Cast Coil Dry Type
Distribution Transformers

112.5 kVA Through 15,000 kVA
2300V Through 46 kV Primary Voltage
120V Through 15 kV Secondary Voltage
ABB is the global leader in power and automation technologies, partnering with utility and industrial customers to improve performance while reducing environmental impact. We are a full line transformer supplier representing an international community of 58 ABB transformer factories in 30 countries.

Our people make certain that our world renowned quality is exemplified by every product that bears the ABB name. An experienced and dedicated work force ensures the quality of our work and your satisfaction with our products. We strive for operational excellence, lowest manufacturing cost, and short cycle times.

ABB’s mission is to be the leader in delivering quality products and services for generation, transmission and distribution, industrial processes, mass transit, and environmental control that meet the needs and requirements of our customers and contribute to their success. To ensure customer satisfaction, ABB provides value-added, integrated solutions that are driven by superior technology and performance.

ABB employees are committed to leadership in applying the company’s unique combination of experience and global resources to meet societal goals for sustainable growth and clean energy.
ABB’s Cast Coil transformers provide the utmost space saving design along with ultimate reliability and efficiency. No other transformer comes close to the performance of Cast Coil for severe operating conditions.

Cast Coil transformers are non-flammable and moisture proof. They feature a solid insulation system which is partial discharge free. The coil design has minimal exposed surfaces that are smooth and predominantly vertical. This feature virtually eliminates particulate matter accumulation and minimizes maintenance.

Ultimate reliability, quick installations, low operating costs, and minimal maintenance, combined with superior dielectric capabilities, make ABB Cast Coil transformers the transformer of choice for extreme applications.

**Product Scope:**
- 112.5 kVA-15,000 kVA
- Primary Voltages: 2300V through 46 kV
- Primary BIL: Up to 250 kV
- Secondary Voltages: 120V through 15 kV
- Secondary BIL: Up to 95 kV

**Temperature Rise:** 80/115˚C

**Construction features:**
- HV Coils Vacuum Cast in Epoxy in a Metal Mold
- LV Coils 2400V and Less Hermetically Sealed in Epoxy
- LV Coils Greater Than 2400V Cast Under Vacuum in a Mold

**Benefits/Advantages:**
- Ultimate Impulse Withstand
- Minimal Maintenance
- No Liquids to Leak
- No Danger of Fire or Explosion
- UL Listed, ISO 9001 Registered
- Partial Discharge Free (Less than 20PC @ 120% operating voltage)
- 185˚C Insulation Class
- Moisture and Chemical Resistant
- Available With Indoor or Outdoor Enclosures

ABB’s Cast Coil transformers are designed for the most demanding customer requirements. The high voltage windings, which are the most sensitive and vulnerable part of any transformer, are cast under vacuum and locked in place by a heavy epoxy build. This concrete-like block protects the windings from distortion during power surges, the crushing forces of short circuits, and provides unequalled integrity required for operating voltages up to 46 kV and 250 kV BIL. The electrical integrity of this design is complemented by its flexible construction geometry. Cast Coil units utilize round or cruciform core and coil designs for specifically harsh loads with brutal short circuit demands.

**Typical Applications**
- Offshore Drilling Platforms
- Windmills
- Traction Substations
- Automotive Assembly
- Wastewater Treatment
Core and Coil Construction

Core Construction

ABB Cast Coil transformers utilize a step-lap mitered core construction to ensure optimum performance and minimal sound levels. The mitered core joints allow efficient flux transfer along natural grain lines between the core legs and yoke. The step-lap construction further enhances the efficiency of the joint by reducing joint fringing, which reduces core losses and exciting current.

The core is manufactured from high permeability, cold rolled, grain oriented silicon steel. The steel is precision cut to assure that it will be smooth and burr-free.

The core is designed to provide the lowest possible losses from the effects of magnetic hysteresis and eddy currents. All possible steps are taken to prevent local circulating currents and to avoid built-in bending stresses.

Coil Construction

ABB Cast Coil transformers utilize the electrical and mechanical strength of epoxy to provide the highest levels of performance and environmental protection.

Low Voltage Windings

Low voltage windings are hermetically sealed in epoxy using one of two processes. The windings can also be designed with air ducts for improved cooling performance.

The first method used to seal low voltage windings is the pre-impregnated insulation process. This process consists of winding the sheet conductor(s) in parallel with an epoxy pre-impregnated sheet of insulation. After the winding process is completed the coil is baked to dry the moisture from the winding and to cure the epoxy pre-impregnated insulation.

The curing process binds the coil together to form a solid winding block. The ends of the coil are then sealed with epoxy for added protection.

The second process is to cast the low voltage winding in a mold. Windings with operating voltage less than 600 volts are cast utilizing a pressure injection process. Windings with operating voltages greater than 600 volts are processed using the same techniques employed for the high voltage windings.

High Voltage Windings

ABB’s high voltage windings are typically wound using rectangular magnet wire or foil strip depending on the current capacity and voltage rating of the winding. Winding construction may be layer, disk or pancake construction. Transient analysis tests have been performed to verify the electrical stress distribution through the windings.

Primary windings are cast in epoxy, in a mold, under vacuum using a computer controlled mixing and vacuum casting process that insures the absence of voids. The epoxy used in the vacuum casting process is a mineral filled epoxy that is approved by UL. The mineral filled epoxy has been proven to enhance pure epoxy to increase its thermal conductivity, mechanical strength, arc resistance, and adhesion to the conductor; and change its coefficient of thermal expansion to be closer to that of the conductor material.

The windings are also fiberglass reinforced to provide additional mechanical strength. Each winding is partial discharge tested using induced voltage after it is completed to insure that it is void free.
ABB Cast Coil transformers are utilized in some of the harshest indoor and outdoor environments imaginable. While core and coil technologies have been enhanced to combat caustic and humid environments, transformers still require the protection of a properly designed enclosure.

An enclosure which flexes or bends under high wind loading can compromise electrical clearances from the transformer to the enclosure, which can lead to transformer failures as well as electrical safety hazards. An enclosure that allows excess water entry into the enclosure also poses undue risk. ABB designs have been tested for extreme weather requirements and the mechanical stresses associated with seismic criteria. ABB’s enclosure designs have been used along coastal areas and frigid northern slopes where high winds and driving rain are common.

ABB enclosures are custom fabricated using heavy gauge sheet steel as standard; aluminum and stainless are also available.

Electrostatically deposited dry powder paint, baked onto a phosphated surface, provides added protection against harsh outdoor or indoor environments.

A variety of options ranging from NEMA 2 drip-proof roofs to filters, screens, hinged panels, and special hardware can be added. Modifications can be made to extend the enclosure, add bottom plates, add end sheets, and special cut-outs for specific applications.
**Forced Air Cooling Increases kVA Capacity**

**Provisions for future fan cooling (FFA)**

When specified, transformers, can be supplied with provisions for future forced air cooling. This option includes bus work rated for increased current capacity and provisions for future installation of fans and fan control equipment.

**Forced air cooling (AA/FA)**

When specified, transformers, can be supplied with forced air cooling. Forced air cooling equipment includes fans, control wiring, thermal sensors, and a three phase electronic temperature monitor. The temperature sensors are located in the low voltage windings and are factory connected to the three phase winding temperature monitor which controls the forced air cooling automatically.

![Three phase electronic temperature monitor tracks the transformer temperature with automatic displays and functions.](image1)

**Electronic Temperature Monitor (ETM)**

The ETM combines temperature indication and fan control functions for the transformer and accepts input from three thermal sensors.

Features:
- Digital temperature display
- Hottest winding temperature is automatically displayed
- Temperature of any single winding can be displayed
- Maximum temperature can be recalled even if the supply power has been interrupted
- Fan, alarm, and trip functions are controlled by the hottest winding temperature
- DPDT contacts are provided for fan, alarm, and trip functions
- Contacts are dry
- Alarm relay is fail-safe
- Fans can be manually operated
- Includes internal sonic alarm, which can be temporarily silenced without canceling the alarm circuit
- Isolation box to separate gauge from energized components
- Alarm reset can be automatic or manual with auto condition start-up
- State-of-the-art solid state construction
- UL component recognized
- Non-magnetic Type E thermocouple standard
- Easy retrofit with existing panels
- Open thermocouple circuits are detected and indicated, but do not affect instrument operation
- Accepts 115 or 230 VAC supply power
- Form C relays.

**Optional Features**

- Fan exerciser (programmable) will energize fans once per week
- Remote communication available through RS-232 port.

Typical forced air cooling increases the rated capacity of ABB Cast Coil transformers 33 1/3% on units up to 5000 kVA and 25% for units 5001 kVA and larger.
The following tests are made on all transformers unless noted as an exception. The numbers shown do not necessarily indicate the sequence in which the tests will be made. All tests will be made in accordance with the latest revision of ANSI C57.12.91 Test Code for Transformers.

1. Resistance measurements of all windings on the rated tap and on the tap extremes on one unit of a given rating on a multiple unit order
2. Ratio Tests on the rated voltage connection and all tap connections
3. Polarity and Phase-relation Tests
4. No-load loss at rated voltage
5. Excitation current at rated voltage
6. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes on one unit of a given rating on a multiple unit order
7. Applied Potential Tests
8. Double Induced Potential Test.
Specifications

Standard Duracast Features

1. Winding construction:
   - HV coils vacuum cast in epoxy in a metal mold
   - LV coils (encapsulated) or pressure-injected in integral mold for 600V and below.
2. Aluminum windings—copper optional
3. Step-lap mitered core
4. 180˚C insulation system-115˚C average temperature rise
5. Four (4) full-capacity taps on HV winding rated 2 1/2% 2-FCAN—2-FCBN on units with voltage above 601V
6. NEMA 1 heavy-gauge ventilated enclosure with removable panels front and rear
7. ANSI 61 gray paint-electrostatically applied using dry powder
8. Vibration isolation pads between core and coil and enclosure
9. Base equipped with jacking pads and designed for rolling or skidding enclosure in any direction
10. Provisions for lifting core and coil assembly
11. Diagrammatic aluminum nameplate
12. 100% QC impulse test
13. Partial discharge-free (less than 20 pc @ 120% rated voltage)

Options & Accessories

- Copper windings
- 80˚C average temperature rise
- UL listing
- NEMA 3R enclosure
- LV windings vacuum cast in a mold 2400V and below through 2500 kVA
- Provisions for future fan cooling
- Three-phase electronic temperature monitor
- Forced cooling package with three-phase electronic temperature monitor
- Increased basic impulse levels
- Loss optimized designs
- Air-filled terminal chambers
- Special paint colors
- Retrofit designs

Temperature Rise/Overload Capacity

<table>
<thead>
<tr>
<th>Temperature Rise</th>
<th>Base Rated kVA</th>
<th>115˚C Rise kVA</th>
<th>Fan Cooled kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>80˚C</td>
<td>1000</td>
<td>1170</td>
<td>1556</td>
</tr>
</tbody>
</table>

Standards and Certifications

- ANSI C57.12.01
- ANSI C57.12.91
- ANSI N45.2-1977
- UL
- NRC 10CFR50 Appendix B
- ISO 9001
- NEMA ST20
- CSA Z 299.3
- MIL-I-45208A

ABB Cast Coil transformers are constructed with 180˚C class insulation and have a maximum temperature rise of 115˚C.

When ordered with 80˚C rise, the transformer (if specified) will have a 117% continuous overload capability (156% with fans). AA/FA/FA
Standard Transformer Ratings
Primary Voltage Class 600V through 34.5 kV 150˚C rise 30˚C average ambient

Altitude Derating Factor

<table>
<thead>
<tr>
<th>Altitude (FT)</th>
<th>Duracast (AA)</th>
<th>Forced Air (FA)</th>
<th>BIL Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>4000</td>
<td>.994</td>
<td>.989</td>
<td>.98</td>
</tr>
<tr>
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<td>.985</td>
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<td>.92</td>
</tr>
<tr>
<td>7000</td>
<td>.966</td>
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<td>.929</td>
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</tr>
<tr>
<td>9000</td>
<td>.948</td>
<td>.914</td>
<td>.83</td>
</tr>
<tr>
<td>10,000</td>
<td>.939</td>
<td>.898</td>
<td>.80</td>
</tr>
<tr>
<td>11,000</td>
<td>.930</td>
<td>.883</td>
<td>.77</td>
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<td>13,000</td>
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<tr>
<td>14,000</td>
<td>.903</td>
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<tr>
<td>15,000</td>
<td>.894</td>
<td>.823</td>
<td>.67</td>
</tr>
</tbody>
</table>

NOTE: 3.28 FT = 1 Meter

Audible Sound Levels

<table>
<thead>
<tr>
<th>Equivalent Two-Winding (kVA)</th>
<th>Self-Cooled</th>
<th>Ventilated Forced Air Cooled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class AA Rating</td>
<td>kVA</td>
</tr>
<tr>
<td>0-9</td>
<td>40</td>
<td>0-1167</td>
</tr>
<tr>
<td>10-50</td>
<td>45</td>
<td>1168-1667</td>
</tr>
<tr>
<td>51-150</td>
<td>50</td>
<td>1668-2000</td>
</tr>
<tr>
<td>151-300</td>
<td>55</td>
<td>2001-3333</td>
</tr>
<tr>
<td>301-500</td>
<td>60</td>
<td>3334-5000</td>
</tr>
<tr>
<td>501-700</td>
<td>62</td>
<td>5001-6667</td>
</tr>
<tr>
<td>701-1000</td>
<td>64</td>
<td>6668-8333</td>
</tr>
<tr>
<td>1001-1500</td>
<td>65</td>
<td>1.2</td>
</tr>
<tr>
<td>1501-2000</td>
<td>66</td>
<td>1.2</td>
</tr>
<tr>
<td>2001-3000</td>
<td>68</td>
<td>1.2</td>
</tr>
<tr>
<td>3001-4000</td>
<td>70</td>
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</tr>
<tr>
<td>6001-7500</td>
<td>75</td>
<td>1.2</td>
</tr>
</tbody>
</table>

BIL’s Associated Voltages

<table>
<thead>
<tr>
<th>Nominal System Voltage (kV)</th>
<th>BIL’s in common use (kV crest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>S 1 1</td>
</tr>
<tr>
<td>2.5</td>
<td>S 1 1</td>
</tr>
<tr>
<td>5.0</td>
<td>S 1 1</td>
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<tr>
<td>8.7</td>
<td>S 1 1</td>
</tr>
<tr>
<td>15.0</td>
<td>S 1 1</td>
</tr>
<tr>
<td>25.0</td>
<td>2 S 1 1</td>
</tr>
<tr>
<td>34.5</td>
<td>2 S 1 1</td>
</tr>
</tbody>
</table>

NOTES:
S = Standard value.
1 = Optional higher levels where exposure to overvoltage occurs and improved protective margins are required.
2 = Lower levels where protective characteristics of applied surge arresters have been evaluated and found to provide appropriate surge protection.

Impedance Chart

<table>
<thead>
<tr>
<th>kVA</th>
<th>ANSI Std.</th>
<th>ABB</th>
</tr>
</thead>
<tbody>
<tr>
<td>112.5-500</td>
<td>None Specified</td>
<td>5.75%</td>
</tr>
<tr>
<td>501 &amp; Larger *</td>
<td>5.75%</td>
<td>5.75%</td>
</tr>
</tbody>
</table>

* For Units with 60 kV Primaries and below.
* For Units with 208V Secondaries, the standard impedance value will be a 5.0% guaranteed minimum.

NOTE: 3.28 FT = 1 Meter
The transformer shall be vacuum cast epoxy resin construction and shall be mounted in a suitably ventilated (indoor, outdoor) enclosure.

The transformer shall be manufactured by a company which is certified to ISO 9001:1994, EN ISO 9001:1994; BS EN ISO 9001:1994; ANSI/ASQC Q9001: 1994 for design and manufacture of Power, Distribution and Specialty Dry Type Transformers. A certificate of Compliance to this requirement shall be provided with the proposal.

The transformer shall be rated _____ kVA with a primary voltage of _____kV (delta, wye) connected and have a BIL rating of _____ kV. The transformer coils shall be produced in the USA to ensure discharge extinction at or above 120% rated voltage.

The transformer coils shall be reinforced with fiberglass mat.

The high voltage and low voltage windings shall be constructed using (copper, aluminum) conductors.

The high voltage windings shall be vacuum cast in epoxy in a metal mold utilizing a proven casting process that ensures the absence of voids. The vacuum cast coils shall use a mineral filled casting epoxy which has been proven to provide acceptable thermal and mechanical performance. The mineral filler shall enhance the pure epoxy to increase its thermal conductivity, mechanical strength, arc resistance, and adhesion to the conductor; plus change its coefficient of expansion to be closer to that of the conductor material. The vacuum cast coils shall also be reinforced with fiberglass mat.

The transformer shall be constructed of individually cast primary and secondary coils, coaxially mounted. The low voltage windings shall be wound separately. The low voltage coils shall be blocked radially to the core to ensure short circuit integrity.

The finished primary and secondary coil must be hermetically sealed in epoxy utilizing a proven manufacturing system that demonstrates its ability to minimize hot spots and partial discharge. An induced partial discharge test shall be performed on each winding. The induced partial discharge test shall be performed by measuring partial discharge levels beginning at 80% rated voltage and continuing in 10% step increments through 200% rated voltage. Partial discharge inception and extinction levels above 10 Pico-Coulombs and shall be recorded. Acceptance criteria is Partial discharge extinction at or above 120% rated voltage.

The transformer coils shall be produced in the USA to ensure availability of replacement coils should it ever become necessary to have service. In addition, the manufacturer must have complete in-house capability to perform all ANSI required production tests, and the following optional tests when required: temperature rise, sound level, and full wave impulse.

The transformer core shall be constructed of high grade non-aging silicon steel laminations with magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. A step-lap mitered core joint shall be used to minimize losses, exciting currents and sound levels. The core laminations shall be clamped together with heavy steel members. The finished core and clamping structure shall be coated to protect against corrosion.

Primary and secondary coordination bus assemblies, as required for connection to associated switchgears are to be of bolted construction.

The transformer shall have vibration isolation pads installed between core and coil assembly and enclosure base structures to prevent the transmission of structure borne vibration.

The impulse rating of the transformer must equal or exceed the basic impulse level specified by ANSI for the applicable voltage class. The basic impulse level shall be inherent to the winding design and is to be obtained without the use of supplemental surge arresters.

The enclosure shall be constructed of heavy gauge sheet steel and shall be finished in ANSI 61 paint color. The paint shall be applied using an electrostatically deposited dry powder paint system. All ventilating openings shall be in accordance with NEMA and the NEC standards for ventilated enclosures. The base of the enclosure shall be furnished with ground pads located on opposite diagonal corners. The base shall have jacking pads and shall be constructed of heavy steel members to permit skidding or rolling in any direction. The core shall be visibly grounded to the frame by means of a flexible grounding strap.

Forced air cooling, when required, shall increase the continuous self cooled rating of the transformer by 33 1/3% on units through 5000 kVA and by 25% on units greater than 5000 kVA. The FA increase shall be possible with forced cooling without exceeding the specified maximum temperature rise. The forced air cooling shall be regulated automatically by sensors placed in the low voltage winding’s air ducts. Forced air cooling shall include: three phase electronic digital temperature monitor, fans, control wiring, control panel with test switch, indicator lights, alarm and alarm silencing switch.

After completion, each transformer shall undergo the following routine tests per ANSI C57.12.01 and ANSI C57.12.91. Testing shall be accomplished using calibrated test equipment which have recorded accuracy traceable to National Institute of Standards Technologies (NIST). Certification of Calibration shall be provided with test reports, if requested.

In addition to routine testing a 100% QC Impulse Test shall be performed on each transformer furnished.
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120V Through 15 kV Secondary Voltage