



Dry-Type Medium Voltage  
Distribution (Power) Transformer  
1.2 kV to 46 kV Class  
500kVA to 34 MVA

power to perform



Hammond  
Power Solutions



## Dry-Type Distribution (POWER) Transformers Catalog

The Hammond Power Solutions (HPS) HPWR Dry-Type Medium Voltage Distribution (Power) Transformers Catalog contains updated product, technical, installation and service information which enables HPS to continue to be your first choice for quality and reliable dry-type medium voltage distribution (power) transformers.

This catalog is designed to ensure every decision you make is an informed decision. Unlike other manufacturers, our catalog details everything you need to know about all aspects of our dry-type medium voltage distribution (power) transformer product. Whether from materials to construction or from installation to servicing, the HPWR catalog has it all.

Thank you for choosing HPS as your transformer supplier and if you have any questions regarding this catalog please feel free to contact us at the numbers listed on the back cover.



## Selecting & Ordering your HPS Transformer

In addition to the quality and reliability that is built into every HPS transformer you purchase, we also know that the ease at which you can find the correct product to match your needs and have it delivered is equally important. HPS has more ways to accomplish this than any other transformer manufacturer in the market today.

### **Additional Product Information**

The HPWR catalog, as well as any other product literature, is available in print form and electronically from [www.hammondpowersolutions.com](http://www.hammondpowersolutions.com). Download your free copies anytime.

### **Quotation and Pricing**

To authorized<sup>1</sup> customers, we offer access to the industry's most powerful on-line specification and quotations program. The HPS "E-Quotes" program allows anyone to specify, price or quote almost any standard or custom HPS product. Each quote provides detailed product specifications and pricing as well as current stock and availability information. To request access, just go to ([www.hammondpowersolutions.com](http://www.hammondpowersolutions.com)) and on the top menu bar, under the "Online Tools" select "HPS E-Quotes". On this page you will see a link to request access to E-Quotes.

<sup>1</sup>Available upon request to any Partner Distributors and authorized customers only. Contact Hammond Power Solutions for details.



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# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

## SECTION 1

### THE COMPANY

Established in 1917, Hammond Power Solutions Inc. (HPS), is an industry leader in magnetic transformer design and development. With our headquarters in Guelph, Canada, HPS operates out of multiple facilities globally. HPS has expanded its manufacturing and product base to offer the broadest ranges of both standard and specialty transformers.

Our engineering experience and capability has resulted in a computer database of over one million transformer designs. We offer the most cost effective, highest quality transformers in order to satisfy your requirements.

There are HPS facilities in Canada, USA, Mexico, Italy and India to service your global needs.



### COMPETITIVE EDGE

North American stand-alone leader for the design and manufacture of standard & custom electrical engineered dry-type transformers.

- Multi-national manufacturing presence
- Multiple channels to market
- Highly regarded for our engineering expertise
- Dominant Supplier in the transformer industry
- Globally recognized and respected

### HPS DRY-TYPE MEDIUM VOLTAGE TRANSFORMERS

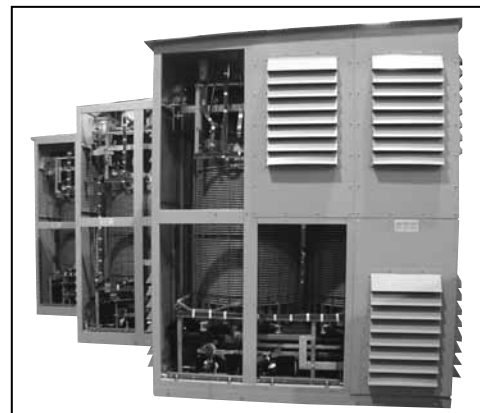
Our dry-type medium voltage distribution (power) transformers are regarded for their high level of quality and service reliability that has become synonymous with HPS transformer products. With three phase ratings up to 34 MVA, 46 kV, 250 kV BIL and single phase to 5 MVA, we feature the newest technology and manufacturing processes.

### APPLICATIONS

With the continued development in the technology of materials, designs and manufacturing methods, the use of dry-type medium voltage transformers is growing rapidly throughout North America.

HPS Transformers are suitable for any commercial, industrial, manufacturing or production process application. Distribution (power) transformers, unit substation transformers, drive & rectifier duty and distribution transformers can be offered for a variety of environmental conditions and built to meet the most onerous duty.

In addition to conventional indoor applications, our dry units are located outdoors, on drilling platforms, in network vaults and in every location where airborne contaminants pose a risk to electrical equipment.



## CUSTOMER SERVICE

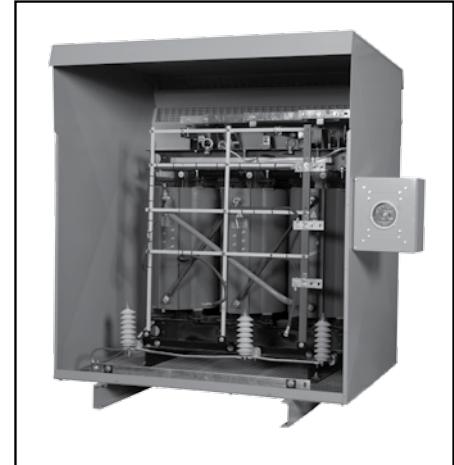
Our inside sales team is available to answer your questions immediately. They are technically trained and are able to answer most questions over the phone. Stock checks, expediting, quotations and technical information are always readily available. Our commitment to customer service means you will be an informed, relaxed and satisfied customer as quickly as possible. Call our inside sales team and let us serve you.



## DESIGN CAPABILITIES

HPS engineering services are located throughout our manufacturing facilities. Our history and experience in transformer magnetics places us at the top in the industry. Our extensive testing program including all qualification tests and short circuit testing, plus an exemplary field service record, ensures that our products not only meet all the standards necessary, but more importantly, fulfill your expectations and requirements.

Our designs are cost-effective and our transformers are built with modern manufacturing techniques. We particularly emphasize our 'Value Added Engineering' where our design staff will work with your team to produce the optimum and cost effective solution for your application. Our fully computerized design, CAD and 3-D modeling capabilities permits quick and effective communication when time is vital.



## A RELIABLE SOURCE

For over 95 years, HPS has continued to grow from a small family business to an industry leader in dry-type transformer technology. Our customers have come to rely on our products and services and continue to depend on us for support at the most critical stages of their need. Our stability and integrity as a supplier are paramount, particularly in an industry environment where demands must be resolved quickly and effectively.

## TECHNICAL SUPPORT

The experienced HPS technical team is available to help you with your applications or design questions. Call our regional offices for assistance.

## QUALITY ASSURANCE

HPS has been regarded for its quality since its very inception. With our commitment to 'Excellence' and 'Continuous Improvement', we build value and reliability into every HPS product. All facilities have implemented quality management systems based on ISO 9001:2008 with the Guelph facility having certification to that quality standard. Our distribution (power) transformer products are designed to meet ANSI/IEEE, CSA, UL, IEC and NEMA standards.



## TRANSFORMER TERMINOLOGY

### Applied Potential (Hi-pot) Test

This dielectric test verifies the integrity of the insulation of each winding to all other windings and ground.

### Coil Hot-Spot Temperature

The coil hot-spot temperature is the absolute maximum temperature present in the transformer. This number is equal to the sum of the following:

$T_{\text{Hot Spot}} = T_{\text{ambient}} + T_{\text{average winding rise}} + T_{\text{hot spot rise adder or rise above average}}$

### Continuous Rating

Continuous rating is the continuous power (kVA) the transformer delivers to the load without exceeding its specified temperature rise.

### Delta Connection ( $\Delta$ )

The delta connection is a standard three phase connection with the ends of each phase winding connected in series to form a closed loop. Sometimes referred to as three wire. The phase relationship will form a Delta.

### Wye Connection ( Y )

A wye connection is a standard 3-phase transformer connection with similar ends of each of the phase coils connected. This common point forms the electrical neutral point and may be grounded. When the neutral is brought out it makes a 4 wire system.

### Dielectric Tests

These tests consist of the application of a voltage higher than the rated voltage for a specified time, for the purpose of determining the adequacy of insulation strength and electrical clearances.

### Impedance

Is the impeding element against current flow.

### Basic Impulse Level Tests (BIL)

Impulse tests are dielectric tests consisting of the application of a voltage waveform with a very steep rise voltage applied to a winding. The test simulates a voltage and current surge through the transformer winding when a lightning induced voltage surge reaches the transformer.

### Efficiency

Efficiency is the ratio of useful power output to the total power input.

### Exciting Current (No-Load Current)

Exciting current is current drawn by the transformer under no load conditions. It is usually expressed in percent of the rated current of the winding in which it is measured.

### Frequency

In AC circuits, currents & voltages follow a cyclic pattern. Frequency designates the number of such cycles repeated every second. The unit of measure is hertz.

### Induced Potential Test

This dielectric test verifies the integrity of insulation within a transformer winding and between phases.

### Insulating Materials

These materials are used to electrically insulate the transformer. That includes windings - turn to turn and layer to layer, and other assemblies in the transformer such as the core and bus work.

### kVA or Volt-Ampere Output Rating

The kVA or volt-ampere rating designates the output which a transformer can deliver for a specified time at rated secondary voltage and rated frequency, without exceeding the specified temperature rise. (1 kVA = 1000 VA)

### Natural Convection Cooling

Natural convection is the cooling class in which the transformer is cooled by the natural circulation of air.

### Load

The load of a transformer is the apparent power delivered by the transformer in MVA, kVA, VA.

### No-load Losses (Excitation Losses)

When a transformer is energized under no-load, some power is drawn from the supply, predominately to feed transformer core losses, but to a smaller extent feed losses in the winding due to excitation current. These losses are termed "no-load losses".

### Load Losses

Load losses are incident to load carrying. Load losses include  $I^2R$  losses in the windings due to load current, eddy current losses in the winding conductors, stray loss due to stray fluxes in the winding, core clamps, etc. and due to circulating currents in parallel windings.



## Transformer Terminology continued

### Phase

Unlike DC, AC power can be vectorially displaced. Various vectorially displaced windings can be connected to make an AC system. Each displaced winding is a phase. In 3 phase transformers there are 3 vectorially displaced windings.

### Power Factor

Power factor in a circuit is the relation of watts to volt amps.

### Polarity Tests

This standard test on transformers determines the instantaneous direction of the voltages between the windings. It determines if the winding connections are correct.

### Primary Voltage Rating

This rating designates the input voltage for which the input winding is designed.

### Primary Winding

The primary winding is the winding on the energy input (supply) side.

### Ratio Test

A ratio test is a standard test applied to transformers and used to determine the ratio of turns between the windings.

### Scott 'T' Connection

This is the connection for three phase using two special single phase transformers. It is most frequently used to change from two phase to three phase or three phase to two phase.

### Secondary Voltage Rating

This rating designates the no-load load-circuit voltage for which the secondary winding is designed.

### Secondary Winding

The secondary winding is the winding on the energy output side.

### Tap

A tap is a connection brought out of a winding at some point between its extremities, usually to permit changing the voltage ratio.

### Temperature Class

Temperature class is a rating system for maximum temperature for the insulation in a transformer, i.e.

#### Insulation Rating

Class 105

Class 150 or 130

Class 180

Class 200

Class 220

### Temperature Rise

The average increase in temperature of a winding over ambient (determined by change in resistance) is known as the Temperature Rise of a winding.

### Transformer

A transformer is an electrical device without moving parts which, by electromagnetic induction, transforms power between circuits at the same frequency, usually with changed values of voltage and current.



## COMPLIANCE WITH ENGINEERING STANDARDS

All HPS dry-type distribution (power) transformers are CSA certified and meet the following additional standards:

- ➡ **CSA-C22.2 No. 47:** Air-Cooled (Dry-Type) Transformers
- ➡ **CSA-C9:** Dry-Type Transformers

UL approved transformers are available upon request and will meet the following additional standards:

- ➡ **UL 1561:** Dry-Type General Purpose and Power Transformers
- ➡ **UL 1562:** Transformers, Distribution, Dry-Type over 600 volts

**Energy Efficient Standards:**

- ➡ **CSA C802.2 (SOR/94651):** Canadian Energy Efficiency Regulations
- ➡ **DOE 10 CFR Part 431:** United States Energy Efficiency Regulations

HPS dry-type distribution (power) transformers can be built to comply with the following engineering standards:

- ➡ **IEEE-C57.12.01:** General Requirements for Dry-Type Distribution and Power Transformers.
- ➡ **IEEE-C57.12.51:** Requirements for Ventilated Dry-Type.
- ➡ **IEEE-C57.12.70:** Terminal Markings & Connections for Distribution & Power Transformers.
- ➡ **IEEE-C57.12.91:** Test Code for Dry-Type Distribution and Power Transformers.
- ➡ **IEEE-C57.12.91:** Guide for Short Circuit Testing of Distribution and Power Transformers.
- ➡ **NEMA 250, UL 50 & UL 50E:** Enclosures for Electrical Equipment.
- ➡ **NEMA TR 1-1993 (R2000):** Transformers, Regulators and Reactors.

## TRANSFORMER TEST STANDARDS

All distribution (power) transformers are tested at the manufacturing facility prior to shipment. Transformers must meet very specific criteria to be certified acceptable for release. Tests are categorized as 'Production Tests' and 'Type Tests'. Production Tests are applied to every transformer, where Type Tests are required either to qualify a new product or to further certify a production product. Type tests are optional and are available at an additional cost.

### Type Tests

The following are descriptions of type tests performed (upon request) on HPS power transformers.

#### Temperature Rise Test

The temperature rise test determines the thermal performance of a transformer for which it was designed. The temperature rise test is conducted at rated current and/or voltage as per the procedures defined in all relevant standards (e.g. CSA-C9, IEEE-C57.12-91 etc.).

#### Sound Level Test

The sound level test determines the sound emitted by a transformer.

Most standards require the test to record a weighted sound pressure level which is the weighted average of sounds of different frequencies as defined in the standards. The sound pressure level is measured in dB with the transformer energized at rated voltage with no load (IEEE-C57.12.91).



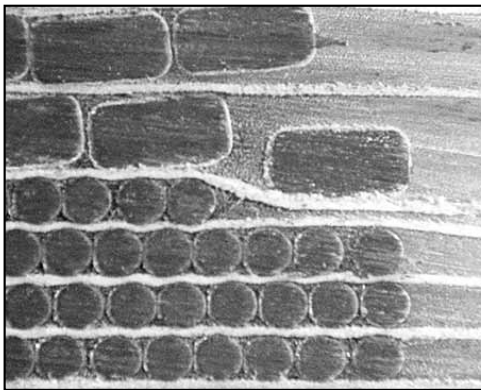
## Transformer Test Standards continued

### Partial Discharge Test

Partial discharge is defined as an electric discharge which only partially bridges the insulation between conductors, and which may or may not occur adjacent to a conductor.

Partial discharges occur when the local electric field intensity exceeds the dielectric strength of the dielectric involved, resulting in local ionization and breakdown. Depending on intensity, partial discharges are often accompanied by emission of light, heat, sound and radio influence voltage (with a wide frequency range).

The relative intensity of partial discharge can be observed at the transformer terminals by measurement of the apparent charge. However, the apparent charge (terminal charge) should not be confused with the actual charge transferred across the discharging element in the dielectric which in most cases cannot be ascertained.



### Basic Impulse Level Test (BIL Test)

The BIL test determines the adequacy of the insulation structure to withstand a lightning induced voltage surge. The test comprises of the application of an impulse voltage of a specific wave shape to the winding terminal under consideration, with all other terminals and metal parts grounded.

The standard impulse levels for stand alone dry-type transformers are:

Voltage Class	BIL Full & Chopped Wave
5 kV	30 kV
15 kV	60 kV
18 kV	95 kV
25 kV	110* kV
34.5 kV	150 kV
46 kV	200 kV

\*110 kV - IEEE C57.12.01 or 125 kV - CSA C9.02

Impulse levels are also important for the selection of lightning arresters. For special applications or where the hazard of lightning strikes is high, higher than standard BIL can be supplied. For more information, please contact your local sales offices.



When a lightning or surge arrester is applied at the transformer terminals, the voltage stress at the terminals is limited by the arrester.

If there is any possibility the transformer terminals will be subjected to transient over-voltages exceeding 80% of their BIL, it is recommended that they be protected with the appropriate surge arresters.

### Short-Circuit Test

CSA & IEEE Standards require dry-type transformers be capable of withstanding a short circuit, with rated voltage applied, provided that the magnitude of the RMS. symmetrical current does not exceed 25 times the rated current and the duration of the short circuit is limited to 2 seconds. The RMS symmetrical short circuit current is a direct inverse function of total impedance (transformer impedance + system impedance as applicable as per standard) and is calculated as follows:

$$\text{Rated Current} \times \frac{100}{Z \text{ in percent}}$$

That is 5.0% Z gives 20 X normal, 6.0% gives 16.6 X normal, etc.

IEEE standard C57.12.91 "Test Code For Dry-Type Distribution and Power Transformers" defines a procedure by which the mechanical capability to withstand a short circuit may be demonstrated. The prescribed tests are not designed to verify thermal performance; conformance to short circuit thermal requirements is by calculation. Most standards specify a method of heat calculation and formulae to be utilized.



## Transformer Test Standards continued

### Short Circuit Experience

Critical to the life expectancy of transformers is their ability to withstand system short circuits. Standards typically call for a distribution (power) transformer to survive the mechanical and thermal stresses of a short circuit across any winding, while all other windings operate at rated voltage. The magnitude of the RMS symmetrical current can be as much as 25 times the normal rated current in that winding, and can last for as long as 2 seconds.

At HPS, we recognize the importance of this in our standard construction as there is little in the way of recovery or resolution after an incident in the field.

As part of our development program to enhance the quality of our transformers from time to time, HPS will complete short circuit testing of some units to confirm optimum design and construction.

Make no assumptions about the ability of your distribution (power) transformer to withstand short circuits. Ask your supplier to show you the record.

### Electric & Magnetic Field (EMF) Test

Electric and Magnetic Fields (EMF) are produced by the distribution of electricity through current carrying devices. New techniques have been developed by HPS that allow for a reduction of the radiated EMF levels produced on a particular side of a transformer. HPS offers lab testing and certification for transformer EMF levels.



## Production Tests

The following production tests are performed on every HPS transformer above 500 kVA.

### D.C. Resistance Measurement

Measures the DC resistance of a coil using a DC resistance bridge.

### Voltage Ratio (turns ratio)

To confirm the voltage ratio conforms to the nameplate voltage rating (within limits of acceptable error as defined in the standards).

### Polarity and Phase-Relation Test

Polarity and phase-relation tests are made to determine angular displacement and relative phase sequence as required by customer specifications.

### No-Load and Excitation Current Test

Rated voltage is applied to one winding and the current and losses are measured.

### Impedance Voltage and Load Loss Test

One winding is shorted and a voltage is applied to the other winding to force rated current in the transformer windings. The losses, voltages and currents are measured.

### Dielectric Tests

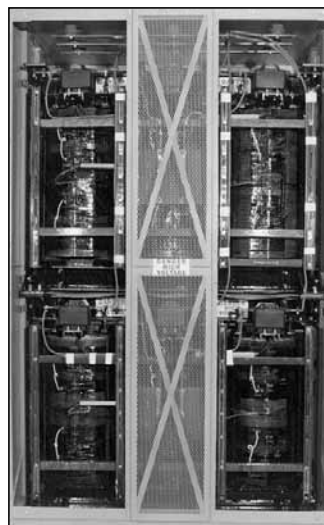
The purpose of dielectric tests is to demonstrate that the transformer has been designed and constructed to withstand the over-voltages required by standards.

### Applied Voltage Test

A power frequency such as 60 Hz, is applied to the winding voltage under test at a voltage corresponding to the voltage class of the winding, in accordance with table (5) in IEEE-C57-12-01 or tables 9 or 10 of CSA-C9. The voltage is applied to the winding under test for 1 minute with all other windings and the core grounded.

### Induced Voltage Test

A voltage at 2 times the rated voltage is applied for 7200 cycles between terminals of a winding with terminals of all other windings open.



## MANUFACTURING PROCESSES

HPS produces the most reliable, technologically superior medium voltage distribution (power) transformers in the market today.

This is a result of continuing development in all phases of the design and manufacturing processes in meeting the requirements of a broad range of customers and the most onerous applications. Additionally, these transformers have demonstrated improved withstand ability to short circuits and will provide a life expectancy considerably in excess of current industry standards.

### Core Construction

HPS cores are manufactured from high grade non-aging, fully processed silicon steel laminations. Cores are precision cut to close tolerances using modern equipment, eliminate burrs and minimize losses. They feature core construction that optimizes energy efficiency.

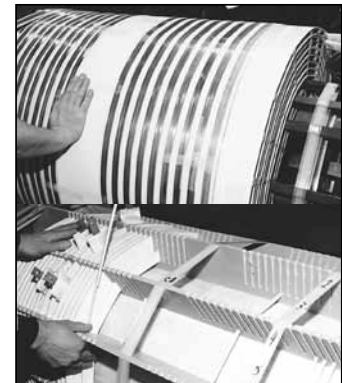
The core is resin sealed to prevent the ingress of moisture.

### Coil Construction

Coils are either layer (barrel) or disc wound to suit the voltage class. Typically, disc wound coils are utilized above 8.7 kV class. Available in aluminium or copper, windings are designed with wire or foil conductors for optimum performance for the application.

Disc wound coils feature comb construction to electrically balance voltage stresses over the full length of the coil.

All internal connections are brazed or TIG or MIG welded.



### Insulation

Typically HPS dry-type medium voltage distribution (power) transformers are manufactured with a 220°C insulation system. High temperature resistant materials are used including NOMEX® Aramid papers, silicone coated fiberglass, NOMEX® sleeving, supersil duct sticks and pressure sensitive glass tape. All materials meet or exceed UL standards for use on dry-type medium voltage distribution (power) transformers.

### Core and Coil Assembly

As a completed assembly, the coils are held rigidly in place between insulators clamped to the upper and lower core frames under high compression.

Winding terminals can be secured firmly to the transformer structure.

The picture to the right shows how low voltage bus bars are bolted to the upper or lower steel support frame with insulators and quality hardware, all to ensure the integrity of the core and coil assembly. Other optional termination methods are available.



### Impregnation

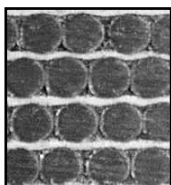
It is critical that transformers maintain the integrity of the dielectric properties of the insulation materials essential for long-term life expectancy. In order to meet designed life expectancies, transformers must not be compromised during the impregnation process.



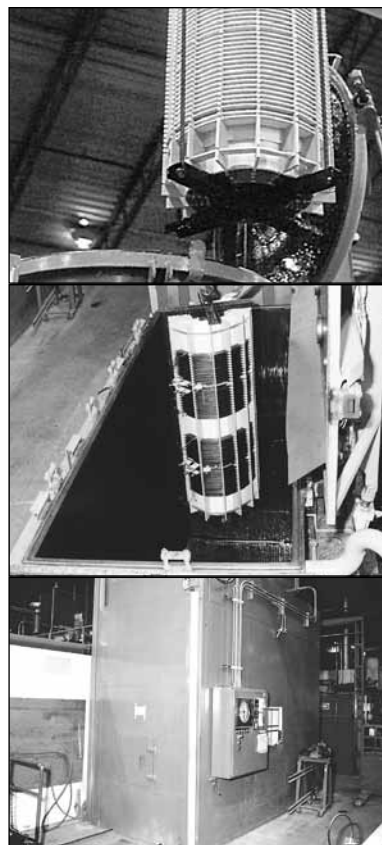
## Manufacturing Processes continued

At HPS, transformer coils are impregnated with two complete vacuum-pressure impregnating cycles:

- Coils are placed in a sealed tank and a full vacuum is drawn.
- The impregnation resin is then introduced into the chamber and the coils, or assembly, are completely immersed in the impregnation resin.
- The tank is pressurized to force the impregnation resin to thoroughly penetrate the windings.
- The coils or assembly are removed from the chamber and oven cured.
- A complete second impregnating cycle follows to ensure thorough and complete impregnation.



The result are transformer coils which exhibit virtually partial discharge free performance, a superior resistance to environmental conditions and a new standard of reliability even for the most onerous industrial, utility or commercial applications.

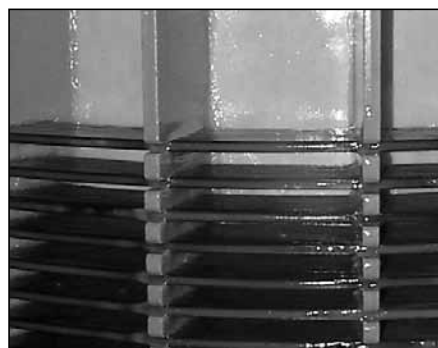


## VACUUM IMPREGNATION

### Polyester Resin Impregnation

For most general purpose indoor transformer applications regardless of voltage class, our 'HPS' resin impregnation system is preferred. This material is a blend of resins that exhibit much higher dielectric strength and bonding properties than any varnishes previously used or other encapsulations including oil modified epoxies. This resin system is ideal for transformers in meeting the following requirements:

- Low moisture absorption
- High dielectric strength
- High bond strength
- Excellent mechanical properties
- Stability at high temperatures
- Excellent thermal shock properties
- Longevity of life at maximum transformer temperatures
- UL approved for 220°C insulation systems for any voltage class
- Fungus resistant reactive components makes it environmentally superior
- Thixotropic epoxy encapsulation is available to customers considering additional protection



## MEDIUM VOLTAGE DISTRIBUTION TRANSFORMER ENERGY EFFICIENCY GUIDELINES

In the past several years, there has been an accelerated rate of change to introduce energy efficiency standards for transformers in North America. In addition to the benefits to the environment, energy efficient transformers realize substantial savings in operating costs, thereby having a direct impact on the initial investment evaluated over a period of time.

### United States - Energy Efficiency Regulations

In the U.S. all medium voltage dry-type distribution transformers (as defined below) manufactured after January 1st, 2010, must meet the minimum energy efficiency standards outlined in DOE 10 CFR Part 431.

The range of product covered by these standards are:

<b>Primary (high) Voltage</b>		601V to 34.5 kV
<b>Secondary (low) Voltage</b>		600V and below
<b>Dry-Type Rating</b>	<b>Single Phase</b>	15-833 kVA
	<b>Three Phase</b>	15-2500 kVA
<b>Frequency</b>		60 Hz only

For transformers exempted from the DOE efficiency regulations please refer to the following DOE link:  
[http://www.access.gpo.gov/nara/cfr/waisidx\\_09/10cfr431\\_09.html](http://www.access.gpo.gov/nara/cfr/waisidx_09/10cfr431_09.html)

US Department of Energy DOE 10 CFR Part 431 Efficiency Levels Dry-Type Distribution Transformers - <u>Medium Voltage</u>							
Single Phase				Three Phase			
kVA	20 - 45 kV BIL Efficiency (%)	46 - 95 kV BIL Efficiency (%)	≥ 96 kV BIL Efficiency (%)	kVA	20 -45 kV BIL Efficiency (%)	46 - 95 kV BIL Efficiency (%)	≥ 96 kV BIL Efficiency (%)
15	98.10	97.86	-	15	97.50	97.18	-
25	98.33	98.12	-	30	97.90	97.63	-
37.5	98.49	98.30	-	45	98.10	97.86	-
50	98.60	98.42	-	75	98.33	98.12	-
75	98.73	98.57	98.53	112.5	98.49	98.30	-
100	98.82	98.67	98.63	150	98.60	98.42	-
167	98.96	98.83	98.80	225	98.73	98.57	98.53
250	99.07	98.95	98.91	300	98.82	98.67	98.63
333	99.14	99.03	98.99	500	98.96	98.83	98.80
500	99.22	99.12	99.09	750	99.07	98.95	98.91
667	99.27	99.18	99.15	1000	99.14	99.03	98.99
833	99.31	99.23	99.20	1500	99.22	99.12	99.09
				2000	99.27	99.18	99.15
				2500	99.31	99.23	99.20

All efficiency values are at 50% of nameplate-rated load at 75°C reference temperature.





# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

## Canada - Energy Efficiency Regulations

In Canada, all medium voltage dry-type distribution transformers (as defined below) manufactured after January 1st, 2005, must meet the minimum energy efficiency guidelines as per CSA C802.2. As a result, in 2010 the Canadian Energy Efficiency Act - Energy Efficiency Regulations (SOR/94-651) has been updated and the regulation harmonized the minimum efficiency levels with those established in the U.S. DOE 10 CFR Part 431. This became effective April 12, 2012.

The range of product covered by these standards are:

<b>Primary (high) Voltage</b>		35 kV or less
<b>Secondary (low) Voltage</b>		Less than 4000 Amps
<b>Dry-Type Rating</b>	<b>Single Phase</b>	15-833 kVA
	<b>Three Phase</b>	15-7500 kVA
<b>Frequency</b>		60 Hz only

For transformers exempted from the Canadian Efficiency Regulations please refer to the following NRCan link:  
<http://laws.justice.gc.ca/eng/sor-94-651/page-1.html>

Canadian Energy Efficiency Act - Energy Efficiency Regulations							
Efficiency Levels							
Dry-Type Distribution Transformers - <u>Medium Voltage</u>							
Single Phase				Three Phase			
kVA	20 - 45 kV BIL Efficiency (%)	46 - 95 kV BIL Efficiency (%)	≥ 96 kV BIL Efficiency (%)	kVA	20 - 45 kV BIL Efficiency (%)	46 - 95 kV BIL Efficiency (%)	≥ 96 kV BIL Efficiency (%)
15	98.10	97.86	97.60	15	97.50	97.18	96.80
25	98.33	98.12	97.90	30	97.90	97.63	97.30
37.5	98.49	98.30	98.10	45	98.10	97.86	97.60
50	98.60	98.42	98.20	75	98.33	98.12	97.90
75	98.73	98.57	98.53	112.5	98.49	98.30	98.10
100	98.82	98.67	98.63	150	98.60	98.42	98.20
167	98.96	98.83	98.80	225	98.73	98.57	98.53
250	99.07	98.95	98.91	300	98.82	98.67	98.63
333	99.14	99.03	98.99	500	98.96	98.83	98.80
500	99.22	99.12	99.09	750	99.07	98.95	98.91
667	99.27	99.18	99.15	1000	99.14	99.03	98.99
833	99.31	99.23	99.20	1500	99.22	99.12	99.09
				2000	99.27	99.18	99.15
				2500	99.31	99.23	99.20
				3000	99.34	99.26	99.24
				3750	99.38	99.30	99.28
				5000	99.42	99.35	99.33
				7500	99.48	99.41	99.39

All efficiency values are at 50% of nameplate-rated load at 75°C reference temperature.



## Standard Weight and Dimensional Specifications

The tables on pages 16, 17 and 18 list three phase general purpose distribution (power) transformers specifications for 150°C temperature rise units.

Table 1 and Table 2 list Energy Efficient (CSA C802.2 and DOE 10 CFR Part 431) copper and aluminum respectively, for units 500 kVA to 7500 kVA in voltage classes from 1.2 kV to 15 kV.

Table 3 and Table 4 list non-energy efficient copper and aluminum respectively, for units 500 kVA to 15000 kVA in voltage classes from 1.2 kV to 46 kV.

For specifications on other sizes and ratings or specialty transformers such as: dual HV windings, dual LV windings, rectifier transformers, traction duty transformers or cycloconverter transformers, please consult our quotations department.

## Typical Specifications

To download a current copy of the HPS Dry-Type Medium Voltage (Power) Transformer Typical Specifications (CSI Format) document, please visit our website: [www.hammondpowersolutions.com](http://www.hammondpowersolutions.com).

## SPECIAL APPLICATIONS

The HPS line of distribution (power) transformers offers unparalleled reliability and performance for the most difficult applications including mining, excavation, transit, marine, pulp and paper and utility. Any applications where harmonics, short circuits, high intermittent loads or exposed environmental hazards are prevalent, or reduced electromagnetic emissions or energy efficiencies are required, HPS distribution (power) transformers should be the one of choice.



## IMPULSE LEVELS

HPS offers voltage classes up to 46 kV and 250 kV BIL. The unique design parameters utilizing disc wound technology readily adapt to these higher voltage classes. Our designs have been subjected to all type tests per IEEE and CSA specifications and have proven their capability and reliability.



# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

**Table 1 - Energy Efficient, 3 Phase, Aluminum, 150°C Rise**

kVA	Class (kV)	Minimum LV (Volts)	Core & Coil Stubs Up (Fig. 1)				Stubs Up Bus Arrgt. (Fig. 2 or 3)					Straight Bus to End (Fig. 4)				
			W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)
500	1.2	208Y/120	45	40	32	2400	NJ2	48.5	59	34	2800	P3	66	72	54	3100
	2.5 & 5	208Y/120	49	52	35	3100	NJ6	64	71	40	3700	P3	66	72	54	3800
	15	208Y/120	66	62	35	5600	P12	78	91.5	60	6700	P13	90	91.5	60	6900
750	1.2	208Y/120	46	49	32	3600	NJ3	51.5	66	39	4000	P3	66	72	54	4300
	2.5 & 5	208Y/120	49	53	36	4100	NJ7	64	75	47	4700	P3	66	72	54	4800
	15	208Y/120	66	63	37	6400	P12	78	91.5	60	7500	P13	90	91.5	60	7700
1000	1.2	208Y/120	57	56	35	3900	NJ6	64	71	40	4500	P6	78	72	60	5000
	2.5 & 5	208Y/120	59	60	36	4700	NJ7	64	75	47	5300	P12	78	91.5	60	5900
	15	208Y/120	70	67	38	7400	P12	78	91.5	60	8500	P13	90	91.5	60	8700
1250	1.2	416Y/240	63	58	38	4900	P6	78	72	60	5900	P6	78	72	60	6000
	2.5 & 5	416Y/240	63	59	38	5600	P12	78	91.5	60	6700	P12	78	91.5	60	6800
	15	416Y/240	72	67	41	7500	P13	90	91.5	60	8700	P13	90	91.5	60	8800
1500	1.2	416Y/240	64	58	38	5300	P6	78	72	60	6300	P6	78	72	60	6400
	2.5 & 5	416Y/240	65	60	38	6300	P12	78	91.5	60	7400	P12	78	91.5	60	7500
	15	416Y/240	73	69	41	9600	P13	90	91.5	60	10800	P13	90	91.5	60	11000
2000	1.2	416Y/240	68	59	41	7200	P6	78	72	60	8200	P13	90	91.5	60	8600
	2.5 & 5	416Y/240	69	61	41	7800	P12	78	91.5	60	8900	P13	90	91.5	60	9200
	15	416Y/240	75	74	44	10800	P20	114	110	72	12600	P20	114	110	72	12800
2500	2.5 & 5	416Y/240	74	66	44	8300	P13	90	91.5	60	9500	P13	90	91.5	60	9700
	15	416Y/240	79	79	44	11500	P20	114	110	72	13300	P20	114	110	72	13500
3000	2.5 & 5	416Y/240	78	66	44	10000	P13	90	91.5	60	11200	P15	102	91.5	60	11500
	15	416Y/240	84	84	44	12800	P20	114	110	72	14600	P20	114	110	72	14800
4000	2.5 & 5	600Y/346	88	78	46	15400	P20	114	110	72	17200	P20	114	110	72	17400
	15	600Y/346	91	84	50	16300	P20	114	110	72	18100	P20	114	110	72	18300
5000	2.5 & 5	600Y/346	92	79	52	17900	P20	114	110	72	19700	P20	114	110	72	19900
	15	600Y/346	96	85	55	18400	P20	114	110	72	20200	P20	114	110	72	20400
7500	15	2400Y/1385	100	102	59	22800	Consult Factory					Consult Factory				

**Note:** All dimensions above are estimates only. For exact dimensional information please refer only to a certified "Approval Drawing" that must be requested at the time of order/quote. Please refer to page 19 for termination configuration details.

**Table 2 - Energy Efficient, 3 Phase, Copper, 150°C Rise**

kVA	Class (kV)	Minimum LV (Volts)	Core & Coil Stubs Up (Fig. 1)				Stubs Up Bus Arrgt. (Fig. 2 or 3)				Straight Bus to End (Fig. 4)					
			W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)
500	1.2	208Y/120	40	40	29	2800	NJ2	48.5	59	34	3200	P3	66	72	54	3400
	2.5 & 5	208Y/120	46	47	35	3200	NJ6	64	71	40	3900	P3	66	72	54	4000
	15	208Y/120	65	62	35	5800	P12	78	91.5	60	6900	P13	90	91.5	60	7200
750	1.2	208Y/120	48	41	32	3700	NJ3	51.5	66	39	4200	P3	66	72	54	4300
	2.5 & 5	208Y/120	48	52	36	4200	NJ7	64	75	47	4800	P3	66	72	54	4900
	15	208Y/120	61	66	37	6500	P12	78	91.5	60	7600	P12	78	91.5	60	7800
1000	1.2	208Y/120	57	54	34	4400	NJ6	64	71	40	4900	P6	78	72	60	5500
	2.5 & 5	208Y/120	61	57	36	5200	P3	66	72	54	6100	P6	78	72	60	6300
	15	208Y/120	68	66	38	8000	P12	78	91.5	60	9100	P13	90	91.5	60	9400
1250	1.2	416Y/240	63	56	37	6300	P6	78	72	60	7300	P6	78	72	60	7400
	2.5 & 5	416Y/240	67	60	37	6700	P12	78	91.5	60	7800	P13	90	91.5	60	8100
	15	416Y/240	70	71	37	7700	P12	78	91.5	60	8800	P13	90	91.5	60	9100
1500	1.2	416Y/240	66	58	38	6400	P6	78	72	60	7400	P6	78	72	60	7600
	2.5 & 5	416Y/240	69	57	38	7200	P6	78	72	60	8200	P13	90	91.5	60	8600
	15	416Y/240	69	74	38	9400	P20	114	110	72	11200	P20	114	110	72	11500
2000	1.2	416Y/240	68	58	41	8100	P6	78	72	60	9100	P13	90	91.5	60	9500
	2.5 & 5	416Y/240	73	59	41	8500	P12	78	91.5	60	9600	P13	90	91.5	60	9900
	15	416Y/240	79	70	41	11800	P13	90	91.5	60	13000	P20	114	110	72	13400
2500	2.5 & 5	416Y/240	72	64	44	9500	P12	78	91.5	60	10600	P13	90	91.5	60	11000
	15	416Y/240	75	75	44	12500	P20	114	110	72	14300	P20	114	110	72	14600
3000	2.5 & 5	416Y/240	72	64	44	10900	P12	78	91.5	60	12000	P13	90	91.5	60	12400
	15	416Y/240	76	72	44	13200	P20	114	110	72	15000	P20	114	110	72	15300
4000	2.5 & 5	600Y/346	84	72	46	15800	P13	90	91.5	60	17000	P15	102	91.5	60	17400
	15	600Y/346	86	78	50	16600	P20	114	110	72	18400	P20	114	110	72	18800
5000	2.5 & 5	600Y/346	84	80	52	18400	P20	114	110	72	20200	P20	114	110	72	20600
	15	600Y/346	88	90	55	19100	P23	114	122	72	21200	P23	114	122	72	21600
7500	15	2400Y/1385	96	90	59	24900	P23	114	122	72	27000	P23	114	122	72	27400

**Note:** All dimensions above are estimates only. For exact dimensional information please refer only to a certified "Approval Drawing" that must be requested at the time of order/quote. Please refer to page 19 for termination configuration details.

## Table 3 - Non-Energy Efficient, 3 Phase, Aluminum, 150°C Rise

kVA	Class (kV)	Minimum LV (Volts)	Core & Coil Stubs Up (Fig. 1)				Stubs Up Bus Arrgt. (Fig. 2 or 3)					Straight Bus to End (Fig. 4)				
			W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)
500	1.2	208Y/120	42	43	29	2300	NJ2	48.5	59	34	2700	P3	66	72	54	2800
	2.5 & 5	208Y/120	47	47	32	2600	NJ6	64	71	40	3100	P3	66	72	54	3200
	15	208Y/120	63	52	32	4000	P6	78	72	60	5000	P13	90	91.5	60	5300
	25	208Y/120	69	64	38	4700	P13	90	91.5	60	5900	P13	90	91.5	60	6000
	34.5	208Y/120	73	69	39	5600	P13	90	91.5	60	6800	P15	102	91.5	60	7000
	46	208Y/120	81	77	40	5900	P20	114	110	72	7700	P20	114	110	72	7800
750	1.2	208Y/120	48	53	30	2700	NJ3	51.5	66	39	3200	P3	66	72	54	3300
	2.5 & 5	208Y/120	47	49	33	3600	NJ6	64	71	40	4100	P3	66	72	54	4200
	15	208Y/120	63	54	34	4700	P6	78	72	60	5700	P13	90	91.5	60	6000
	25	208Y/120	69	65	34	5700	P13	90	91.5	60	6900	P13	90	91.5	60	7000
	34.5	208Y/120	73	70	39	6500	P13	90	91.5	60	7700	P15	102	91.5	60	7900
	46	208Y/120	81	78	40	7600	P20	114	110	72	9400	P20	114	110	72	9500
1000	1.2	208Y/120	55	54	32	4000	NJ6	64	71	40	4500	P6	78	72	60	5100
	2.5 & 5	208Y/120	57	56	33	4400	NJ6	64	71	40	4900	P6	78	72	60	5500
	15	208Y/120	67	59	35	5700	P12	78	91.5	60	6800	P13	90	91.5	60	7000
	25	208Y/120	69	70	35	6600	P13	90	91.5	60	7800	P13	90	91.5	60	7900
	34.5	208Y/120	75	75	39	7400	P20	114	110	72	9200	P20	114	110	72	9400
	46	208Y/120	81	82	42	9200	P20	114	110	72	11000	P20	114	110	72	11200
1250	1.2	416Y/240	61	56	35	4500	P3	66	72	54	5400	P6	78	72	60	5600
	2.5 & 5	416Y/240	61	56	35	5100	P3	66	72	54	6000	P6	78	72	60	6200
	15	416Y/240	69	60	37	6700	P12	78	91.5	60	7800	P13	90	91.5	60	8000
	25	416Y/240	73	70	37	7600	P13	90	91.5	60	8800	P15	102	91.5	60	9000
	34.5	416Y/240	77	77	39	8700	P20	114	110	72	10500	P20	114	110	72	10700
	46	416Y/240	85	84	42	10700	P20	114	110	72	12500	P20	114	110	72	12700
1500	1.2	416Y/240	63	56	35	5400	P6	78	72	60	6400	P6	78	72	60	6500
	2.5 & 5	416Y/240	63	57	35	6000	P6	78	72	60	7000	P6	78	72	60	7100
	15	416Y/240	71	62	37	7700	P13	90	91.5	60	8900	P13	90	91.5	60	9100
	25	416Y/240	77	72	38	8900	P20	114	110	72	10700	P20	114	110	72	10900
	34.5	416Y/240	81	78	39	10100	P20	114	110	72	11900	P20	114	110	72	12100
	46	416Y/240	87	84	42	12100	P20	114	110	72	13900	P20	114	110	72	14100
2000	1.2	416Y/240	67	57	37	7400	P6	78	72	60	8400	P13	90	91.5	60	8800
	2.5 & 5	416Y/240	67	58	37	7900	P6	78	72	60	8900	P13	90	91.5	60	9300
	15	416Y/240	73	68	40	9300	P13	90	91.5	60	10500	P13	90	91.5	60	10700
	25	416Y/240	79	72	40	10800	P20	114	110	72	12600	P20	114	110	72	12800
	34.5	416Y/240	87	80	42	12000	P20	114	110	72	13800	P20	114	110	72	14000
	46	416Y/240	93	88	45	14800	P23	114	122	72	16900	P24	120	122	72	17200
2500	2.5 & 5	416Y/240	73	64	40	8500	P12	78	91.5	60	9600	P13	90	91.5	60	9900
	15	416Y/240	77	74	40	10400	P20	114	110	72	12200	P20	114	110	72	12400
	25	416Y/240	85	82	40	12200	P20	114	110	72	14000	P20	114	110	72	14200
	34.5	416Y/240	93	90	42	13700	P23	114	122	72	15800	P24	120	122	72	16100
	46	416Y/240	101	98	44	17500	P24	120	122	72	19800	P26	130	122	72	20100
3000	2.5 & 5	416Y/240	77	64	40	10200	P13	90	91.5	60	11400	P13	90	91.5	60	11600
	15	416Y/240	83	79	40	12200	P20	114	110	72	14000	P20	114	110	72	14200
	25	416Y/240	91	78	40	14400	P20	114	110	72	16200	P20	114	110	72	16400
	34.5	416Y/240	97	87	42	15900	P23	114	122	72	18000	P24	120	122	72	18300
	46	416Y/240	105	95	45	20000	P26	130	122	72	22400	P28	145	122	72	22900
4000	2.5 & 5	600Y/346	87	76	42	15700	P15	102	91.5	60	17000	P15	102	91.5	60	17200
	15	600Y/346	90	80	46	16300	P20	114	110	72	18100	P20	114	110	72	18300
	25	600Y/346	93	81	48	18000	P20	114	110	72	19800	P20	114	110	72	20000
	34.5	600Y/346	101	88	48	19700	P24	120	122	72	22000	P26	130	122	72	22300
	46	600Y/346	109	96	50	24900	P26	130	122	72	27300	P28	145	122	72	27800
5000	2.5 & 5	600Y/346	91	77	48	18300	P15	102	91.5	60	19600	P20	114	110	72	20300
	15	600Y/346	95	81	50	18800	P20	114	110	72	20600	P20	114	110	72	20800
	25	600Y/346	93	88	50	20200	P20	114	110	72	22000	P20	114	110	72	22200
	34.5	2400Y/1385	101	96	52	21900	P24	120	122	72	24200	P26	130	122	72	24500
	46	2400Y/1385	109	102	56	29700	Consult Factory					Consult Factory				
7500	15	2400Y/1385	99	90	54	23200	P23	114	122	72	25300	P24	120	122	72	25700
	25	2400Y/1385	101	92	54	26100	P23	114	122	72	28200	P24	120	122	72	28600
	34.5	2400Y/1385	109	98	60	29600	P26	130	122	72	32000	P28	145	122	72	32500
	46	2400Y/1385	117	102	63	39900	Consult Factory					Consult Factory				
10000	15	2400Y/1385	115	94	60	26000	P26	130	122	72	28400	P26	130	122	72	28700
	25	2400Y/1385	124	100	62	29000	P28	145	122	72	31700	P28	145	122	72	31900
	34.5	2400Y/1385	138	110	62	36000	P30	163	122	72	38900	P30	163	122	72	39200
	46	2400Y/1385	146	113	64	43800	Consult Factory					Consult Factory				
15000	15	2400Y/1385	118	110	60	27000	P26	130	122	72	29400	P26	130	122	72	29700
	25	2400Y/1385	126	110	60	29300	P28	145	122	72	32000	P28	145	122	72	32100
	34.5	2400Y/1385	140	112	64	36000	P30	163	122	72	38900	P30	163	122	72	39300
	46	2400Y/1385	148	118	68	45000	Consult Factory					Consult Factory				

**Note:** All dimensions above are estimates only. For exact dimensional information please refer only to a certified "Approval Drawing" that must be requested at the time of order/quote. Please refer to page 19 for termination configuration details.



# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

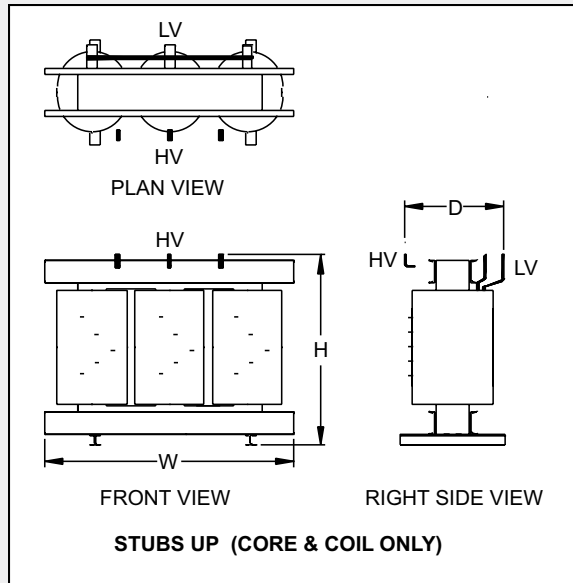
**Table 4 - Non-Energy Efficient, 3 Phase, Copper, 150°C Rise**

kVA	Class (kV)	Minimum LV (Volts)	Core & Coil Stubs Up (Fig. 1)				Stubs Up Bus Arrgt. (Fig. 2 or 3)				Straight Bus to End (Fig. 4)					
			W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)	Encl. No.	W (IN)	H (IN)	D (IN)	Weight (LB)
500	1.2	208Y/120	45	39	27	2500	NJ2	48.5	59	34	2900	P3	66	72	54	3100
	2.5 & 5	208Y/120	44	42	32	2700	NJ3	51.5	66	39	3100	P3	66	72	54	3300
	15	208Y/120	62	52	32	4100	P6	78	72	60	5100	P6	78	72	60	5200
	25	208Y/120	62	63	37	4700	P12	78	91.5	60	5800	P13	90	91.5	60	6100
	34.5	208Y/120	67	68	39	5100	P13	90	91.5	60	6300	P13	90	91.5	60	6500
	46	208Y/120	73	74	42	5400	P20	114	110	72	7300	P20	114	110	72	7400
750	1.2	208Y/120	46	40	30	3025	NJ3	51.5	66	39	3500	P3	66	72	54	3600
	2.5 & 5	208Y/120	46	48	33	3400	NJ3	51.5	66	39	3800	P3	66	72	54	4000
	15	208Y/120	58	57	34	4800	P9	66	91.5	54	5800	P12	78	91.5	60	6000
	25	208Y/120	64	65	34	5700	P12	78	91.5	60	6800	P13	90	91.5	60	7100
	34.5	208Y/120	69	70	39	6400	P13	90	91.5	60	7600	P15	102	91.5	60	7900
	46	208Y/120	75	72	40	6800	P20	114	110	72	8700	P20	114	110	72	8800
1000	1.2	208Y/120	55	52	31	4400	NJ6	64	71	40	4900	P6	78	72	60	5500
	2.5 & 5	208Y/120	59	53	33	4800	NJ6	64	71	40	5300	P6	78	72	60	5900
	15	208Y/120	65	58	35	6200	P12	78	91.5	60	7300	P13	90	91.5	60	7600
	25	208Y/120	69	67	35	6700	P13	90	91.5	60	7900	P13	90	91.5	60	8100
	34.5	208Y/120	74	72	39	7700	P20	114	110	72	9600	P20	114	110	72	9700
	46	208Y/121	79	76	41	8400	P20	114	110	72	10300	P20	114	110	72	10400
1250	1.2	416Y/240	61	57	34	5600	P3	66	72	54	6500	P6	78	72	60	6700
	2.5 & 5	416Y/240	65	57	34	5900	P6	78	72	60	6900	P6	78	72	60	7000
	15	416Y/240	67	64	36	7000	P12	78	91.5	60	8100	P13	90	91.5	60	8400
	25	416Y/240	73	67	36	8100	P13	90	91.5	60	9300	P15	102	91.5	60	9600
	34.5	416Y/240	79	72	40	9000	P20	114	110	72	10900	P20	114	110	72	11000
	46	416Y/240	85	80	42	9800	P20	114	110	72	11700	P20	114	110	72	11800
1500	1.2	416Y/240	65	50	35	6500	P6	78	72	60	7500	P6	78	72	60	7700
	2.5 & 5	416Y/240	67	54	35	6900	P6	78	72	60	7900	P13	90	91.5	60	8400
	15	416Y/240	67	67	35	7600	P12	78	91.5	60	8700	P13	90	91.5	60	9100
	25	416Y/240	77	69	35	9200	P13	90	91.5	60	10400	P15	102	91.5	60	10800
	34.5	416Y/240	83	74	38	10200	P20	114	110	72	12100	P20	114	110	72	12300
	46	416Y/240	89	82	42	10900	P20	114	110	72	12800	P24	120	122	72	13400
2000	1.2	416Y/240	67	53	37	8200	P6	78	72	60	9200	P13	90	91.5	60	9600
	2.5 & 5	416Y/240	71	56	37	8700	P6	78	72	60	9700	P13	90	91.5	60	10100
	15	416Y/240	77	67	37	10200	P13	90	91.5	60	11400	P15	102	91.5	60	11800
	25	416Y/240	79	72	37	11400	P20	114	110	72	13300	P20	114	110	72	13500
	34.5	416Y/240	85	78	40	12500	P20	114	110	72	14400	P20	114	110	72	14600
	46	416Y/240	93	84	44	13600	P20	114	110	72	15500	P24	120	122	72	16100
2500	2.5 & 5	416Y/240	71	62	40	9700	P12	78	91.5	60	10800	P13	90	91.5	60	11200
	15	416Y/240	73	70	40	11400	P20	114	110	72	13300	P20	114	110	72	13500
	25	416Y/240	79	74	40	12500	P20	114	110	72	14400	P20	114	110	72	14600
	34.5	416Y/240	85	80	42	13700	P20	114	110	72	15600	P20	114	110	72	15800
	46	416Y/240	91	86	44	15900	P20	114	110	72	17800	P24	120	122	72	18400
3000	2.5 & 5	416Y/240	71	62	40	11100	P12	78	91.5	60	12200	P13	90	91.5	60	12600
	15	416Y/240	75	70	40	12500	P20	114	110	72	13700	P20	114	110	72	14100
	25	416Y/240	84	75	40	14600	P20	114	110	72	16500	P20	114	110	72	16700
	34.5	416Y/240	91	81	42	15800	P20	114	110	72	17700	P20	114	110	72	17900
	46	416Y/240	97	88	45	18100	P24	120	122	72	20400	P26	130	122	72	20800
4000	2.5 & 5	600Y/346	83	70	42	16100	P13	90	91.5	60	17300	P15	102	91.5	60	17700
	15	600Y/346	85	74	46	16600	P20	114	110	72	18500	P20	114	110	72	18700
	25	600Y/346	89	78	48	19100	P20	114	110	72	21000	P20	114	110	72	21200
	34.5	600Y/346	95	84	48	20500	P20	114	110	72	22400	P24	120	122	72	23100
	46	600Y/346	103	92	50	22400	P25	121	122	72	24700	P26	130	122	72	25100
5000	2.5 & 5	600Y/346	83	78	48	18800	P20	114	110	72	20700	P20	114	110	72	20900
	15	600Y/346	87	86	50	19500	P20	114	110	72	21400	P20	114	110	72	21600
	25	600Y/346	91	86	50	21300	P20	114	110	72	23200	P24	120	122	72	23400
	34.5	2400Y/1385	98	92	52	22700	P23	114	122	72	24800	P26	130	122	72	25300
	46	2400Y/1385	105	100	56	26400	Consult Factory				Consult Factory					
7500	15	2400Y/1385	95	86	54	25400	P20	114	110	72	27300	P20	114	110	72	27600
	25	2400Y/1385	101	90	54	29000	P23	114	122	72	31100	P24	120	122	72	31600
	34.5	2400Y/1385	109	96	60	32200	P26	130	122	72	34600	P28	145	122	72	35300
	46	2400Y/1385	115	102	63	37200	Consult Factory				Consult Factory					
10000	15	2400Y/1385	120	94	60	30000	P27	139	122	72	32000	P27	139	122	72	32300
	25	2400Y/1385	126	100	62	35000	P28	145	122	72	37100	P28	145	122	72	37400
	34.5	2400Y/1385	132	110	62	38000	P29	154	122	72	40900	P29D	154	122	78	41200
	46	2400Y/1385	140	113	64	41300	Consult Factory				Consult Factory					
15000	15	2400Y/1385	122	110	60	42500	P27	139	122	72	44400	P27	139	122	72	44700
	25	2400Y/1385	126	110	60	51000	P28	145	122	72	53100	P28	145	122	72	53400
	34.5	2400Y/1385	136	112	64	58000	P30	163	122	72	60300	P30	163	122	72	60600
	46	2400Y/1385	145	118	68	69000	Consult Factory				Consult Factory					

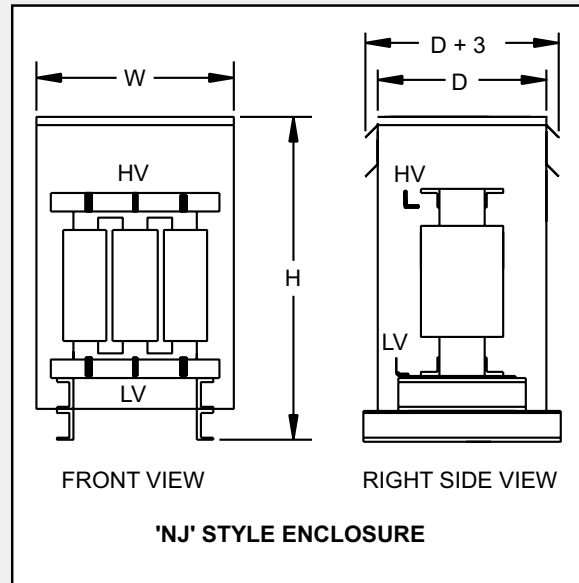
**Note:** All dimensions above are estimates only. For exact dimensional information please refer only to a certified "Approval Drawing" that must be requested at the time of order/quote. Please refer to page 19 for termination configuration details.

## TYPICAL TERMINAL LOCATIONS

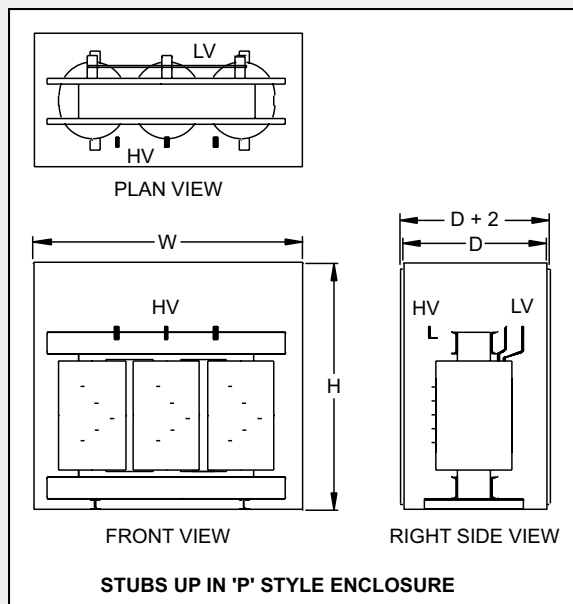
The following are some of the examples of terminal locations available on HPS Dry-Type Medium Voltage Distribution (Power) Transformers.



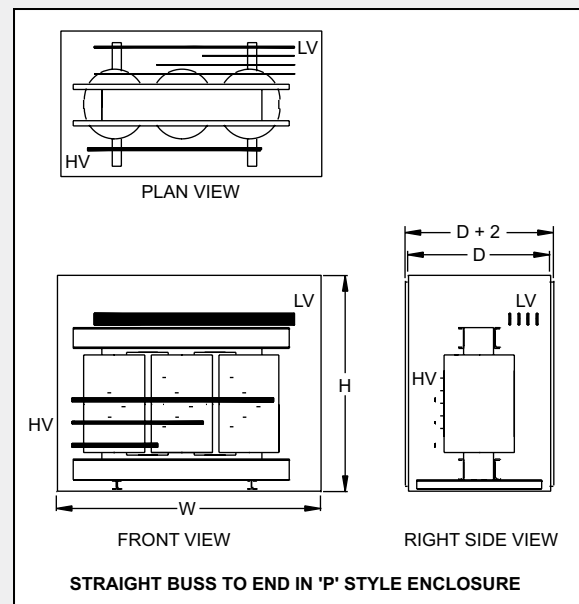
**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**

**Note:** HPS Dry-Type Distribution (Power) Transformers are also available with terminations that align with common switchgear/switchboard designs.

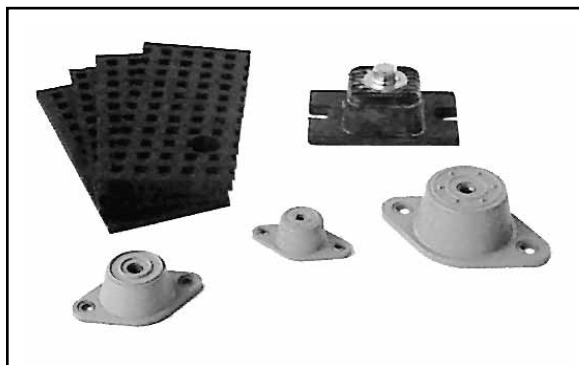
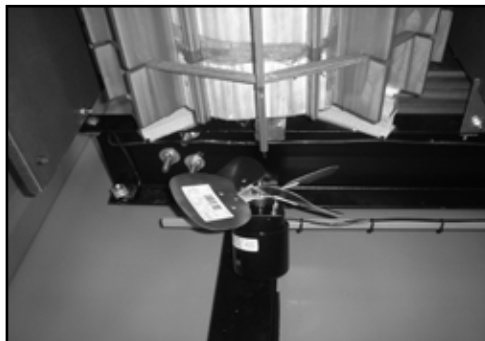


# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

## OPTIONS AND ACCESSORIES

The following options/accessories are available on all HPS Distribution (Power) Transformers:

1. Neutral grounding resistors and monitors.  
Commonly installed to meet regulatory codes.
2. Temperature monitoring devices.
  - For customers requiring on-line monitoring on transformer conditions. Option for digital and dial type, with and without contacts.
3. Strip Heater
  - Commonly used to maintain the interior temperature of an installation in the event of shutdown or cold weather conditions.
4. Ground Fault Relay
  - For use where customer requires on-going monitoring of ground fault status.
5. Anti-vibration Mountings: anti-vibration pads and/or vibrations isolators.
  - When additional noise dampening is required, anti-vibration pads or noise isolators can be used to reduce operating noise even further. Isolators can also be used for meeting anti-sway requirements for elevated installations.
8. Fans: Fans with or without control circuit, or provision only for fan rating.
  - Fans can be added after for additional cooling when desired.



9. Seismic: Seismic snubbers, restraints or provision.
  - Additional isolation protection for certain Seismic environments.



### **Other accessories available include:**

6. Lightning Arresters: station, intermediate, distribution class.
    - For extra protection against failure under adverse electrical conditions caused by lightning.
  7. Nameplate: aluminum or stainless steel
    - In some environments, the customer may want nameplates with a longer lifespan for visibility many years beyond normal.
- Power source for fans/thermometers
  - Secondary Circuit Breaker in Separate Component
  - Bushings: high voltage or low voltage
  - Provisions for Cable Entry
  - Ground Bus (1/4" X 2" Copper)
  - Mimic Bus
  - Kirk Key Interlock
  - Current and Potential Transformers
  - Secondary metering: ammeter or voltmeter
  - Electrostatic Shield



## HPS ENCLOSURES

An enclosure is a surrounding case constructed to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection to the enclosed equipment against specified environmental conditions.

### Applicable Engineering Standards

HPS Enclosures are designed in accordance with the following standards:

- CSA-22.2 No. 47 (General Purpose)
- CSA-22.2 No. 94 (Specialty Enclosures)
- NEMA 250
- UL 50 and UL 50E

**Please ensure to reference all local and national electrical codes and applicable transformer standards before selecting an enclosure for your application.**

### Definitions

**Degree of protection:** The extent of protection provided by an enclosure against access to hazardous parts, against ingress of foreign solid objects and/or against ingress of water and verified by approved standardized test methods.

**Hazardous parts:** A part that is hazardous to approach or to touch.

**Indoor Locations:** Areas which are protected from exposure to the weather.

**Non-ventilated:** Constructed so as to provide no intentional circulation of external air through the enclosure.

**Outdoor locations:** Locations that are exposed to the weather.

**Ventilated:** Constructed so as to provide for the circulation of external air through the enclosure to remove excess heat, fumes or vapors.

### Enclosure Selection

The selection of the appropriate enclosure is vital for the long term reliability of your HPS product. The “degree of protection” an enclosure actually provides can only be determined by referencing the appropriate test methods outlined in the above mentioned standards.

The list below is just some of the typical enclosure types available for HPS products, their applications, and the environmental conditions they are designed to meet.

### HPS Typical Enclosure Types

#### **TYPE 1**

This is a general purpose ventilated enclosure constructed for indoor use only to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt).

#### **TYPE 2**

This is a general purpose ventilated enclosure constructed for indoor use only to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping or light splashing).

#### **TYPE 3RI**

This is a general purpose ventilated enclosure constructed for indoor use only to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (sprinkler head spray, light splashing of liquids).



# HPS DRY-TYPE DISTRIBUTION (POWER) TRANSFORMERS

## TYPE 3R

This is a general purpose ventilated enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow); and that will be undamaged by the external formation of ice on the enclosure.

## TYPE 3RE

This is a general purpose ventilated enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt and circulating dust); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, circulating snow); and that will be undamaged by the external formation of ice on the enclosure.

## TYPE 4

This is a general purpose non-ventilated enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt and windblown dust); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external. (Note: not submersible)

## TYPE 4X

This is a general purpose non-ventilated enclosure constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (windblown dust); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); that provides an additional level of protection against corrosion; and that will be undamaged by the external formation of ice on the enclosure. (Note: not submersible)

## TYPE 12

This is a general purpose non-ventilated enclosure constructed (without knockouts) for indoor use only to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against the ingress of solid foreign objects (falling dirt and circulating dust, lint, fibers, and filings); and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing). (Note: not submersible)

## CONVERSION OF NEMA ENCLOSURE TYPE RATINGS TO IEC 60529 ENCLOSURE CLASSIFICATION DESIGNATIONS (IP) (Cannot be Used to Convert IEC Classification Designations to NEMA Type Ratings)

IP 1st Character	NEMA Enclosure Type																IP 2nd Character	
	1		2		3, 3X, 3S,3SX		3R, 3RX		4, 4X		5		6		6P		12, 12K, 13	
IP0_																		IP_0
IP1_																		IP_1
IP2_																		IP_2
IP3_																		IP_3
IP4_																		IP_4
IP5_																		IP_5
IP6_																		IP_6
																		IP_7
																		IP_8
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B

**IP First Character** = The A shaded block in the "A" column represents the first IP character. This indicates that the NEMA Enclosure Type exceeds the requirements for the respective IEC 60529 IP First Character Designation. This IP First Character Designation is the protection against access to hazardous parts and solid foreign objects.

**IP Second Character** = The B shaded block in the "B" column represents the second IP character. This indicates that the NEMA Enclosure Type exceeds the requirements for the respective IEC 60529 IP Second Character Designation. This IP Second Character Designation is the protection against the ingress of water.

**Example:** NEMA Type 3R = IP24

**Note:** Please refer to NEMA standards publication 250-2003 for exact details of the above table.

[illegible]



NOTES

Notes section containing 20 horizontal lines for writing.



## OTHER HPS CATALOGS

**Yes, I am interested in receiving the following information on other HPS Products.**

Literature Name	Code	Qty
Showcase of Products Brochure	SCOPB	_____
Transformer Products Catalog	HTP-12	_____
Medium Voltage Dry-Type Distribution (Power) Transformers	HPWR	_____
Capabilities Brochure	HPSCB8	_____
Global Solutions Brochure	HPSCSL	_____
Energy Efficient Distribution Transformer Brochure	ENEDIS	_____
HPS EnduraCoil™ Cast Resin Transformer Brochure	ENDCOI13	_____
Oil & Gas Solutions Brochure	OILGAS13	_____
HPS Spartan® Industrial Open Core & Coil Control Transformer Brochure	SPACON	_____
HPS Imperator® Encapsulated Machine Tool Industrial Control Transformers	ENCCON	_____
HPS Fortress™ Commercial Encapsulated Brochure	FORPOT	_____
HPS Titan® Series Encapsulated Distribution Transformer Brochure	TSETB8	_____
HPS PowerPlus™ Mini Power Center Brochure	PWRPLS11	_____

The literature listed above is available either electronically as a free PDF download or paper copies. To access the free PDF versions, please go to <http://www.hammondpowersolutions.com>. To receive paper copies of any of the catalogs, brochures or flyers shown above, please fill in the information below, photocopy this page and fax it to the following:

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