Vacuum Cast Coil Dry Type Distribution Transformers

The reliability at your hand.
Mission

ABB is a global leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact.

Introduction to ABB

ABB is the world’s leading supplier of Distribution Transformers. We offer:

- All technologies (Dry/Liquid)
- All standards (IEC, ANSI, etc)
- Applications up to 72,5 kV

Facts and figures (approx)

- Production facilities around the world: 30
- Countries with Sales and Services centers: 140
- Number of units sold yearly: 400,000

Working with us, you have access to a worldwide network of factories and facilities serving you locally with a full range of products and solutions. Our warranty provides one ABB quality and service. Working together gives you access to production facilities using the most up to date technologies, providing the highest quality for standard and specialty products as well as solutions.

Quality statement

Our production facilities are ISO 9001/14001 certified. Our aim is to deliver your distribution transformers fast, on time and conform to your specifications.
In almost every place where people live and work you will find at least one transformer. But as long as it keeps working and supplying power to the escalator in the department store, the hotel lift, the office computer, the oven in the local bakery, the farm machinery or the petrochemical plant nobody gives it a second thought.

ABB Vacuum Cast Coil dry transformers are manufactured in accordance with the international quality standard ISO 9001 and ISO 14001.

ABB Vacuum Cast Coil dry transformers are moisture-proof, suitable for operation in humid or heavily polluted environments. They are the ideal transformers for operation in environments with a humidity higher than 95 % as well as at temperatures down to -25 °C.

With more than 100,000 dry transformers working around the world, produced in specialised dedicated focus factories summing the largest production capacity than any of our competitors, ABB is the technology leader providing the broadest experience and application range of ABB Vacuum Cast Coil dry transformers.

ABB Vacuum Cast Coil is the only cast resin transformer certified by UL with a Thermal Index at least 180 °C (Class H) according to ANSI C57.12.60 - IEEE Trial-Use Standard Test Procedures for Thermal Evaluation of Insulation Systems for Solid-Cast and Resin-Encapsulated Power and Distribution Transformers.

Closer to the user – dry transformers are the only one that can be installed close to the utilisation point which allows to optimise installation design reducing to the minimum the low voltage circuits with the corresponding savings in losses and low voltage connections. In many countries it is mandatory to install dry transformers when substations are located inside public buildings.

The most economical

- Less space needed
- Less civil work needed
- No special safety features required (fire detection)
- Maintenance free
- Longer transformer life due to low thermal and dialectic ageing
- Can be installed closer to the point of consumption reducing load cable losses
- Optimal design subject to constant improvements in design as new materials become available
- Produced in high throughput, specialised and efficient ABB Focus Factories

Safe and Environmental friendly

- Reduced environmental contamination
- Zero risk of leakage of flammable or contaminating substances
- Environmental safe in production (closed system)
- Well suited to damp and contaminated areas
- No fire hazard
- Transformers are non flammable and self-extinguishing
- High resistance to short circuits
- High capacity to support overloads
- High performance in dealing with seismic phenomenon
- Capable of withstanding the most severe of rolling and vibrating conditions

The lowest partial discharge value thanks to the most advanced casting technology.

Epoxy resin casted under vacuum avoids entry of moisture and protects against aggressive environments. Fiberglass reinforcement provides superior mechanical strength.

Unique coil finishing provides smooth surface eliminating dust accumulation.

Self-extinguishing in the event of fire or arcing and no gases released with danger potential.
ABB Vacuum Cast Coil dry transformers range from 50 kVA up to 30 MVA with operating voltages up to 52 kV.

Classification according to IEC 60076-11:
- Climatic C1/C2
- Environmental E2
- Fire F1

Step lap core configuration granting lower values of no load losses, no load current and noise level.

Aluminium foil-disk in high voltage winding (copper optional).

Aluminium foil in low voltage winding (copper optional).

High impulse withstand through foil-disk winding, providing a linear voltage distribution.

High capacity to withstand overloads due to high thermal inertia.
The **magnetic core** has a miter step-lap joint to ensure optimum performance and minimum sound levels. The magnetic steel is cut to length in a sequential way and automatically stacked, ensuring dimensional accuracy and single sheet interlacing within the full stack.

**The encapsulation process** is a fundamental operation in the manufacturing procedure and should be carried out and controlled under the most strict conditions in order to ensure optimum insulating and mechanical characteristics. On the one hand, the windings are put through a preheating oven and kept inside until the mould temperature reaches the encapsulation temperature. On the other hand, the resin mix is prepared in a continuous mixing plant. Components are mixed together just before the encapsulation process. In the next step, the preheated coils are moved into the vacuum casting chamber. Once the vacuum in the chamber has been reached, the resin is poured in the moulds. In this way the viscosity of the resin mix when poured in the moulds is very low, filing interstices allowing to reach the lowest level of partial discharges. After the casting is finished the coils are placed into the curing oven for the resin compound gel to cure, and achieve its final properties.

**The high voltage winding** has a continuous drop down disc with an aluminium strip conductor and double layer insulation. Windings are casted under vacuum with epoxy resin. Transient analysis test have been performed to verify the electrical stress distribution through the windings confirming the highest strength of our design.

**The low voltage windings** are made of aluminium foil, and insulating foil preimpregnated with resin. After the winding process the coil is cured into an oven resulting in an extremely compact winding which can withstand the dynamic stresses produced by a short-circuit.

The latest European standard applicable to the design of Vacuum cast coil Transformer, the IEC 60076-11 specifies a maximum level of partial discharges of 10 pC. Partial discharges are measured in each and every ABB transformer. Our statistics show that the average value measured is always lower than 10 pC and in 90 % of the cases partial discharges are lower than 5 pC. This low level of partial discharge can be granted thanks to the efficient design of ABB Vacuum Cast Coil dry transformers, to the high quality of the material used and to the most modern encapsulation technology.
But ABB leadership does not only rely on above production steps. In ABB transformer factories the whole tendering, design and production process is controlled and planed with the most sophisticated software ensuring the highest productivity and reducing production time down to the lowest level ever achieved keeping the highest quality standards. Once the order is confirmed it is automatically logged in our system allowing us to automatically coordinate commercial, engineering, procurement, production, laboratory, logistics and order handling departments. We are using the most advanced production technology and the most demanding control system to guarantee the highest product quality and the total product reliability.

8 MVA ABB Vacuum Cast Coil dry transformer designed to withstand seismic conditions.
We have a proven solution to your needs

With more than 100,000 units working around the world, ABB is by far the most experienced supplier of dry type transformers and is determined to keep this position thanks to its active investment strategy.

A large variety of sites demand ABB Vacuum Cast Coil dry transformers: Public and high rise buildings such as hospitals, shopping centers, multipurpose cultural centers feel highly safe with ABB Vacuum Cast Coil technology. Contribution to fire hazard reduction, no need of oil pit, no polluting liquids makes them ideal.

ABB Vacuum Cast Coil dry transformer is the technology leader for windmill applications with more than 5000 units working. ABB has accumulated a wide experience in this particular demanding application: presence of harmonic content, transient phenomenons, high number of disconnections.

ABB Vacuum Cast Coil dry transformers are used to provide electrical power for marine propulsion and distribution system. Demanding installation requirements including reduced noise and vibration levels, limited space, special cooling systems, high degree of security to avoid human risks are reasons to choose ABB Vacuum Cast Coil dry transformers.

ABB Vacuum Cast Coil dry transformers are connected to a large range of drives, frequency converters and rectifiers to provide complete solutions for pumps, fans, compressors, conveyors, drilling packages, mills, thrusters, gas turbines, generators, mixers. The mechanical strength and overload capacity of the ABB Vacuum Cast Coil technology turns them into the most suitable product to withstand all solicitations from the service.

On load tap changer with motor drive for the uninterrupted and automatic adjustment of the transformation ratio under load conditions.

ABB Vacuum Cast Coil dry transformer for marine applications. AFWF (air forced/water forced) cooling by hydrocoolers. Design and manufacturing approved by LLOYD’S Shipping Register, Bureau Veritas, DNV, RINA, ABS.
Railway fixed traction installations, underground stations, cranes at seaports, offshore platforms amongst other applications are the right scenario where the high reliability of ABB Vacuum Cast Coil dry transformers is appreciated.

Thanks to ABB Vacuum Cast Coil technology a wide range of applications is covered, becoming one of the largest dry type transformer supplier improving the manageability, efficiency and energy economic processes.
ABB enclosures are made of bolt on steel sheets with removable panels to access connections and tapings. Finishing can be galvanised, painted or galvanised and painted depending on the application and your requirements. The design has been optimised in order to secure the requested cooling of the transformer for all levels of protection degree. Enclosures can be shipped assembled on the transformer or flat packed for assembly on site. Cable entry is from the bottom and optionally from the top or on the side through air insulated cable boxes.

**Manufacturing options**
- Reduced losses transformers
- Copper winding
- Low voltage/low voltage transformers
- Layer windings for special application
- Class H transformers
- Temperature rise below 100 K/above 100 K
- Double primary voltage
- Double secondary winding
- Encapsulated low voltage
- Low voltage connections at the bottom
- Frequency 50 Hz, 60 Hz and 16 2/3 Hz
- Special connection groups
- Sealed low voltage winding

**Other accessories**
- Antivibration pads
- Space heater
- Electrostatic screen
- Current transformers
- Delta connection encapsulated
- Plug in bushings
- High voltage switch
- Surge arrestors
- Cooling fans with up to 50% power increase

*Enclosure IP 23*

*IP 21 enclosure for windmill applications specially designed to fit into the limited space available in side the tower.*
Cooling fans AN/AF (air natural/air forced) transformers refrigerated by fans designed to canalise the air flow into the cooling channels. Up to 50% capacity increase.
The most demanding control procedures to grant you the highest reliability

Coil Impulse withstand Test

High voltage winding is the most critical part of a cast coil transformer and where high manufacturing quality drives the difference.

ABB Power Technology assures the total reliability of its product through the use of the most demanding manufacturing control. High voltage coils are tested after winding and before casting by means of a repetition impulse test where the coil is put to 200 impulses of 8 kV during one minute in order to verify that no dielectric problems are present before casting. Once this is assured, the coil is encapsulated under vacuum. After the encapsulation, the partial discharges level is measured confirming the absence of bubbles or gaps, thus proving the long life of the whole high voltage insulation.

ABB Vacuum Cast Coil dry transformers are designed and built to meet all the applicable Standards as well as the client’s specifications.

Each and every ABB Vacuum Cast Coil dry transformer is submitted to a complete set of routine test. Each result is automatically compared to the design and guarantee values and statistical analysis are performed. This process allows us to ensure a consistent quality and to improve on a permanent basis our engineering and design tools.

Routine tests

- Measurement of windings resistances
- Transformation ratio measurement and connection checking
- Load loss and short-circuit impedance measurements
- No load loss and current measurements
- Separate source voltage-withstand test
- Induced over voltage withstand test
- Partial discharges measurements

Other tests such as type test can be carried out. These tests are used to be performed in case of important design modification in order to confirm that the quality of the product is maintained or improved. They can also be performed on order when requested by our clients.

Type Tests

- Temperature rise test
- Lightning impulse test

Special tests

Always performed under customer request:

- Noise level test
- Measuring zero-sequence impedance
- Measuring insulation resistance
- Measuring of harmonics of the no-load current
- Measuring of the parallel capacity of windings and tag \( \delta \)
- Anti-corrosion protection measurement
- Short circuit test

These tests are carried out in accordance with the relative IEC, EN, and/or IEEE/ANSI standards.(*)

Our test laboratory is certified according to the standard UNE-EN-ISO/IEC 17025:2000. This accreditation gives the authority to the certified company to act as an independent official laboratory and to test and issue the corresponding test reports as an independent third party. This is a unique service ABB can provide since no other transformer manufacturer has been certified according to this norm showing that our products are submitted to the most demanding control procedures.

Additionally our transformers have the following certificates:

- The class F1 "Fire behavior" certificate
- The class C1 and C2 "Climatic" certificate
- The class E2 "Condensation and humidity" certificate

EN: European Standards, harmonizes all relevant European Standards NF, BS, VDE, DIN, CEI, UNE,...
Computerized measuring equipment and test room facilities

Reliability for heavy duty
Overload Capacity

Experience has shown us that a dry type transformer usually lasts several decades. However, the exact figure is impossible to calculate, because it depends on the conditions it has been exposed to.

Life of a dry type transformer depends specifically on the overload suffered during its lifetime. These overloads can create a fluctuation of temperature during the winding that degrades the insulation because of thermic ageing.

However, a transformer can function with some overloads without affecting its lifetime. This is possible if the normal charge is smaller than the nominal power. These admissible overloads ($K_2$) are limited on time ($t_p$) according to the previous functioning rate (charge factor, $K_1$) and depend on the average ambient pondered temperature $\theta_a$.

Transformers are manufactured for a nominal power functioning, at a normal ambient temperature according to the standard IEC 60076-11:
- Maximum temperature: 40 °C
- Daily average temp.: 30 °C
- Annual average temp.: 20 °C
The reference temperature, if not specified other, will be the annual average temperature 20 °C.

A transformer, which has been designed to work under an annual average ambient temperature of 20 °C can be used in ambient under higher or lower temperatures, reducing or increasing the power according to the following figures:

<table>
<thead>
<tr>
<th>Annual Average Considered Ambient Power Temperature:</th>
<th>(% according to $P_{nom}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 °C</td>
<td>116 %</td>
</tr>
<tr>
<td>0 °C</td>
<td>110 %</td>
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<tr>
<td>10 °C</td>
<td>104 %</td>
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<tr>
<td>20 °C</td>
<td>100 %</td>
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<tr>
<td>25 °C</td>
<td>97 %</td>
</tr>
<tr>
<td>30 °C</td>
<td>94 %</td>
</tr>
<tr>
<td>35 °C</td>
<td>90 %</td>
</tr>
</tbody>
</table>
Technical Data IP 00, IP 21 up to 33
(higher protection level on demand)

Outline drawing - ABB Vacuum Cast Coil dry transformers IP 00

Outline drawing - ABB Vacuum Cast Coil dry transformers IP 21 up to 33
## Technical Data IP 00

### Highest Voltage for Equipment (Um) 12 kV

| Rated Power (kVA) | 50 | 100 | 160 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 |
|-------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| Rated Power (kVA) | 50 | 100 | 160 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 |

### Technical Data IP 21 up to 33

### Highest Voltage for Equipment (Um) 12 kV

### Highest Voltage for Equipment (Um) 24 kV

### Highest Voltage for Equipment (Um) 36 kV

Loses based according to CENELEC HD 538 Standard and aluminium windings. Other losses and conductor material available under request.
Distribution transformers offered by ABB

Liquid filled distribution transformers:
- up to 72.5 kV
- single phase and three phase
- ground mounted, pole mounted or pad mounted

Dry transformers:
- Open Wound
- Vacuum Cast Coil
- Resibloc®

Transformers for special applications like:
- Railway application
- Marine: propulsion and distribution
- Carrier Vessel Nuclear
- Rectifier Transformers
- Variable Speed Drive
- Excitation Transformers
- HVDC Converter
- Transformers for windmills
- Autotransformers
- Grounding/Earthing Transformers
- Neutral Earthing Reactors
- Current Limiting Reactors
- Arc Furnace
- Boostertransformers

Services offered by ABB Distribution Transformers
- Environmental Services - PCB Elimination Services
- Installation and Commissioning
- Training
- Testing and maintenance
- Retrofits, Revamping and up-grading
- Spare parts procurement

Technical information available from abb.com/distributiontransformers
Note:

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