life.

This level of reliability must be maintained during its handling, storage, and transport and the appropriate checks must be made when it is put into service, with the protections established by the **H.V. Regulations** from each country**.** In addition, the maintenance standards detailed within this manual must be applied.

At the installation site all the necessary measures must be taken to protect those persons who work regularly, or from time to time, in the proximity of the transformer whilst at the same time ensuring that all those persons not involved in its operation do not have access to it.

PAY ESPECIAL ATTENTION TO SAFETY RECCOMENDATIONS

SIGNAL INDICATIONS

Following the signal indications that the transformers carry out

REGULATIONS

Carrying out the of the protection and safety requests defined in the High Voltage Regulations that have been established by the regulations from each country, in force at the time.

FIRE EXTINCTION

It is not necessary to provide a device for collecting dielectric liquid or to install fire extinction systems. These transformers should be installed in such a way that the heat generated does not represent a fire risk for the materials nearby.

5. CONSTRUCTION DETAILS

The dry-type transformer can be supplied with or without enclosure. The cooling system can be by natural air (AN) or forced air by means of fans (ANAF).

The insulating system is designed to withstand 100 K in the middle conductor and a maximum temperature of 155ºC, in accordance with class F defined in IEC 60076 standard, part 2.

The normal operating conditions are:

- Altitude ≤1000 m.
- Ambient temperature:

  - 5ºC up to +40ºC (C1 type)

  -25ºC up to + 40ºC (C2 type)

The customer must specify all those environmental conditions that are not normal, in order to include the necessary variations in the design modifications.

6. RECEIPT, TRANSPORT, HANDLING AND STORAGE

6.1 Receipt.

The transformer is supplied totally mounted and ready to be connected to the H.V. and L.V. lines and inside a plastic cover that protects it from dust and rain.

In some cases HV outer connection bar can be delivered disassembled in order to avoid damages during transportation.

When the transformer is received, either at the client's warehouse or at its final site, the following points should be checked:

-The characteristics of the transformer, indicated on the Name Plate, should coincide with those that appear on the Test Record Sheet and these, in turn, should match the order specifications.

-Check that the transformer has the relevant safety warnings.

-Check the general state of the machine. There should be no dents in encapsulated phases or connections.

-The state of the paint: check that there is no flaking, scratches, etc. on the enclosure (if the transformer is of this type) or on metallic parts.

-Check all of the transformer's accessories (wheels, thermometer, etc.) If any damage is observed or if any of these have been lost during transport the transport company and manufacturer should be informed immediately to determine who is responsible and to calculate the cost involved.

-Before unpacking the transformer, especially during the winter or when the difference in temperature between the room and outdoors is considerable, a prudential period of time should elapse (8 to 24 hour) so that the transformer temperature has time to rise to that room. This is to prevent undesired condensation of the transformer surface.

IMPORTANT:

-In the event that an anomaly is discovered when the transformer is received, the manufacturer should be contacted immediately. If, within a period of 5 days, the manufacturer has not received notification of anomalies or defects it will be considered that the transformer is in perfect condition and the manufacturer will not be liable for what may occur to the transformer during operation nor its consequences.

6.2 Transport and handling.

During transport the transformer should not be moved by pushing on coils or connections. The transformer is fitted with four rings on the wheel base profiles for attaching cables to drag it. If the transformer has to be pushed, then this can be carried out by pushing on the flanges that hold the magnetic circuit in place.

The top flanges have 4 lifting eyes and hoisting can be carried out by attaching slings that form an angle of 50-70º to the eyes or to the transformer enclosure walls.

-The name plate indicates the total weight of the transformer. This must be taken into account when deciding on the elements to use for lifting.

-The attachment holes or lifting eyes have a minimum diameter of 40 mm.

-The base and cooling elements are designed to ensure that the transformer can be moved using a lever and do not impede handling; however, care must be taken not to push on the encapsulated phases. If levers are used then we recommend using wooden stops to protect these elements.

The transformer must always remain upright. Only use the lifting lugs and tie holes provided in the core clamps during transport. Nothing must be fastened to the transformer coils or enclosure during transport, as severe damages can result.

6.3 Storage.

The dry-type transformer is for indoor installation. Do not store in places where it is exposed to effects of the weather.

If the transformer is not going to be put into operation immediately then it should be stored bearing in mind the following recommendations:

6.3.1 The temperature in the storage place can not be below than –25ºC (C1 and C2 type). When C1 type transformers **storage** will be **lengthy** with temperatures lower than –25ºC it must be consult with the manufacturer.

6.3.2 The place will be dry, clean and good ventilated.
When in storage, this type of transformer should be remaining inside its plastic packaging cover.
In particularly damp places, bags with humidity absorber products like silica gel should be placed near the coils and to provide adequate ventilation.

6.3.3 The indications given in point 6.2 will be followed for lifting and transporting the transformer.

6.3.4 The indications given in point 6.2 will be taken into account during transport and handling. Do not pressure on the encapsulated phases, connections or terminals. Do not damage paintwork.

6.3.5 If the transformer is lifted and transported by means of a fork-lift truck, the prongs of the truck should be inserted inside the wheel coupling profiles, protecting the cooling elements (in case of fans) from any possible damaged that could be caused by the lifting machine.

6.3.6 If the transformer is equipped with plug-in terminals, these should all have cone protectors to ensure that the terminal contacts remain clean and undamaged.

ABB Power Technology is not to be held responsible of the possible damage if the storage conditions are not respects.

7. INSTALLATION

The transformer manufacturer is not responsible for its installation. Installation must be carried out in accordance with the laws currently in force and following the instructions given by the manufacturer.

The following points must be taken into account when installing the machine:

- Bolt HV outer connection bar to free terminals in the extreme windings (when delivered disassembly). Check torques with table in section 11.

-Earth all voltage less metallic parts by means of the screw available for this purpose.

-Connect the L.V. neutral to earth when this is compulsory or when it is a requirement of the earth fault protection system.

-Ensure that terminals and bridges are correctly connected and that all of the transformer's mobile parts are securely fixed.

-In transformers with a dual ratio in H.V. or L.V. ensure that the transformer is connected at that which corresponds to the mains voltage or output voltage.

-Check that the position of the diverter switch is correct in accordance with the mains.

-Consult the name plate when the position is changed.

-Connect the thermal protection system in accordance with the diagram supplied.

-To revise the tight-fitting of all the screws according to the list of the chapter 11.4

The electric current passing through the windings and the magnetization of the magnetic circuit produce electric losses that are transformed into heat. To prevent this heat from accumulating in the transformer with the consequent risks that this involved, the transformer is designed to cool naturally; however, there should also be adequate ventilation at the installation site.

The transformer is designed and built to withstand abnormal situations of overvoltage and overcurrents including those of a short-circuit in the secondary winding; however, the magnitude and duration of these should be limited by means of the appropriate elements.

7.1 Installation site and protection of persons.

The site conditions and design, both for technical reasons and for the protection and safety of persons and property, are defined in the **High Voltage Regulations** established by Korea law (or the corresponding country law) in force at the time.

The instructions of the Electricity Company, which is familiar both with the Regulations and the specific characteristics of the system to which the transformer is to be connected, must also be taken into account.

A horizontal base that can withstand the weight of the transformer without deformation should be prepared. The total weight is indicated on the transformer's name plate.

The wheels should also be blocked to prevent the transformer from moving during operation.

7.2 Transformer protection.

Although the **H.V. Regulations** from each country indicate the type of protection that the transformer must have, the following is essential to ensure the reliability and operation of the transformer.

7.2.1 Protection from overcurrents and overheating.

The transformer must be protected from the thermal and dynamic effects caused by overcurrents and short-circuits.

For this purpose there should be an automatic diverter switch or short-circuit fuses which take into account the possible overloads and are calibrated to prevent currents from passing that are 1.5 or 2 times greater than the assigned current (see name plate).

7.2.2 Ventilation of the transformer cell.

As has already been indicated, there should be suitable ventilation to stop the transformer from overheating above the limits established by the standards.

If the transformer is mounted inside a cell, it should be ensured that it is well-ventilated and that it is of the correct size to allow air to pass in and out.

The transformer must be located at least 100 mm from the cell walls and its bushing must be at least 350 mm from the cell roof and walls.

The input E and output S surfaces should have at least the surface areas in m^2 given by the following formulas:

$$E = \frac{P}{5.4 \times \sqrt{H}} \qquad S = 1.15E$$

Where:

H = Distance between the centers of openings, expressed in meters.

P = The sum of the no-load and full-load losses of the transformer in kW.

NOTE: This formula is valid for a maximum room temperature of 40ºC and a maximum altitude of 1000 m.

The following should be avoided:

-The ambient air temperature should not exceed that indicated by the standards.

-The transformer should not be installed in small rooms with blinds or metallic walls exposed to direct sunlight.

-The air for cooling the transformer should not be aspired or expelled in the same room in which it is installed.

-The transformer should not be installed in premises that are destined for other uses; in particular in those in which there are machines that work at high temperatures: boilers, steam generators, etc.

-If the transformer cannot be installed in premises with sufficient natural ventilation, forced ventilation should be used.

7.2.3 Fire extinction systems.

It is not necessary to provide a device for collecting the dielectric liquid or to install fire extinction systems. These transformers should be installed in such a way that the heat generated does not represent a fire risk for the materials nearby.

7.2.4 Protection from overvoltages.

To protect the transformer from industrial frequency overvoltages and those of an atmospheric origin, variable resistance lightning arresters should be used. The characteristics of the lightning arresters will depend on the level of insulation of the transformer, characteristics of the mains system. They will be earthed in accordance with **H.V. Regulations** from each country**.**

At this point it is essential to receive the collaboration of the Electricity Company to whose system the transformer is going to be connected.

8. CONNECTIONS

8.1 Coupling.

When the transformer is connected to the H.V. and L.V. circuits the connections should be carried out in such a way that they do not exert any strain on the terminals and should have a large enough section to prevent excessive heating. They should also be able to dilate.

It is important to make sure of a suitable connection and tightening of all the bolts.

IMPORTANT 

Check that the tap changer is in the correct position and, in the case of multi-voltage transformers, that the H.V. winding is connected at what is going to be the working voltage.

THE TAP CHANGERS SHOULD ALWAYS BE MANIPULATED WITHOUT VOLTAGE!

-Using an ohmmeter check the continuity of the circuit with the tap changer in all of the positions as well as checking that the bridges are correctly fixed in the working position.

-The enclosure or lower flange of the transformer should be securely and permanently connected to earth by means of the earthing screws on the bottom right of the two larger, lower, opposite faces of the enclosure or flange. The earthing conductor should be of the dimensions indicated in the **H.V. Regulations** from each country and in accordance with the characteristics of the transformer.

8.2 Parallel Operation.

If the transformer has to be parallel-coupled to other transformers, check that it fulfils the voltage compatibility conditions established by the standards, check the position of diverter switches, impedance voltage and connections unit. See standards no. IEC 60076-4 and IEC 60606-4.

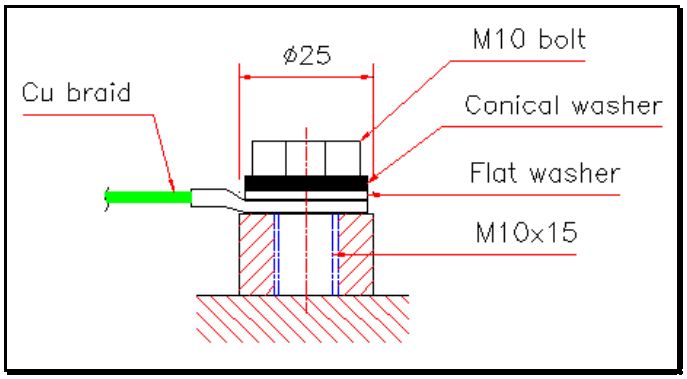
-Identical rated voltages and frequencies (voltage tolerance 0,5%).
-The transformers should belong to the same vectorial group.
- Identical short-circuit voltage (tolerance +/- 10%)
- Power ratio of (maximum) 1/3 at continuous load.

8.3 Ground Connection.

Permanent and adequate grounding is essential for the enclosure, core and coil assembly of transformers. Grounding is required to remove static charges that accumulate, as well as protect the equipment should the transformer windings accidentally come in contact with the core or enclosure.

To ensure a solid core ground, transformers have copper straps embedded in the core laminations and securely connected to the lower flame.

The transformer is equipped with two ground terminals, one on each side of the lower flame. Main grounding must be connected to one of these ground terminals or ground pads as shown in following fig.



The grounding conductor should be of the dimensions indicated in the HV Regulations and in accordance with the characteristics of the transformer.

8.4 Tap Connection.

Voltage regulation (± change over) must be done by the no load tap changer which is attached to the high voltage winding. Following fig. is the general type of tap changer.

Before changing tap make sure transformer to be de-energized.

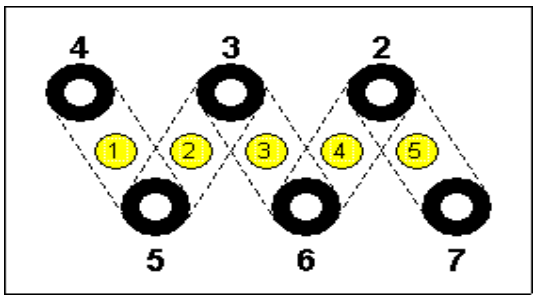
The voltage steps are indicated on the nameplate. On dispatch, the transformer is connected in the rated position.

When changing the voltage the tap connector must be moved to the required position. The tap connections should be re-tightened and locked in such a way that they do not exert any strain on the terminals and should have a large enough section to prevent excessive heating.

Using an ohmmeter check the continuity of the circuit with the tap changer in all of the positions as w ell as checking that the bridges are correctly fixed in the working position.

Caution

Take care that the tap connectors are in the same position



8.5 Cable Connection.

The cable is connected to the insulator on the upper yoke, or connection terminals on the coil. To ensure good connection between terminals and the connecting cables, the contact plates must be cleaned for anti-oxidization. This is very important in order to ensure a low connecting resistance and to avoid the heating of the screw connections. When dispatched from our works the contact plates are cleaned.

When connecting terminals, confirm the sign of each phase.

And when connecting transformer terminals with cable, the cable should be supported to cubicle or other place solidly without moving.

8.6 Bus Connection.

When transformer terminals are connected with bus duct, it is necessary to use flexible bus bar. If connecting transformer terminal with bus duct directly without flexible bus bar, vibration of transformer may cause damage to bus duct or increasing of noise.

To ensure good connection between the low voltage bushings and the bus bars or the connecting cables, the contact plates must be cleaned for oxidization. This is very important in order to ensure a low connecting resistance and to avoid the heating of the screw connections.

When dispatched from our works the contact plates are cleaned and covered with silicone grease as a protection against oxidization. For the first connection it is therefore sufficient to remove the silicon grease immediately before the connection is carried out.

Attention **CLEANING OF CONNECTION PLATES**

Size Bolts and Nuts	Flat washer [mm]	Conical washer		Current per screw [A]	
		NO.	Dimension [mm]	one-side connection	both-side connection
M 10	ϕ 10.5/21×1.1	2	ϕ 10.5/23×2.5	250	400
M 12	ϕ 14.2/28×1.5	2	ϕ 13.0/29×3.0	500	750
M 16	ϕ 16.3/34×1.5	3	ϕ 17.0/39×4.0	800	1250

9. PREVENTION OF NOISE AND ELECTRICAL BREADOWN DISCHARGES

9.1 Noises.

-When the transformer is connected to the mains, check that the position of the diverter switch and the H.V. winding connection (if there is more than one) is that of the working voltage. Otherwise the magnetic circuit may become over saturated and the noise level will increase notably.

-Check that the transformers four wheels are firmly resting on the ground.

-Do not attach grids or guards to the metallic walls of the transformer.

-Fit flexible L.V. cables, held in place by means of insulating brackets.

Rated power kVA	**Power noise level dB(A)**	
	Until 24 kV	**36 kV**
50	59	-
100	59	-
160	62	66
250	65	67
400	68	69
630	70	71
1000	73	73
1600	76	76
2500	81	81

The acoustic power level values indicated in the table are the maximum admissible and are determined based on the acoustic pressure values measured in the transformer axles in four positions at 0.3 m according to standard IEC 60076-10.

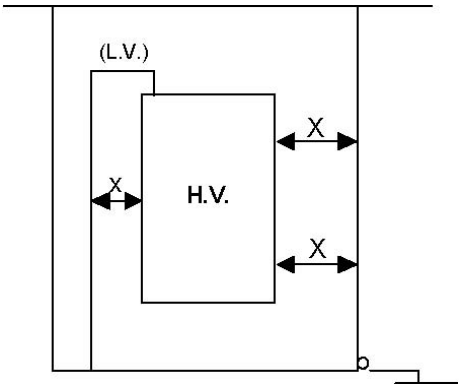
9.2 Electrical Breakdown discharges.

To prevent disruptive discharges, maintain the distances indicated in the table, between H.V. and L.V. or metallic parts.

These distances are ;

HIGHEST VOLTAGE FOR EQUIPMENT (kV)	**DISTANCE (X) (mm)** From insulated parts
12	50
24	120
36	200

Caution



It is very important to maintain the minimum distance **x** from the insulating parts of the High Voltage windings to the metallic parts or Low Voltage, to avoid a possible breakdown.

For distances between High Voltage non-insulation parts and Low Voltage metallic parts will be taken the suitable values in the High Voltage regulations or applicable standards in each country will be taken.

ABB Power Technology does not accept any liability for possible failures if this distance is not respected.

VERY IMPORTANT

The insulation of the coils does not guarantee the safety of persons in the event of accidental contact. For this reason these transformers should not be installed in easily accessible places.

Warning and danger signs that are easily visible should be placed on the coil covering.

10. CHECKS TO BE CARRIED OUT BEFORE THE TRANSFORMER INTO OPERATION

10.1 Checks.

The transformer is supplied ready for installation but before proceeding to put it into operation the following checks should be carried out:

-All of the recommendations indicated in Chapters: 7. Installation, 8. Connections, and 9. Prevention of noise and electrical breakdown discharges should be checked.

-The transformer should also be cleaned with a vacuum cleaner to eliminate any dust.

-Check the thermal protection device (see Chap. 14 "Accessories").

-Check insulation resistance according to the following table:

Insulation between:	Test Voltage	Minimum Value in MΩ(≥)
H.V./L.V.	5.000 V	1 per kV A.T.
H.V./Earth	5.000 V	1 per kV A.T.
L.V./Earth	2.000 V	2

10.2 Putting the transformer into operation.

Once the transformer has been connected to the H.V. mains:

-Voltage will be applied in a non-load state and observed for one hour. No anomalies should occur during this period of time.
-Afterwards storage or disconnection during a prolonged period, first it is recommendable to connect the transformer during four hours in no-load for loss the possible damp with the core heating. After this period it can be put into a normal operation.
-The voltage will be measured at the L.V. terminals to check the corresponding output voltage depending on the transformation ratio.
-To apply the load progressively until the rated power is reached and check the increase in temperature.

11. MAINTENANCE

11.1 Frequency of checks.

Transformers, like other electric equipment, require periodical maintenance to ensure normal operation. Inspections should be scheduled at regular intervals and corrective measures taken when necessary. There are two kinds of inspection as following

Routine Inspection

It is to check a state in which transformer is operating. Inspection items are as follows.

Record load condition (Voltage, Current, kW, etc.)

Record temperature and humidity

Check for abnormal noise, smell and evidence of overheating.

Periodical Inspection

The period of these checks depends on the environmental conditions in which the unit operates. A check cycle is as follows.

Annually: in normal environments.

Quarterly: environments that are contaminated with dust or industrial fumes, and also the transformers placed in windmills and having vibrations.

11.2 Precautions.

All the precautions stipulated by current legislation must be taken. The following measures are amongst the most important ones.

Before examining or carrying out maintenance on the transformer:

-Disconnect the H.V. and L.V. switches so that the transformer is de-energized and out of service.

-Using an insulating rod the transformer bushings should be earthed to ensure that there is no remaining static charge.

-The bushings are then short-circuited and earthed.

11.3 Checks.

-Check and tighten screws, connections, voltage change bridges and coil subjection plug.

-Clean any dust from surfaces using a vacuum cleaner or by blowing with dry air or

nitrogen (maximum pressure 3 Kg/cm^2). Nitrogen bottles as normally supplied, equipped with a pressure reducer, can also be used.

-Check the thermal protection device that includes the sensors (Pt100 type or thermistors) and the measuring control unit (see chapter 14 "Accessories").

ATTENTION!
This is a low-maintenance transformer

The above indicated points do not imply the exemption from fulfilling the requirements established by current laws concerning Transformation Centers with regards to:

The protection of persons and the integrity and functionality of the goods that may be affected by the installations themselves.

This inspection must be carried out on all transformers. If less than ten years has passed since their manufacture, the inspection must be carried out in cooperation with the manufacturer who should be informed of the results in order to be able to recommend corrective actions, if necessary.

11.4 Tightening torque of connections.

INSTRUCTIONS TO MAKE SCREWED JOINTS IN LOW AND HIGH VOLTAGE

H.V. & L.V. SCREWED CONNECTIONS			
	Indoors	**Outdoors**	
Quality of nuts and bolts	8.8	8.8	Stainless steel A2 or A4
Lubricant for nut and bolt	Oil SAE 30 or 40 Vaseline grease	Molybdenum bisulphide grease (MoS2)	
Nuts/Bolts	**Grip torques (Nm)**		
M 8	10	15	20
M 10	20	30	40
M 12	40	60	75
M 16	80	120	140

When one or both of the bars to be joined together are aluminum, the layer of aluminum oxide must be removed by brushing or sandpapering. This layer is practically invisible and extremely resistant, so its presence prevents making a good contact. This operation must be repeated if the connection bars are dismounted for any reason.

Once clean, apply a very fine coat of special grease for electrical contacts.

Aluminum/copper joints must have a bi-metal plate.

The grip torques, indicated on the table, correspond to greased bolts.

Greasing oil or white vaseline grease can be used, in order not to soil the area around the connection.

Molybdenum bisulphide grease must be used for stainless or hot galvanised nuts and bolts. Any excess must be cleaned after tightening.

H.V. SCREWED CONNECTIONS					
Nuts/bolts	M6	M8	M10	M12	M16
Grip torques(Nm)	5	10	20	40	100

H.V. bolts must not be greased because are screwed in brass.

12. ENVIRONMENT

12.1 Introduction.

ABB Power Technology has implemented and certified at its plant Environmental Management System as per standard ISO 14001 and it has identified the possible accidents, incidents and situations that could produce environmental effects that are detrimental to the Environment.

The environmental management system is applied both in the manufacturing processes and in the product operation as set out in the environmental policy.

Our commitment is for continuous improvement and within this context we offer our customers environmental information that affects the product and which we develop in points 3, 4 and 5 of this chapter. This information is based on our current knowledge always with the commitment to improve it as our knowledge increases.

We inform you, too, that the existing legislation is broad and extensive and is continuously evolving, which makes it difficult to offer an updated overview of it

The Quality and Environment Dept. of ABB Power Technology at the disposal of its customers to answer any queries or give assistance on Environment-related issues.

12.2 Environmental Policy

ENVIRONMENTAL POLICY

Our criterion with regards to the Environment is to respect Nature and Lift

All activities, processes, and services are directed towards compliance with Environmental requisites, towards continuous improvement, and Towards contamination prevention.

We commit ourselves to:

- We will comply with relevant laws and regulations for environmental protection.
- We will strive to reduce environmental impacts of our operations and our products, conserve resources and deliver products that are safe in use, can be recycled, reused or disposed of safely.
- We will set environmental standards for our suppliers and work with them to achieve these.
- We will set and review objectives and targets for continuous environmental performance improvement with annual action plans.
- We will educate, train and motivate our employees to carry out their tasks in an environmentally responsible manner.
- We will periodically conduct environmental audits in order to continually improve our environmental performance.

We will ensure that the above aspects are understood and accepted at all levels 14001/1996 of the organization by means of training and continuous improvement programs.

We adhere to standards ISO and applicable Regulations of the Environmental Management System that establish the environmental requirements in our business.

General Manager

ABB Power Technology

Distribution transformers

12.3 Environmental impact of the transformer in use.

Environmental impact

This is any action, whether it be harmful or beneficial, that transforms the environment, said action being caused by directly by the activities, products and services.

Environmental impacts identified with the transformer in use:

-Electricity consumption.

-Noise emission.

-Increase of surrounding temperature.

12.3.1 Electricity consumption.

The transformer is a static electrical machine, which has an efficiency of approximately 98%. This 2% power lost is inverted into losses in its magnetic circuit and in the windings.

These losses dissipate into heat in the surrounding environment and they are limited and subject to compliance with Standards and/or specifications of our customers.

12.3.2 Noise emission.

The transformer has a magnetic circuit, which, due to the effect of magneto-striction caused by the magnetic flow, issues a noise, which may be troublesome for people, as well as vibrations, which are transmitted through the floor or structure causing noises in places close to the location of the transformer.

The sound level of the transformers is regulated by the relative IEC standards, as well as by town council regulations, which depend on whether it is located in urban or industrial areas.

We can limit its impact if we follow the instructions given in chapter 9.

12.3.3 Increase of the surrounding temperature.

The dissipation of losses in the magnetic core and in the windings gives rise to an increase in the temperature around the transformer, which, in turn, is dissipated into the medium helped by the lower surrounding temperature.

The non-existent emission of gases or losses of coolant make the environmental impact minimal.

12.4 Environmental aspects in emergency situations.

Electricity consumption.

Causes: Excessive voltage or current supply.

Excessive noise level.

Causes: Excessive voltage supply. Slackening of the magnetic core. Foreign objects close to the transformer, bad location of the transformer near reflecting objects. Bad support. Rigid connection in L.V.

Excessive heating.

Causes: Excessive voltage or current supplies, nearby objects that prevent the natural cooling and/or foreign bodies are blocking the cooling channels.

Fire.

Causes: Faulty operation of the transformer. Internal short-circuit.

The transformer is self-extinguishing.

Combustion gases.

Causes: Fire.

These gases are not harmful for health or for the environment.

12.5 Waste.

This type of transformer does not generate waste in normal operation.

The packaging and/or the plates that are included in the transformer delivery are wooden and can be recycled or used again according to its condition.

The packaging is plastic and/or wood and is made of elements that can be recycled, if correctly managed.

During their maintenance they do not generate waste and at the end of their lifespan the following can be generated:

-*Encapsulated windings*. Any aluminum or copper scrap can be recovered if the resin coating is destroyed. The resin is managed in the same way as inert urban waste and the copper or aluminum can be recycled.

-*Copper or aluminum L.V. windings*. They can be recycled by eliminating the insulating coating adhered to its surface.

-The *magnetic plate* can be eliminated as scrap or to retrain.

-The *flanges, casings, wheels, nuts and bolts* and in general the metal parts can be eliminated as scrap or to retrain.

12.6 Fire.

This transformer is self-extinguishing and resistant to burning; nevertheless, the following measures must be taken into account to extinguish it:

EXTINGUISHING MEANS

- Carbon dioxide
- Foam
- Dry powder

WARNING!

Do NOT use WATER to try to fight the fire

13. REPAIRS

–If an anomaly in the operation of the transformer is observed, this should be reported to the manufacturer who will then advise the appropriate actions.

–If, having checked the transformer, it is found that it has to be repaired or altered; these operations will be carried out by the manufacturer.

WARNING!

If you receive the transformer in damaged conditions, you should contact the factory immediately (see page 42 of this manual). Please bear in mind that it might also be important to take pictures of anomalies before unloading the transformer and to make a note of them in the carriers CMR.

NOTE;

If there instructions are not followed, the original manufacturer is no longer responsible for the functionality of the transformer and its reliability. This responsibility falls on the person who has carried out the repair.

14. ACCESSORIES

The transformer is fitted with the following accessories, in accordance with current UNE standards or customer specifications.

- ☒ Name plate.
- ☒ Two earth terminals.
- ☒ Safety warning notices.
- ☒ Thermal protection. Temperature sensors mounted in a compartment on the L.V. phases (Optional : control unit for temperature measurement)
- ☐ Fans.
- ☐ Enclosure.

14.1 Thermal Protection.

The thermal protection system or temperature control is supplied packed along with the transformer so that our clients can install it wherever required.

Two protection systems are used:

-Protection consisting of Pt100 sensors with measuring and alarm and triggering signals in control unit. Diagram 1.

The instructions for the adjustment of control units and for changing alarm and trigger signals are indicated in the information supplied with the control unit.

The advised programmed temperature values for the alarm and trip signals, when speaking of an average winding heating of 100 K and a maximum ambient temperature of 40ºC for F class, are:

	SENSOR Pt100
Alarm (℃)	130
Trip (℃)	150
Fans (Connect./Disconnect.) (℃)	120/110

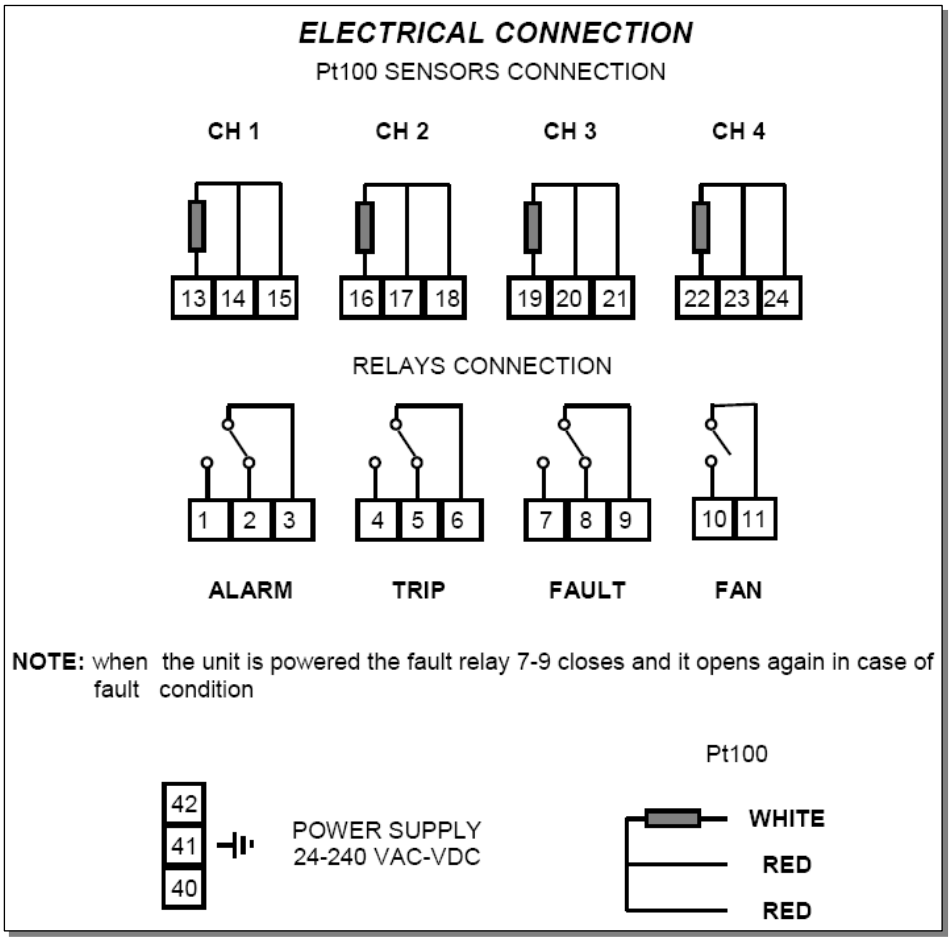
For H class the temperature indicated will be increase in 20 (℃)

INTERCONNECTION BETWEEN TRANSFORMER AND CONTROL TEMPERATURE UNIT

The transformer includes three Pt-100 sensors, one per phase, which must be connected to the control temperature. The connection of the three Pt-100 sensors from the transformer to the exchange is carried out with nine wires. The nine transformer terminals and the exchange are numbered in exactly the same way: 13,14,15,16,17,18,19,20,21

Channel 1 of the control temperature unit corresponds to the U phase of the transformer,
Channel 2 to the V phase and
Channel 3 to the W phase

Diagram 1



CH4 *- Fans or fourth sensor in core (optional)*

15. POSSIBLE ANOMALIES AND RECOMMENDED SOLUTIONS

The following table briefly describes anomalies which may be found during operation or when periodic checks are carried out and indicates how to resolve them.

SYMPTOMS	AFFECTED ELEMENTS PROBABLE CAUSES	SOLUTIONS
Low insulation resistance	**Dielectric.** Presence of humidity on surface of windings.	Clean with dry air Ventilate.
	Dielectric. Ageing, dirt.	Contact manufacturer. Clean with dry air.
The automatic protection device is triggered at the transformer connection	**Windings.** Defective windings.	Contact manufacturer.
	Tap Changer The primary voltage does not coincide with the tap changer	Check that the position of the switch coincides with the primary voltage.
	Fuses Incorrectly calibrated	Change fuse.
	Protection relays Timing and/or current is incorrectly adjusted.	Check timing and current setting.
Abnormal secondary voltage	**Primary Voltage** Absence of primary voltage.	Check installation and contact Electricity Company.
	Tap Changer Incorrectly positioned.	Change positioning.

SYMPTOMS	AFFECTED ELEMENTS PROBABLE CAUSES	SOLUTIONS
	Windings No continuity in windings.	Contact manufacturer.
Very low voltage	**Primary voltage** Very low	Check installation and contact Electricity Company.
Very high voltage	**Primary voltage** Very high	Check installation and contact Electricity Company.
Unbalanced voltage	**Tap Changer** Incorrectly positioned in one of the phases.	Check the position of the 3 switches. Check installation and contact the Electricity Company.
	Fuse Fuse has blown.	Change fuse.
	Windings No continuity in windings.	Contact manufacturer.
	L.V. installation Load imbalance. Incorrect coupling.	Check L.V. installation. Check L.V. connections.
Spurious triggering during operation	**Thermometer** Incorrect operation. Triggering and alarm incorrect set.	Check. Change. Check setting. Correct.

SYMPTOMS	AFFECTED ELEMENTS PROBABLE CAUSES	SOLUTIONS
	Pt100 sensors or thermistor Defect of sensors or thermistors.	Check sensors or thermistors.
	Windings Perforation of insulating material.	Contact manufacturer.
	Fuse Blown fuse	Change fuse.
	Relays Incorrect timing.	Check timing.
Abnormal operating temperature	**Installation premises** Insufficient ventilation. High ambient temperature.	Check ventilation of premises.
	L.V. mains Overloaded	Check for possible power increases and discharge the transformer.
High level of noise	**Magnetic core** High supply voltage **Loose accessories** Certain elements have been poorly mounting, producing vibrations.	Adjust diverter switch or regulator. Check over. Re-tighten.
	Not enough distance to walls Reflecting elements.	Remove elements. Study of the area.

16. RATING PLATE

All of the transformers have a name plate indicating and defining all of its basic characteristics.

This plate is placed (unless indicated otherwise by our clients) on the L.V. side and is riveted, stuck or screwed to the top flange on a welded bracket or on the casing of the transformer.

17. GUARANTEE

On behalf and in representation of ABB Power Technology, Distribution Transformers at its site , the manager of Quality Assurance and Environment

Certifies:

That the transformer indicated in the attached record sheet has been manufactured and tested in accordance with order specifications and applicable standards and codes, obtaining satisfactory results.

And thus, issues

Guarantees:

For all manufacturing defects for a period of twelve months from its commissioning or eighteen months from its date of dispatch for said transformer.

This guarantee does not cover the effects caused by the mistreatment or misuse of the transformer.

Quality Assurance

18. NOTES

19. TECHNICAL SERVICE

ABB Power Technology has a 24 hour Technical Service. In the event of any query or anomaly we are at your entire disposal at the following telephone numbers and departments:

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