Dry-Type Medium Voltage Distribution (Power) Transformer
1.2 kV to 46 kV Class
500kVA to 34 MVA
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. Download your free copies anytime.

Quotation and Pricing

To authorized 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) 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.
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 it's 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 Hot Spot = T ambient + T average winding rise + T 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 impedance 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 the transformer core losses, but to a smaller extent eddy 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 FR 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.

<table>
<thead>
<tr>
<th>Insulation Rating</th>
<th>Class 105</th>
<th>Class 150 or 130</th>
<th>Class 180</th>
<th>Class 200</th>
<th>Class 220</th>
</tr>
</thead>
</table>

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.
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.

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 per standard) and is calculated as follows:

Rated Current $X \frac{100}{2}$ 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.

Energy Efficient Standards:
- NEMA 250, UL 50 & UL 50E:
- IEEE-C57.12.91:
- IEEE-C57.12.70:
- IEEE-C57.12.51:
- IEEE-C57.12.01:
- DOE 10 CFR Part 431:
- UL 1562:

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-C57.12.91: Test Code for Dry-Type Distribution and Power Transformers.
- NEMA 250, UL 50 & UL 50E: Enclosures for Electrical Equipment.

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).

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:

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>BIL Full &amp; Chopped Wave</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 kV</td>
<td>30 kV</td>
</tr>
<tr>
<td>11 kV</td>
<td>60 kV</td>
</tr>
<tr>
<td>18 kV</td>
<td>95 kV</td>
</tr>
<tr>
<td>25 kV</td>
<td>110* kV</td>
</tr>
<tr>
<td>34.5 kV</td>
<td>150 kV</td>
</tr>
<tr>
<td>46 kV</td>
<td>200 kV</td>
</tr>
</tbody>
</table>

*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.
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, 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.

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.

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:

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

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

ENERGY EFFICIENCY GUIDELINES

US Department of Energy
DOE 10 CFR Part 431 Efficiency Levels

<table>
<thead>
<tr>
<th>KVA</th>
<th>20 - 45 kV BIL Efficiency (%)</th>
<th>46 - 95 kV BIL Efficiency (%)</th>
<th>≥ 96 kV BIL Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>98.10</td>
<td>97.86</td>
<td>97.50</td>
</tr>
<tr>
<td>25</td>
<td>98.33</td>
<td>98.12</td>
<td>97.90</td>
</tr>
<tr>
<td>37.5</td>
<td>98.49</td>
<td>98.30</td>
<td>98.10</td>
</tr>
<tr>
<td>50</td>
<td>98.60</td>
<td>98.42</td>
<td>98.33</td>
</tr>
<tr>
<td>75</td>
<td>98.73</td>
<td>98.57</td>
<td>98.53</td>
</tr>
<tr>
<td>100</td>
<td>98.82</td>
<td>98.67</td>
<td>98.63</td>
</tr>
<tr>
<td>250</td>
<td>99.07</td>
<td>98.95</td>
<td>98.91</td>
</tr>
<tr>
<td>333</td>
<td>99.14</td>
<td>99.03</td>
<td>98.99</td>
</tr>
<tr>
<td>500</td>
<td>99.22</td>
<td>99.12</td>
<td>99.09</td>
</tr>
<tr>
<td>667</td>
<td>99.27</td>
<td>99.18</td>
<td>99.15</td>
</tr>
<tr>
<td>833</td>
<td>99.31</td>
<td>99.23</td>
<td>99.19</td>
</tr>
<tr>
<td>1000</td>
<td>99.37</td>
<td>99.38</td>
<td>99.15</td>
</tr>
<tr>
<td>1500</td>
<td>99.37</td>
<td>99.38</td>
<td>99.15</td>
</tr>
<tr>
<td>2000</td>
<td>99.37</td>
<td>99.38</td>
<td>99.15</td>
</tr>
</tbody>
</table>

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

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

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

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.

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

<table>
<thead>
<tr>
<th>kVA</th>
<th>Class (kV)</th>
<th>Minimum LV (Volts)</th>
<th>Core &amp; Call Stubs Up (Fig. 1)</th>
<th>Stubs Up Bus Arrng. (Fig. 2 or 3)</th>
<th>Straight Bus to End (Fig. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1.2</td>
<td>208Y/120</td>
<td>46.7</td>
<td>12700</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>3.5</td>
<td>2400Y/1385</td>
<td>66.7</td>
<td>13100</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>4.6</td>
<td>600Y/346</td>
<td>96.5</td>
<td>15000</td>
<td></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>kVA</th>
<th>Class (kV)</th>
<th>Minimum LV (Volts)</th>
<th>Core &amp; Call Stubs Up (Fig. 1)</th>
<th>Stubs Up Bus Arrng. (Fig. 2 or 3)</th>
<th>Straight Bus to End (Fig. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1.2</td>
<td>208Y/120</td>
<td>84.5</td>
<td>11300</td>
<td></td>
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<tr>
<td>25</td>
<td>3.5</td>
<td>2400Y/1385</td>
<td>102</td>
<td>13700</td>
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</tr>
<tr>
<td>25</td>
<td>4.6</td>
<td>600Y/346</td>
<td>120</td>
<td>15600</td>
<td></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>kVA</th>
<th>Class (kV)</th>
<th>Minimum LV (Volts)</th>
<th>Core &amp; Call Stubs Up (Fig. 1)</th>
<th>Stubs Up Bus Arrng. (Fig. 2 or 3)</th>
<th>Straight Bus to End (Fig. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.2</td>
<td>208Y/120</td>
<td>47.4</td>
<td>32000</td>
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<tr>
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<td>600Y/346</td>
<td>97.0</td>
<td>41400</td>
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</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Class (kVA)</th>
<th>Core &amp; Coil Stubs Up (Fig. 1)</th>
<th>Stubs Up Bus Arrt. (Fig. 2 or 3)</th>
<th>Straight Bus to End (Fig. 4)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Minimum LV (Volts)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>W (IN)</td>
<td>H (IN)</td>
<td>D (IN)</td>
</tr>
<tr>
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<td></td>
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<tr>
<td>1.2</td>
<td>208Y/120</td>
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<td>42</td>
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<td>2.5 &amp; 5</td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>208Y/120</td>
<td>62</td>
<td>63</td>
</tr>
<tr>
<td>500</td>
<td></td>
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<tr>
<td>15</td>
<td>208Y/120</td>
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<td>74</td>
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<tr>
<td>25</td>
<td>208Y/120</td>
<td>71</td>
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<tr>
<td>345</td>
<td>208Y/120</td>
<td>71</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>208Y/120</td>
<td>62</td>
<td>63</td>
</tr>
<tr>
<td>500</td>
<td></td>
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<tr>
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<td>71</td>
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<td>74</td>
</tr>
<tr>
<td>345</td>
<td>208Y/120</td>
<td>71</td>
<td>74</td>
</tr>
</tbody>
</table>

### 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.

---

**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.
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.

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.

8. Fans: Fans with or without control circuit, or provision only for fan rating. Fans can be added after for additional cooling when desired.


Other accessories available include:
- Power source for fans/thermometers
- Secondary Circuit Breaker in Separate Component
- Bushings: high voltage or low voltage
- Provisions for Cable Entry
- Ground Bus (1\(\frac{1}{4}\) X 2\(\frac{1}{2}\) 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).
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 ENCLOSED TYPE RATINGS TO IEC 60529 ENCLOSURE CLASSIFICATION DESIGNATIONS (IP)
(Cannot be Used to Convert IEC Classification Designations to NEMA Type Ratings)

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<th>NEMA Enclosure Type</th>
<th>IP 2nd Character</th>
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</thead>
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<td>3R</td>
<td>IP_0</td>
</tr>
<tr>
<td>2</td>
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<td>3X, 3SX</td>
<td>3R, 3RX</td>
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<td>3RX</td>
<td>IP_3</td>
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<td>6</td>
<td>6P</td>
<td>IP_5</td>
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<td>12, 12K, 13</td>
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<td>B</td>
<td>A</td>
<td>IP_8</td>
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**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 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 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.
Yes, I am interested in receiving the following information on other HPS Products.

<table>
<thead>
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<th>Literature Name</th>
<th>Code</th>
<th>Qty</th>
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<td>Showcase of Products Brochure</td>
<td>SCOB</td>
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<tr>
<td>Transformer Products Catalog</td>
<td>HP-12</td>
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<tr>
<td>Medium Voltage Dry-Type Distribution (Power) Transformers</td>
<td>HPWR</td>
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<td>Capabilities Brochure</td>
<td>HPSCB</td>
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<td>HPSCL</td>
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<tr>
<td>Energy Efficient Distribution Transformer Brochure</td>
<td>ENEDS</td>
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<td>HPS EnduraCoil™ Cast Resin Transformer Brochure</td>
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<td>Oil &amp; Gas Solutions Brochure</td>
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<tr>
<td>HPS Spartan™ Industrial Open Core &amp; Coil Control Transformer Brochure</td>
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<td>HPS Imperator® Encapsulated Machine Tool Industrial Control Transformers</td>
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<td>HPS Fortress™ Commercial Encapsulated Brochure</td>
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<tr>
<td>HPS PowerPlus™ Mini Power Center Brochure</td>
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- Panel Builder
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- Engineering Firm

Data subject to change without notice.