ALFA TRANSFORMER

TRANSFORMERS
It's What We Do.

TRANSFORMER DICTIONARY

AUTOTRANSFORMER – A transformer that has only one winding per phase; part of the winding is shared between the primary and secondary

CONDITION

New - All materials and components are new.
Remanufactured - Transformer coils have been rewound; this may include all primary and secondary coils or primary coils only; even if secondary coils are not rewound they will carry the same warranty as the rewound primary coils
Reconditioned - Transformer has passed all standard tests; if needed, broken or missing parts are replaced
Rental - Transformer condition can vary but all rental units will be in good, working condition

CONVENTIONAL VS CSP (POLE MOUNT)

Conventional - A pole mounted transformers with two primary bushings is sometimes referred to as "conventional". They can be used individually to provide single-phase power or they can be banked with two like transformers to provide three-phase power.
Conventional - Pole mounted transformers with one primary bushing are utility type transformers and are the type most commonly used in residential applications. The primary bushing is labeled "H1" and a grounding nut on the tank is labeled "H2". This transformer is connected between a phase and neutral. Some of these transformers are CSP (completely self-protected). They usually include a primary fuse, a primary arrester, and a secondary breaker with weak-link.

DEAD FRONT – Dead front refers to terminations where energized parts are enclosed in molded rubber. A typical dead front connection consists of three parts - a bushing well (installed at the factory), a bushing insert, and an elbow. Incoming (and outgoing) cables are inserted into the elbow to prevent any exposed wire or terminals. See our Transformer Components page for more information.

DELTA – A Delta connection has the windings of three single-phase transformers connected in series with each other to form a closed circuit; on a Delta connection of a three-phase transformer, the transformer will typically have three (3) terminations or bushings.

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DRAIN VALVE – A drain valve provides a means of removing fluid from a transformer. Many drain valves also have a port where samples of the fluid can be taken and sent to a laboratory for analysis.

DRIVE ISOLATION TRANSFORMER – SCR drives generate voltage spikes and transient feedback. Drive isolation transformers are designed to withstand mechanical forces associated with SCR drives and to isolate the line from these destructive electrical conditions. Drive isolation transformers have different ratings than general purpose transformers. They are sized based on drive horsepower. For example, a 550 KVA drive isolation transformer would be used to provide power to a 500 HP drive. The voltages on a drive isolation transformer are also different than those on general purpose transformers. Standard voltages for general purpose transformers are 208V, 240V, and 480V. Standard drive isolation transformer voltages are 230V and 460V.

DRY TYPE TRANSFORMER – A transformer that is cooled solely by air and does not contain any cooling fluid for cooling or insulation.

ELECTROSTATIC SHIELD – An electrostatic shield suppresses common mode noise. The grounded shield provides a low resistance path to ground by the effect of capacitive coupling which prevents high frequency signals present in the source voltage from reaching the secondary windings of the transformer and subsequently the connected load.

ENCLOSURE – There are many types of enclosures for dry type transformers. These enclosures are designed to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection to the transformer from contaminants such as moisture, dust, metallic dust, and chemicals. These enclosures are typically specified by a NEMA rating. The most common dry type transformer enclosures are listed in the table below.

NEMA RATING	DESCRIPTION
1	For indoor use wherever oil, dust or water is not a problem
2	Used indoors to exclude falling moisture and dirt
3R	Provides protection against rain, sleet and snow
4	Needed when subject to great amount of water from any angle, such as areas which are repeatedly hosed down
4X	Same as NEMA 4, except stainless steel
12	Used for excluding oil, coolant, flying dust, lint, etc.

ENVIRONMENT – Certain environments require certain types of transformers or specific materials. Using the wrong type of enclosure or protective materials can result in an unwanted transformer failure or explosion.

DRY TYPE – Ventilated dry type transformers operate best in an indoor environment with no airborne contaminants such as dust, metal dust, corrosive chemicals, salt water, etc. Dry type transformer enclosures can include weathershielding to protect from typical weather conditions such as rain so they can be placed outdoors.
OIL FILLED – Oil filled transformers can operate in typical indoor or outdoor environments. Coastal areas with high moisture and salt content can quickly destroy the exterior of a transformer. Corrosive chemicals can also destroy paint and metal. The presence of explosive gases can be very dangerous around transformers.

FANS – Fans are used to reduce the operating temperature of a transformer.
Dry Type Transformers – Fans can be optionally installed on many dry type. Generally, fans are not installed on small transformers because it is cost-prohibitive. Cooling fan packages can include fans, temperature gauge/fan controller, or other options.
Pad Mounted Transformers – Cooling fans are not available on pad mounted transformers. Fans negate the tamper-resistant rating of the transformer. If you require fans, please let us know so we can make a recommendation.
Substation Transformers – Fans can be optionally installed on many substation transformers as a means of reducing the operating temperature of the transformer. Cooling fan packages can include fans, temperature gauge, auxiliary wiring compartment, mounting hardware, or other options.
Pole Mounted Transformers – Cooling fans are not available on pole mounted transformers.

FEED-THRU INSERTS – A feed-thru insert is a simple way to convert a radial feed primary configuration to a loop feed primary configuration. The 200-amp loadbreak insert is unscrewed from the bushing well and replaced with the feed-thru insert. The feed-thru inserts provide two connection points - one for the incoming primary cables and one for the outgoing primary cables that will loop to another transformer.

FLUID – There are basically two types of dielectric fluids used in transformers for electrical insulating and cooling purposes. Mineral oil and fluids that are less flammable for use indoors or near buildings where fire could spread. Below is information on the most common fluids.
Mineral Oil – This is a highly refined mineral oil that remains stable at high temperatures and has excellent electrical insulating properties.
RTEmp (discontinued) – RTEmp fluid was discontinued by Cooper Power Systems in 2005. This high flash point fluid was replaced by FR3.
FR3 – FR3 is a food-grade oil extracted from plants. It has been declared non-toxic and has the highest flash and fire points of all transformer fluids. FR3 is miscible with mineral oil and RTEmp so you can fill your existing transformers with FR3. It is not miscible with silicone fluid. Cooper Power Systems' Envirotemp FR3 fluid is UL EOVK listed.
Silicone – Silicone is the only other fluid that has the UL EOVK listing. However, it is not miscible with other fluids and is significantly more expensive than FR3.

FREQUENCY – The number of times an alternating current voltage will alternate from positive to negative and back again within a specified period of time. It is typically expressed in cycles per second and identified as Hertz

(Hz). The Western Hemisphere primarily operates on 60 Hz systems. Some 60 Hz systems exist in the Eastern Hemisphere but this region primarily uses 50 Hz systems. A transformer designed for 50 Hz can operate on a 60 Hz supply. A transformer designed for 60 Hz should not be connected to a 50 Hz supply.

FUSING – The most common type of fusing for pad mounted transformers is Bayonet fuses. These fuses are externally removable and the fuse cartridges are replaceable. An optional ELSP backup current-limiting fuse is available to minimize the effects of high fault current stresses on equipment and the distribution system. Many other types of fusing that are installed in transformers have been discontinued or can be costly compared to Bayonet fusing.

GAUGES – See *Liquid Level Gauge, Pressure/Vacuum Gauge,* and *Temperature Gauge*

KVA – Kilo-Volt-Amperes; designates the output which a transformer can deliver at rated voltage and frequency without exceeding a specified temperature rise.

LIGHTNING ARRESTERS – See *Surge Arresters*

LIQUID LEVEL GAUGE – A liquid level gauge is used to determine if the fluid level inside the transformer is within an acceptable range. There are typically three levels shown on the gauge: Low, 25C, and High. The optimum fluid level is 25C. However, this can vary based on the temperature of the fluid.
The arm that connects the indicator needle and the float is very short so small changes in fluid level can result in low or high readings. If you believe your transformer may be low on fluid, you should have qualified personnel check the actual fluid level. Low fluid levels can result in transformer failure and/or fire.
A special liquid level gauge with contacts can be installed to send signals to relays or alarms for monitoring purposes.

LIVE FRONT – Live front refers to terminations with exposed "live" parts. On pad mounted transformers, these bushings are typically porcelain with an eyebolt terminal or spade terminal. Incoming primary cables are stripped and inserted into the eyebolt terminal or lugs.

LOADBREAK ELBOWS – A 200-amp loadbreak elbow is a dead front component that connects to a primary cable and plugs into a 200-amp loadbreak insert. This completes the connection between the incoming cables and the transformer. Special 600-amp elbows are required to connect to 600-amp one-piece integral bushings used for higher current applications. Three important pieces of information are required to properly size the elbow for an application:

1. Insulation thickness – usually expressed in a percentage (100%, 133%, 150%, etc.)
2. Cable size (and quantity) – #4, 2/0, 500MCM, etc.
3. Concentric neutral or shielded?

LOADBREAK INSERTS – A typical dead front connection consists of three parts - a bushing well (installed at the factory), a loadbreak bushing insert, and a loadbreak elbow. The insert is cone-shaped with a threaded-hole in one end that screws into the bushing well. The other end has a smooth hole that will accept the probe of a 200-amp loadbreak elbow. Please note that 600-amp dead front bushings are one piece and have a threaded hole in the front to accept a 600-amp elbow that has a threaded stud rather than a smooth probe. 200-amp components and 600-amp components are not compatible.

LOADBREAK SWITCH – Loadbreak switches are installed in pad mounted transformers to allow power to the transformer to be shut off or to route the incoming power to other places.
Two-Position – This is the most common loadbreak switch. The two positions are "Closed" (on) and "Open" (off). Multiple two-position loadbreak switches can be used in place of a single four-position switch. (see below)
Four-Position – This is sometimes called a "sectionalizing switch". This type of switch is installed on transformers with a loop feed configuration. The four positions are:

1. Open – Transformer and loop are off;
2. A – Transformer is on, loop is off;
3. B – Transformer is off, loop is on;
4. A & B – Transformer and loop are on;

Two (2) Two-Position – This is an alternative to a four-position switch. This is installed on transformers with a loop feed configuration. One switch is connected between the incoming power and the transformer. The other switch is connected between the incoming power and the loop feed bushings. This offers the same control as a four-position switch.

LOOP FEED – Loop feed indicates the incoming primary of a transformer can be fed through (looped) to another transformer of the same voltage and vector. Loop feed transformers have two sets of primary bushings - one set for the incoming feed and one for the outgoing feed. In some installations, the second set of bushings is not used for looping to another transformer but for dead front surge arresters.

PAD MOUNTED TRANSFORMER – A transformer that is installed on a pad with conduit openings so that incoming and outgoing cables can be brought into the termination compartment from underground; the compartment is accessible through one or two locked doors that give the transformer a tamper-resistant rating. Almost all pad mounted transformers are oil filled type.

PHASE – Classification of an alternating current circuit. The most common phases are single-phase and three-phase. Typical transformers do not have mixed phases. If a transformer has a three-phase input, it will have a three-phase output. The same is true of single-phase transformers. It is common to connect a single-phase transformer to a three-phase system to get a single-phase output.

PHASE CONVERTER – In many areas, three-phase power is not available or can be very expensive to obtain. A phase converter can take available single-phase power and convert it to three-phase power.

POLE MOUNTED TRANSFORMER – A transformer that is mounted onto a pole with a hanger; occasionally these transformers may be mounted on a platform between two poles or they may be installed on a concrete pad.
One-Bushing – Pole mounted transformers with one primary bushing are utility type transformers and are the type most commonly used in residential applications. The primary bushing is labeled "H1" and a grounding nut on the tank is labeled "H2". This transformer is connected between a phase and neutral. Some of these transformers are CSP (completely self-protected). They usually include a primary fuse, a primary arrester, and a secondary breaker with weak-link.
Two-Bushing – Pole mounted transformers with two primary bushings are sometimes referred to as "conventional". They can be used individually to provide single-phase power or they can be banked with two like transformers to provide three-phase power.

PRESSURE RELIEF DEVICE (COVER-MOUNTED) – A cover-mounted device that activates when a specified tank pressure is reached. Relieves pressure much more rapidly than a pressure relief valve. Some cover-mounted pressure relief devices have an optional semaphore to help you identify when the device has been activated.

PRESSURE RELIEF VALVE – A device that provides pressure relief on transformers during overpressure conditions, automatically resealing once pressure has fallen. A pull-ring allows the device to be operated manually.

PRESSURE/VACUUM GAUGE – A pressure/vacuum gauge indicates the level of vacuum or pressure (in psi) inside a transformer tank. On colder days or on a de-energized transformer, the gauge may indicate a vacuum. On hotter days or when a transformer has a load on it, the gauge will likely show a positive pressure reading.
What you don't want to see is a reading of zero. This could indicate that the transformer is “breathing” due to a leak. If you see a reading of zero on the pressure/vacuum gauge, check it under different temperature and/or loading conditions to see if it changes or remains at zero.
A special pressure/vacuum gauge with contacts can be installed to send signals to relays or alarms for monitoring purposes.

PRIMARY CURRENT – The amperage capacity of the primary winding of a transformer

PRIMARY VOLTAGE – The INPUT voltage of a transformer

PROTECTIVE CAPS – If you have a transformer with a dead front, loop feed primary configuration but you don't want to loop to another transformer, you can install protective caps to insulate the set of bushings used for looping. These caps plug into a 200-amp loadbreak insert.

RADIAL FEED – Radial feed means the incoming primary cables are connected to the transformer's primary bushings with no outgoing feed.

SECONDARY CURRENT – The amperage capacity of the secondary winding of a transformer

SECONDARY VOLTAGE – The OUTPUT voltage of a transformer

SUBSTATION TRANSFORMER – A transformer that is installed on a pad and may have exposed bushings or bushings that are enclosed in throats or air terminal chambers; substation transformers do NOT have a tamper-resistant rating.
COVER – Utility type station transformers typically have cover-mounted bushings. They are exposed bushings on the cover for easy connection to overhead power lines.
SIDE – Side-mounted bushings are typically connected to other equipment like switchgear. They are normally enclosed in some type of box. The types of enclosing boxes are listed below.
FLANGE – A flange is a shallow frame that surrounds the bushings and can be bolted to an enclosing box.
THROAT – A throat is a deeper frame that may or may not fully cover the bushings. It can be bolted or welded to the transformer. A throat can also be bolted to a box or enclosure of another piece of equipment like bus duct or switchgear.
AIR TERMINAL CHAMBER – Air terminal chambers are boxes that connect to a flange or throat. Some air terminal chambers are partial-height (they don't extend to the pad or floor) and some are full-height (they extend to the pad or floor.

SURGE ARRESTERS – Surge arresters are devices that help reduce the risk of damage due to lightning or other surges. These arresters provide a low-resistance path to ground to route over voltages away from your transformer. There are many types of surge arresters and specifying the correct one is important. Consult your engineer or electrical contractor if you are unsure of how to choose the correct type and rating of arrester.

TAPS – Taps are used to adjust voltage. They are normally located on the high voltage windings. By changing taps, you can compensate for an incoming voltage that is too low or too high. Taps are typically rated in a percentage of the nominal tap (the rated voltage of the transformer) or by the actual voltage rating of each tap. **Taps should be changed when the transformer is in a de-energized state only.** One of the more common tap arrangements for dry type transformers is "2(+) 2(-) at 2.5%". This may be written several ways including "2FCAN, 2FCBN" which means 2 Full Capacity Taps Above Nominal and 2 Full Capacity Taps Below Nominal. On dry type transformers, taps are typically adjusted by connecting a jumper wire between two terminals on the high voltage winding.

TEMPERATURE GAUGE – A temperature gauge indicates the temperature of the cooling fluid. It may include a manually-resettable maximum temperature indicator (red needle) as shown in the photograph.
Most oil filled transformers are designed to operate at 65°C above an average ambient temperature of 30°C with a maximum ambient temperature of 40°C. Excessive heating can cause insulation breakdown and failure.
A special temperature gauge with contacts can be installed to send signals to relays or alarms for monitoring purposes.

TEMPERATURE RISE – Temperature rise is the increase in temperature over the ambient temperature due to loading. These ratings are typically based on an average ambient temperature of 30°C (86°F) over any 24-hour

period with a maximum ambient temperature of 40°C (104°F). Transformers with lower temperature rise ratings operate at a lower temperature than an otherwise equal, higher temperature rise transformer. However, a lower temperature rise rating is essentially a lower KVA rating. For example, a dry type transformer that is rated 2000 KVA at 150°C is rated for only 1500 KVA at 80°C.

DRY TYPE – The standard temperature rise for dry type transformers is 150°C. Optional temperature rises are 115°C and 80°C.

OIL FILLED – The standard temperature rise for oil filled transformers is 65°C. Optional temperature rise is 55°C.

TRANSFORMER – A device that transforms electrical power using electromagnetic coils and core; the voltage and current are generally changed during this transformation.

VECTOR

Vector – Three phase transformers should have a vector (connection type) indicated along with their voltage.

1. Delta – A three-phase connection in which each phase winding is connected in series to form a closed loop; on a Delta connection of a three-phase transformer, the transformer will have three (3) terminations or bushings; commonly denoted using the Greek Delta symbol – Δ
2. Wye – A three-phase connection in which similar ends of each phase winding are connected together at a common point which forms the electrical neutral and is often grounded; on a Wye connection of a three-phase transformer, the transformer will typically have four (4) terminations or bushings

Single-Phase Vector – Single-phase transformers may also have a Wye vector designation to indicate how they will be connected in a three-phase bank, i.e., "7200/12470Y-277/480Y". In this example, the primary may be connected as 7200 Delta or 12470Y/7200. If the voltage is written as "12470-277/480Y" is assumed to mean the primary will be connected as 12470 Delta and the secondary will be connected as 480Y/277.

VOLTAGE

Primary Voltage – The INPUT voltage of a transformer
Secondary Voltage – The OUTPUT voltage of a transformer

WINDING MATERIAL – The primary and secondary windings of the transformer can either be copper or aluminum, or one can be copper and the other aluminum. The industry standard, since the early 1970's, has been aluminum. You can find more information on copper and aluminum on our web site using the Downloads link on our home page.

WYE – A three-phase connection in which similar ends of each phase winding are connected together at a common point which forms the electrical neutral and is often grounded; on a Wye connection of a three-phase transformer, the transformer will typically have four (4) terminations or bushings.