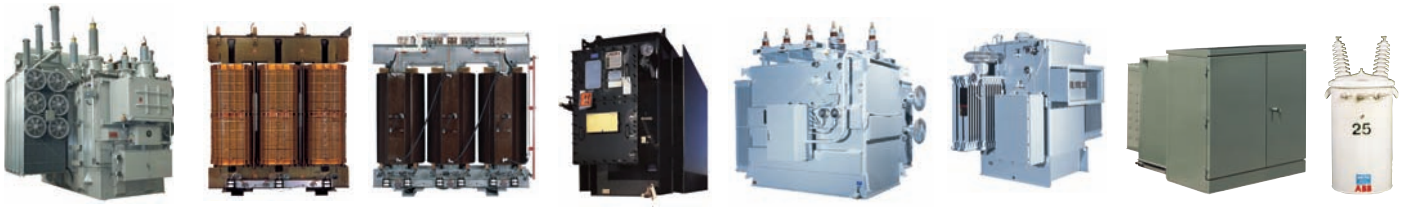
Cast Coil Dry Type Distribution Transformers

112.5 kVA Through 15,000 kVA
2300V Through 46 kV Primary Voltage
120V Through 15 kV Secondary Voltage

Quality Products...Built With Pride



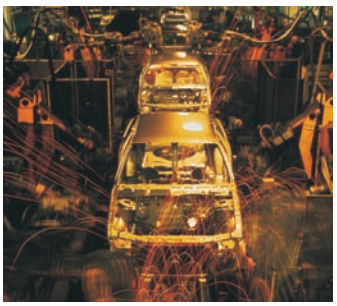


ABB is the global leader in power and automation technologies, partnering with utility and industrial customers to improve performance while reducing environmental impact. We are a full line transformer supplier representing an international community of 58 ABB transformer factories in 30 countries.

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.

Cast Coil transformers are designed to meet the demands of higher operating voltage systems and extreme environments where efficiency and dependability are crucial.

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

Computer controlled epoxy mixing for exacting consistency.

The Cast Coil Process

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

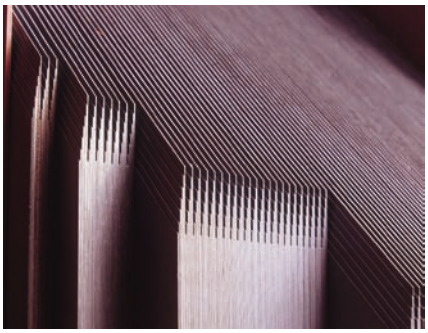
Core and Coil Construction

Core Construction

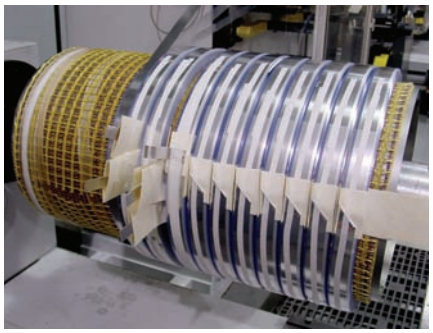
ABB Cast Coil transformers utilize a step-lap mitered core construction to ensure optimum performance and minimal sound levels. The mitered core joints allow efficient flux transfer along natural grain lines between the core legs and yoke. The step-lap construction further enhances the efficiency of 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.

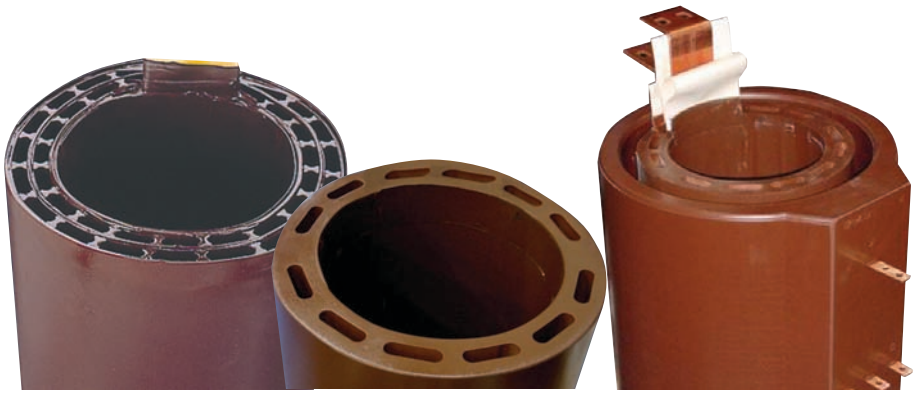
The core is designed to provide the lowest possible losses from the effects of magnetic hysteresis and eddy currents. All possible steps are taken to prevent local circulating currents and to avoid built-in bending stresses.



Step-lap mitered core joints are utilized for efficiency and noise reduction.



High voltage disk winding



Low voltage coils hermetically sealed and low voltage injection cast with cooling ducts

Vacuum cast high voltage with low voltage coil

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.

Indoor/Outdoor Application

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.

NEMA1
Indoor Enclosure

Outdoor Enclosure

Custom enclosures with special paint colors are available.

ABB's dry powder state-of-the art paint system keeps enclosures looking new for years.

Forced Air Cooling Increases kVA Capacity

Provisions for future fan cooling (FFA)

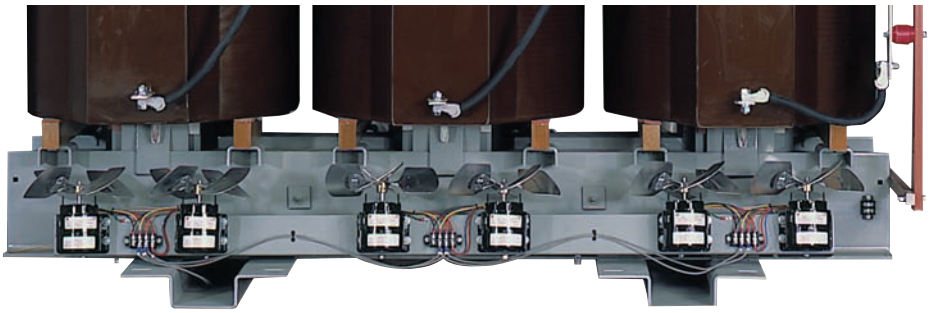
When specified, transformers, can be supplied with provisions for future forced air cooling. This option includes bus work rated for increased current capacity and provisions for future installation of fans and fan control equipment.

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.

The three phase electronic temperature monitor tracks the transformer temperature with automatic displays and functions.

Winding Temperature Indicator provided with isolation barrier.



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.

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.

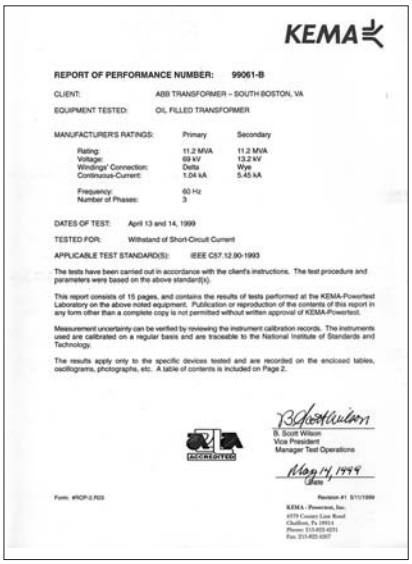
Optional Features

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

Quality Assurance

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.


KEMA

REPORT OF PERFORMANCE NUMBER: 99061-B

CLIENT: ABB TRANSFORMER – SOUTH BOSTON, VA

EQUIPMENT TESTED: OIL FILLED TRANSFORMER

MANUFACTURER'S RATINGS:	Primary	Secondary
Rating:	11.2 MVA	11.2 MVA
Voltage:	69 kV	13.2 kV
Windings' Connection:	Delta	Wye
Continuous-Current:	1.04 kA	5.45 kA
Frequency:	60 Hz	
Number of Phases:	3	

DATES OF TEST: April 13 and 14, 1999

TESTED FOR: Withstand of Short-Circuit Current

APPLICABLE TEST STANDARD(S): IEEE C57.12.90-1993

The tests have been carried out in accordance with the client's instructions. The test procedure and parameters were based on the above standard(s).

This report consists of 15 pages, and contains the results of tests performed at the KEMA-Powertest Laboratory on the above noted equipment. Publication or reproduction of the contents of this report in any form other than a complete copy is not permitted without written approval of KEMA-Powertest.

Measurement uncertainty can be verified by reviewing the instrument calibration records. The instruments used are calibrated on a regular basis and are traceable to the National Institute of Standards and Technology.

The results apply only to the specific devices tested and are recorded on the enclosed tables, oscillograms, photographs, etc. A table of contents is included on Page 2.

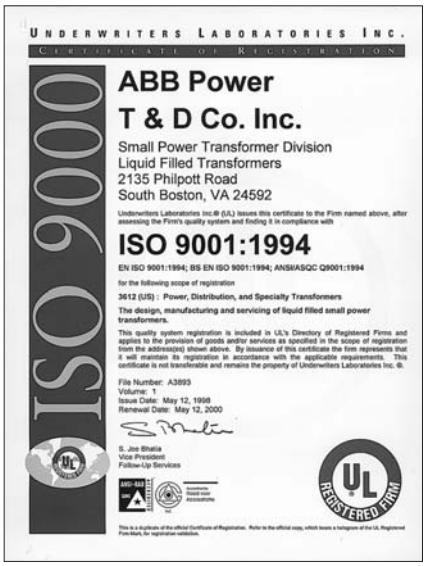
B. Scott Wilson
Vice President
Manager Test Operations

May 14, 1999
Date

Form: #ROP-2.R03 Revision #1: 5/11/1999

KEMA - Powertest, Inc.
4379 County Line Road
Chalfont, Pa 18914
Phone: 215-822-4251
Fax: 215-822-4267

Cast Coil transformers have successfully passed ANSI Short Circuit Tests.


UNDERWRITERS LABORATORIES INC.

CERTIFICATE OF REGISTRATION

ISO 9000

ABB Power
T & D Co. Inc.
Small Power Transformer Division
Liquid Filled Transformers
2135 Philpott Road
South Boston, VA 24592

Underwriters Laboratories Inc.® (UL) issues this certificate to the Firm named above, after assessing the Firm's quality system and finding it in compliance with

ISO 9001:1994

EN ISO 9001:1994; BS EN ISO 9001:1994; ANSI/ASQC Q9001:1994

for the following scope of registration

3612 (US) : Power, Distribution, and Specialty Transformers

The design, manufacturing and servicing of liquid filled small power transformers.

This quality system registration is included in UL's Directory of Registered Firms and applies to the provision of goods and/or services as specified in the scope of registration from the address(es) shown above. By issuance of this certificate the firm represents that it will maintain its registration in accordance with the applicable requirements. This certificate is not transferable and remains the property of Underwriters Laboratories Inc.®.

File Number: A3893
Volume: 1
Issue Date: May 12, 1998
Renewal Date: May 12, 2000

S. Joe Bhatia
Vice President
Follow-Up Services

This is a duplicate of the official Certificate of Registration. Refer to the official copy, which bears a hologram of the UL Registered Firm Mark, for registration validation.

REGISTERED FIRM

Cast Coil transformers are manufactured in an ISO 9001 Certified factory.

Standard Enclosure Design Dimension & Weights

15 kV 95 kV BIL Copper 80°				
kVA	Height Inches (mm)	Width Inches (mm)	Depth Inches (mm)	Weight Lbs. (kg)
300	90 (2286)	90 (2286)	60 (1524)	6000 (2724)
500	90 (2286)	96 (2438)	60 (1524)	7500 (3405)
750	90 (2286)	102 (2591)	60 (1524)	9000 (4086)
1000	90 (2286)	102 (2591)	60 (1524)	10,500 (4767)
1500	102 (2591)	114 (2896)	60 (1524)	14,500 (6583)
2000	102 (2591)	102 (3048)	66 (1676)	15,500 (7037)
2500	102 (2591)	126 (3200)	66 (1676)	20,000 (9080)
3000	102 (2591)	138 (3505)	66 (1676)	23,500 (10,669)

c UL ® LISTED 93DO DISTRIBUTION TRANSFORMER

UL ® LISTED 93DO DISTRIBUTION TRANSFORMER

Specifications

Self-Cooled Power Rating kVA	Primary Voltage kV	Primary BIL kV	Secondary Voltage kV	Secondary BIL kV	Temperature Rise C
112.5-15,000	Up through 46	Up to 250	Up through 15	Up to 95	80/115º

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

Temperature Rise	Base Rated kVA	115°C Rise kVA	Fan Cooled kVA
80°C	1000	1170	1556

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

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

Standard Transformer Ratings

Primary Voltage Class 600V through 34.5 kV 150°C rise 30°C average ambient

kVA 3-Phase			Secondary Voltage		
Self-Cooled	Fan-Cooled Ventilated Dry	Fan-Cooled Weather Resistant Ventilated	208Y/120 240 Delta	480Y/277 480 Delta	2400 Delta 4160Y / 2400 4160 Delta
112 1/2	—	—	X	X	—
150	—	—	X	X	—
225	—	—	X	X	—
300	400	400	X	X	—
500	667	667	X	X	X
750	1000	1000	X	X	X
1000	1333	1333	X	X	X
1000	1333	1333	X	X	X
1500	2000	2000	X	X	X
2000	2666	2666	—	X	X
2500	3333	3333	—	X	X
3750	4687	4687	—	X	X
5000	6250	6250	—	X	X
7500	9375	9375	—	—	X
10,000	12,000	12,000	—	—	X

"X" denotes standard or available.

Altitude Derating Factor

Altitude (FT)	kVA Correction		BIL Correction
	Duracast (AA)	Forced Air (FA)	
3300	1.00	1.00	1.00
4000	.994	.989	.98
5000	.985	.974	.95
6000	.975	.959	.92
7000	.966	.944	.89
8000	.957	.929	.86
9000	.948	.914	.83
10,000	.939	.898	.80
11,000	.930	.883	.77
12,000	.921	.868	.75
13,000	.912	.853	.72
14,000	.903	.838	.70
15,000	.894	.823	.67

NOTE: 3.28 FT = 1 Meter

Audible Sound Levels

Equivalent Two-Winding (kVA)	Self-Cooled	Ventilated Forced Air Cooled	
	Ventilated (Class AA Rating)	kVA	Class FA and AFA Rating
0-9	40	0-1167	67
10-50	45	1168-1667	68
51-150	50	1668-2000	69
151-300	55	2001-3333	71
301-500	60	3334-5000	73
501-700	62	5001-6667	74
701-1000	64	6668-8333	75
1001-1500	65		
1501-2000	66		
2001-3000	68		
3001-4000	70		
4001-5000	71		
5001-6000	72		
6001-7500	75		

BIL's Associated Voltages

Nominal System Voltage (kV)	BIL's in common use (kV crest)									
	10	20	30	45	60	95	110	125	150	200
1.2	S	1	1							
2.5		S	1	1						
5.0			S	1	1					
8.7				S	1	1				
15.0					S	1	1			
25.0						2	S	1	1	
34.5								2	S	1

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

kVA	ANSI Std.	ABB
112.5-500	None Specified	5.75%
501 & Larger *	5.75%	5.75%

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

The transformer shall be vaccum 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 and a secondary voltage of _____V (delta,wye) connected and have a BIL rating of _____ kV.

The transformer is to have an impedance (per manufacturer's standard, _____ %IZ.)

The average temperature rise of the transformer windings shall be rated at (80°C, 115°C). The insulating system used, including epoxy, shall be rated 180°C or higher. The transformer shall not exceed the specified temperature rise when the unit is operated continuously at full nameplate rating. The transformer shall be capable of carrying 100% of the nameplate rating in a 30°C average, not to exceed 40°C maximum ambient in any 24 hour period.

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 hermetically sealed with epoxy and the coil shall be blocked radically 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.

Descriptive Bulletin 47-950 Revised 04/05 The Musselman Group, Roanoke, VA

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