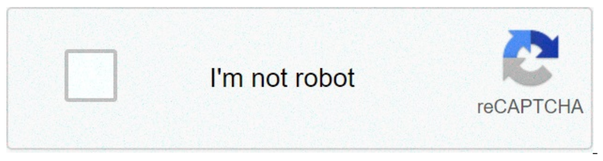

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3-phase transformer kva calculator

In many industries, including health care, manufacturing, electrical contracting, higher education and corrections, reliable, high-quality transformers are essential for keeping operations running efficiently. Large facilities and industrial processes require substantial amounts of power, and they need dependable transformers to convert the energy coming from the power plant into a form they can use for their equipment and building utilities. How do transformers help commercial and industrial facilities achieve these goals? Transformers convert energy from the source to the power required by the load. To use their transformers effectively, businesses need to know how much power their particular transformers can give them. A transformer's rating provides that information. The transformer typically consists of two windings, a primary and secondary winding. Input power flows through the primary winding. The secondary winding then converts the power and sends it to the load through its input leads. A transformer's rating, or size, is its power level in kilovolt-amperes. When a piece of electrical equipment malfunctions, the transformer is often the culprit. In that case, you'll probably need to replace your transformer, and when you do, you'll need to select one with the correct kVA for your needs. If not, you run the risk of frying your valuable equipment. How do you choose a transformer size? Fortunately, sizing your transformer is relatively simple. It involves using a straightforward formula to generate your kVA requirements from the current and voltage of your electrical load. In the guide to transformer kVA ratings below, we'll explain in more detail how to calculate the required capacity kVA rating. Call ELSCO For More Information When you're figuring out kVA size, it's helpful to have the terminology and abbreviations straight before you begin. You'll sometimes see transformers, especially smaller ones, sized in units of VA. VA stands for volt-amperes. A transformer with a 100 VA rating, for instance, can handle 100 volts at one ampere (amp) of current. The kVA unit represents kilovolt-amperes, or 1,000 volt-amperes. A transformer with a 1.0 kVA rating is the same as a transformer with a 1,000 VA rating and can handle 100 volts at 10 amps of current. Calculating kVA Size To determine your kVA size, you'll need to make a series of calculations based on your electrical schematics. The electrical load that connects to the secondary winding requires a particular input voltage, or load voltage. Let's call that voltage V. You'll need to know what this voltage is — you can find it by looking at the electrical schematic. We could say that an example load voltage V must be 150 volts. You'll then need to determine the particular current flow your electrical load requires. You can look at the electrical schematic to determine this number as well. If you can't locate the required current flow, you can calculate it by dividing the input voltage by the input resistance. Let's say the required load phase current, which we'll call I, is 50 amperes. Once you've located or calculated these two figures, you can use them to figure out the load's power requirements in kilowatts. To do that, you'll need to multiply the required input voltage (V) by the required current load in amperes (I) and then divide that number by 1,000: In the example above, you would multiply 150 by 50 to get 7,500 and then divide that number by 1,000 to get 7.5 kilowatts. The last step is to convert the figure in kilowatts to kilovolt-amperes. When you do that, you'll need to divide by 0.8, which represents the typical power factor of a load. In the example above, you'd divide 7.5 by 0.8 to get 9.375 kVA. When you're choosing a transformer, though, you won't find one rated 9.375 kVA. Most kVA ratings are whole numbers, and many, especially in the higher ranges, come in multiples of five or 10 — 15 kVA, 150 kVA, 1,000 kVA and so on. In most cases, you'll want to select a transformer with a rating slightly higher than the kVA you calculated — in this case, probably 10 or 15 kVA. You can also work backward and use the known kVA of a transformer to calculate the amperage you can use. If your transformer is rated at 1.5 kVA, and you want to operate it at 25 volts, multiply 1.5 by 1,000 to get 1,500 and then divide 1,500 by 25 to get 60. Your transformer will allow you to run it with up to 60 amperes of current. If the idea of performing calculations when you need to figure out kVA seems daunting or unappealing, you can always turn to charts. Many manufacturers supply charts to make determining the correct kVA easier. If you use a chart, you'll locate your system's voltage and amperage in the rows and columns and then find the kVA listed where your chosen row and column intersect. Request a Transformer Quote In the example above, we divided by 0.8 to increase the kVA of the transformer slightly. Why did we do that? Starting a device generally requires more current than running it. To account for this additional current requirement, it's often helpful to put a start factor into your calculations. A good rule of thumb is to multiply the voltage by the amperage and then multiply by an additional start factor of 125%. Dividing by 0.8, of course, is the same thing as multiplying by 1.25. However, if you start your transformer often — say more than once an hour — you may want a kVA even larger than your calculated size. And if you're working with specialized loads, such as those found with motors or medical equipment, your kVA requirements may differ substantially. For specialized applications, you'll probably want to consult a professional transformer company for advice on what kVA you need. The equation for three-phase transformers, which we'll discuss in more detail below, is also slightly different. When you're doing calculations with three-phase transformers, you'll need to include a constant to make sure your work comes out correctly. Standard Transformer Sizes It's easy to talk about transformer size calculations in the abstract and come up with an array of numbers. But what are standard sizes for transformers that you might purchase? Especially for commercial buildings, the most common sizes for transformers are the following: 3 kVA 6 kVA 9 kVA 15 kVA 30 kVA 37.5 kVA 45 kVA 75 kVA 112.5 kVA 150 kVA 225 kVA 300 kVA 500 kVA 750 kVA 1,000 kVA How to Determine Load Voltage Before you can calculate the necessary kVA for your transformer, you'll need to figure out your load voltage, which is the voltage required to operate the electrical load. To determine your load voltage, you can look at your electrical schematic. Alternatively, you may have the kVA of your transformer and want to calculate the necessary voltage. In that case, you can adjust the equation we used above. Since you know kVA = V * I / 1,000, we can solve for V to get V = kVA * 1,000 / I. So you'll multiply your kVA rating by 1,000 and then divide by the amperage. If your transformer has a kVA rating of 75 and your amperage is 312.5, you'll plug those numbers into the equation — 75 * 1,000 / 312.5 = 240 volts. How to Determine Secondary Voltage The primary and secondary circuits coil around the magnetic part of the transformer. A couple of different factors determine the secondary voltage — the number of turns in the coils and the voltage and current of the primary circuit. You can calculate the voltage of the secondary circuit by using a ratio of the voltage drops through the primary and secondary circuits, along with the number of circuit coils around the magnetic part of the transformer. We'll use the equation t1/t2 = V1/V2, where t1 is the number of turns in the primary circuit's coil, t2 is the number of turns in the secondary circuit's coil, V1 is the voltage drop in the primary circuit's coil and V2 is the voltage drop in the secondary circuit's coil. Let's say you have a transformer with 300 turns in its primary coil and 150 turns in its secondary coil. You also know that the voltage drop through the first coil is 10 volts. Plugging these numbers into the equation given above yields 300/150 = 10/t2, so you know t2, the voltage drop through the secondary coil, is 5 volts. How to Determine Primary Voltage Remember that every transformer has a primary and secondary side. In many cases, you'll want to calculate the primary voltage, which is the voltage the transformer receives from a power source. You can determine that primary voltage by using the ratios of current and voltage from the transformer's primary and secondary coils. Maybe you know your transformer has a current of 4 amps and a voltage drop of 10 volts through its secondary coil. You also know your transformer has a current of 6 amps through the primary coil. What should the voltage drop through the primary coil be? Let i1 and i2 equal the currents through the two coils. You can use the formula i1/i2 = V2/V1. In this case, i1 is 6, i2 is 4, and V2 is 10, and if you plug those numbers into the formula, you get 6/4 = 10/V1. Solving for V1 gives you V1 = 10 * 4/6, so the voltage drop through the primary circuit should be 6.667 volts. Request a Transformer Quote A single-phase transformer uses a single-phase alternating current. It has two lines of alternating current (AC) power. Below are a few common types: Encapsulated: A single-phase encapsulated transformer is useful for various general loads, including both indoor and outdoor loads. These transformers are common in industrial and commercial operations, including many types of lighting applications. If they wish, facilities can bank these units to create three-phase transformers. These transformers have relatively low ratings, often from about 50 VA to 25 kVA. Ventilated: A ventilated single-phase transformer is useful for multiple single-phase indoor and outdoor loads. These transformers are common in commercial and industrial applications, including lighting applications. They often have ratings ranging from about 25 to 100 kVA. Totally enclosed non-ventilated: Totally enclosed non-ventilated transformers may be single-phase or three-phase units. They are ideal for environments that contain high volumes of dirt and debris. Their ratings typically range from about 25 to 500 kVA. Three-Phase kVA Ratings A three-phase transformer can take one of a few different forms. It typically has three lines of power, where each line is out of phase with the other two by 120 degrees. Compared with single-phase transformers, three-phase transformers come in similar types: Encapsulated: A three-phase encapsulated transformer is useful for numerous general loads, both outdoor and indoor and commercial and industrial, including lighting applications. These transformers often have ratings ranging between 3 and 75 kVA. Ventilated: A three-phase ventilated transformer is useful for many types of general indoor and outdoor loads, both industrial and commercial, including lighting applications. These transformers can have tremendous ratings, up to 1,000 kVA. Totally enclosed non-ventilated: As with single-phase units, these three-phase systems are ideal for environments that contain high volumes of dirt and debris. Their ratings typically range from about 25 to 500 kVA. The calculation for a three-phase transformer kVA is a little different from the calculation for a single-phase kVA. Once you've multiplied your voltage and amperage, you'll also need to multiply by a constant — 1.732, which is the square root of 3 truncated to three decimal places: So if you're working with a three-phase transformer, instead of multiplying the voltage by the amperage and dividing by 1,000 to get the kVA, you'll multiply the voltage by the amperage by 1.732 and still divide by 1,000 to get the kVA. To see the benefits of quality, high-performing transformers in your business, partner with ELSCO Transformers. We provide a range of transformer services to keep your business operating smoothly, including transformer repairs, rebuilds, retrofits, rewinds and emergency replacements. We also offer a few different types of brand-new medium voltage transformers, including dry-type, pad-mount, unit substation and station-type transformers. We're also happy to develop custom-built transformers to meet your facility's unique needs and specifications. We have years of experience supplying transformers for various industries, including electrical contractors, electrical supply houses, hospitals and medical clinics and manufacturing facilities, among many others. A malfunctioning or broken-down transformer can lead to costly delays and make your business less profitable. Keep your operations running efficiently by staying on top of transformer repairs or getting a custom new system from ELSCO Transformers. Our essential staff members have over two decades of experience in the industry, and we parlay that extensive experience, knowledge and expertise into giving you reliable units that will run dependably and perform well for years. Contact us today to learn more.