Westinghouse Electric Corporation
Specialty Transformer Division
Greenville, Pa. 16125

Application Data
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Dry Type, 5000 Volts and Below

Specialty Transformers

Dry Type Autotransformers for General Light and Power Service

How to use two-winding dry type transformers as autotransformers to change voltage on single-phase circuits

Single-phase transformers of standard service voltage ratings can be applied as autotransformers to provide step-up or step-down service.

In some territories local codes prohibit the use of autotransformers. For some applications it is necessary that the load circuit be completely isolated from the supply circuit, since supply circuit faults will affect load circuits when autotransformers are used for voltage transformation. Autotransformers are not usually recommended for step-down service because of the danger of destroying a device by having a voltage greater than its rated voltage accidentally impressed upon it.

Single-Phase Transformers Applied as Autotransformers

Voltage Transformation	Ratio of Low Voltage to High Voltage	Dia. No.	Transformer Rating: Volts	
			Primary	Secondary
240 to 480	0.5	27	240 x 480	120/240
240 to 480	0.5	28	120 x 240	120/240
120 to 240	0.5	29	120 x 240	120/240
480 to 600	0.8	30	240 x 480	120/240

The table provides data on standard dry type, low voltage (600-volt class), single-phase, two-winding transformers used as autotransformers. For step-up service, the ratio of low voltage to high voltage in the first three cases is 0.5 and therefore, the amount of kva transformed is $(1-0.5=0.5)$ 50 percent of the total kva; in the last case, the ratio is 0.8 and the kva transformed is $(1-0.8=0.2)$ 20 percent. Output kva to the load is then 200 percent of the transformer nameplate rating in the first three cases and output is 500 percent for the fourth case

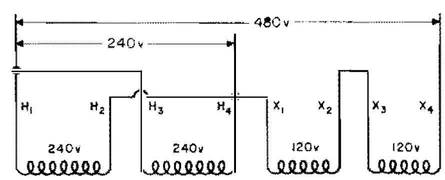
For the accompanying diagrams, lead markings indicate relative directions in the windings. Thus, if H_1 is the start of one high-voltage winding, H_2 is the finish. H_3 is the start and H_4 is the finish of the other high-voltage winding. X_1 is then the start of the first low-voltage winding, and X_3 is the start of the other low-voltage winding.

The two high-voltage windings are connected in multiple by connecting H_1 to H_3 and H_2 to H_4. The two low-voltage windings are connected in series by connecting X_2 to X_3. The two windings thus formed are connected in series aiding by connecting H_4 to X_1 and the autotransformer is complete.

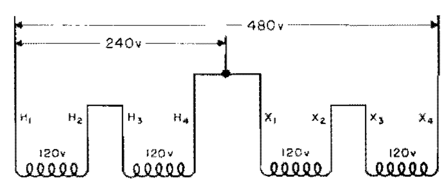
This same reasoning can be applied for dropping voltages as well as stepping up by just applying the high-voltage connections to the supply and the load to the low-voltage connections.

Note: For use of transformers as listed above, refer to Greenville Plant for specific application data.

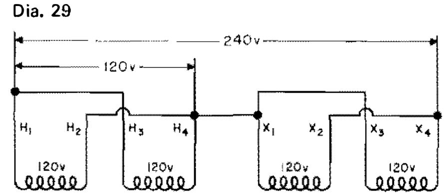
Dia. 27



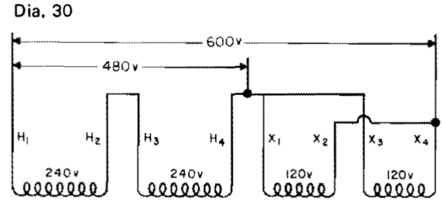
Dia. 28



Dia. 29



Dia. 30



Dry Type Autotransformers for General Light and Power Service

How to use two-winding dry type transformers as autotransformers to change voltage on three-phase circuits
Single-phase transformers of standard service voltage ratings can be combined into banks of three-phase autotransformers in several ways. Perhaps the most satisfactory and economical connections are the "T" and open delta. Each requires two units to make up the three-phase bank. Other connections, **not recommended for use** are the wye, the closed delta, and the extended delta – each requiring three units.

When using standard transformers to make an autotransformer bank in wye, each of the units composing the legs of the wye is under-excited. Assume a desired three-phase ratio of 240 volts to 480 volts Each standard transformer is then connected as a single-phase autotransformer for the ratio of 240 to 480 volts. When placed in the **wye connection,** however, each autotransformer has impressed on it $240/\sqrt{3}$ volts and its output is $480/\sqrt{3}$ volts. Thus, the **maximum economy is not available** since the output kva is only 115 percent of the combined nameplate ratings of the transformers.

Use of the **closed-delta connection is not recommended** when utilizing standard transformers since the saving realized is small due to phase shift.

Extended-delta connection presents odd voltage ratios and phase shift is present. It therefore **is not recommended.**

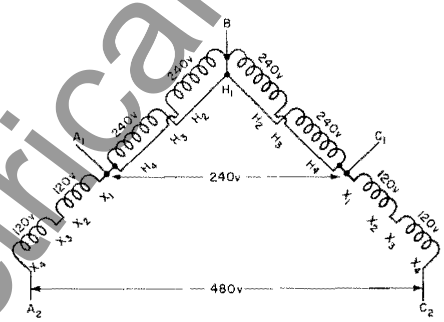
Diagram 31 shows the connections for two autotransformers in an open-delta bank for three-phase conversion from 240 volts to 480 volts, using transformers rated 240 x 480 volts primary, 120/240 volts secondary. Lead markings indicate relative directions in the windings. The high-voltage windings are connected in multiple, and the low-voltage windings are connected in series. The two groups of windings are connected series aiding (boost) to form the autotransformers, and the H_1 points are connected together for the common line to form the three-phase bank. This connection provides a bank output kva equal to 173 percent of the sum of nameplate ratings of the two transformers.

Diagram 32 shows the connections for the same transformers in an open-delta autotransformer bank to provide three-phase conversion from 480 to 600 volts. This connection provides a bank output kva equal to 433 percent of the sum of the nameplate ratings of the two transformers.

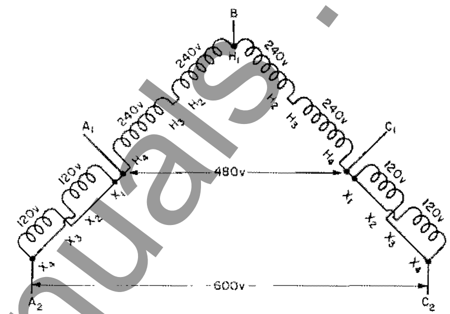
Diagram 33 shows the T-connection for two autotransformers to provide thre-phase conversion from 240 to 480 volts, using transformers rated 120 x 240 primary, 120/240 volts secondary. All windings of each transformer are connected series aiding (boost) and the teaser unit is connected at midpoint of the main unit. In this connection the nameplate rating of each transformer should represent at least 28.85 percent of the bank output kva desired; in other words, the bank output kva is equal to173 percent of the sum of the nameplate ratings of the two transformers (same as Diagram 31).

As with single-phase circuits, three-phase arrangements may be used to drop voltages by placing the load on low-voltage connections and the line on high-voltage connections.

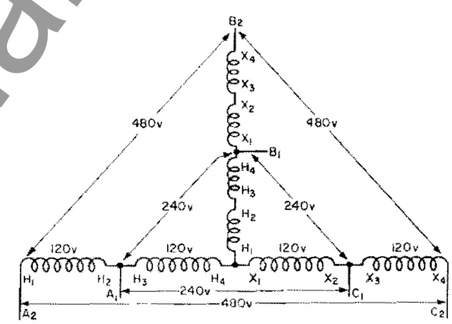
Dia. 31



Dia. 32



Dia. 33



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