Basic Questions and Answers about Transformers

1. What is a Transformer?

ANSWER: A transformer is an electrical apparatus designed to convert alternating current from one voltage to another. It can be designed to "step up" or "step down" voltages.

2. Is it Possible to Change Three Phase to Two Phase or Vice-Versa with Standard Transformers?

ANSWER: Yes. This is a very practical application for standard single phase off-the-shelf transformers. Some typical voltage combinations are as follows:

480 volts three phase to 240 volts two phase, or 240 volts three phase to 480 volts two phase, or 240 volts three phase to 240 volts two phase. Please refer to factory for an exact schematic.

3. How Does a Transformer Work?

ANSWER: A transformer works on the magnetic induction principle. It has no moving parts and is a completely static solid state device, which insures, under normal operating conditions, a long and trouble-free life. It consists, in its simplest form, of two or more coils of insulated wire wound on a laminated steel core. When voltage is introduced to one coil, called the primary, it magnetizes the iron core. A voltage is induced in the other coil, called the secondary or output coil. The change of voltage (or voltage ratio) between the primary and secondary depends on the turns ratio of the two coils.

4. What are Taps and When are They Used?

ANSWER: Taps are provided on some transformers on the high voltage winding to correct for high or low voltage conditions, and still deliver full rated output voltages at the secondary terminals. Standard tap arrangements are at two and one-half and five percent of the rated primary voltage for both high and low voltage conditions. For example, if the transformer has a 480 volt primary and the available line voltage is running at 504 volts, the primary should be connected to the 5% tap above normal in order that the secondary voltage be maintained at the proper rating. The standard ASA and NEMA designation for taps are "ANFC" (above normal full capacity) and "BNFC" (below normal full capacity).

5. What is the Difference Between "Insulating", "Isolating", and "Shielded Winding" Transformers?

ANSWER: Insulating and isolating transformers are identical. These terms are used to describe the isolation of the primary and secondary windings, or insulation between the two. A shielded winding transformer, on the other hand, is designed with a metallic shield between the primary and secondary windings, thereby attenuating transient noise. This is especially important in critical applications such as computers, process controllers and many other microprocessor controlled devices. All two, three and four winding transformers are of the insulating or isolating types. Only autotransformers, which are a type whose primary and secondary are connected to each other electrically, are not of the insulating or isolating variety.

6. Can Transformers be Operated at Voltages other than Nameplate Voltages?

ANSWER: In some cases, transformers can be operated at voltages below the nameplate rated voltage. In **NO** case should a transformer be operated at a voltage in excess of its nameplate rating unless taps are provided for this purpose. When operating below the rated voltage the KVA capacity is reduced correspondingly. For example, if a 480 volt primary transformer with a 240 volt secondary is operated at 240 volts, the secondary voltage is reduced to 120 volts and if the transformer were originally rated 10 KVA, the reduced rating would be 5 KVA, or in direct proportion to the applied voltage.

7. Can 60 Hz Transformers be Operated at 50 Hz?

ANSWER: ACME ELECTRIC transformers rated below 1 KVA can be utilized on 50 Hz service. Transformers 1 KVA and larger, rated at 60 Hz, should not be used on 50 Hz service due to the higher losses and resultant heat rise; special designs are required for this service. However, any 50 Hz transformer will operate on a 60 Hz service.

8. Can Transformers be Used in Parallel?

ANSWER: Single phase transformers can be used in parallel only when their impedances and voltages are equal. If unequal voltages are used a circulating current exists in the closed network between the two transformers which will cause excess heating and result in a shorter life of the transformer. In addition, impedance values of each transformer must be within 7½% of each other. For example: Transformer A has an impedance of 4%, transformer B which is to be parallel to A must have an impedance between the limits of 3.7% and 4.3%. When paralleling three phase transformers the same precautions must be observed as listed above, plus the angular displacement and phasing between the two transformers must be identical.

9. Can Acme Electric Transformers be Reverse Connected?

ANSWER: ACME ELECTRIC dry type distribution transformers can be reverse connected without a loss of KVA rating, but there are certain limitations to observe. Transformers rated 1 KVA and larger single phase, 15 KVA and larger three phase can be reverse connected without any adverse affects or loss in KVA capacity. The reason for this limitation in KVA size is, the turns ratio is the same as the voltage ratio. Example: A transformer with a 480 volt input, 240 volt output — can have the output connected to a 240 volt source and thereby become the primary or input to the transformer, then the original 480 volt primary winding will become the output or 480 volt secondary. On transformers rated below 1 KVA single phase there is a turns ratio compensation on the low voltage winding. This means the low voltage winding has a greater voltage than the nameplate voltage indicates at no load. For example, a small single phase transformer having a nameplate voltage of 480 volts primary and 240 volts secondary, would actually have a no load voltage of approximately 250 volts, and a full load voltage of 240 volts. If the 240 volt winding were connected to a 240 volt source, then the output voltage would consequently be approximately 460 volts at no load and approximately 442 volts at full load. As the KVA becomes smaller, the compensation is greater — resulting in lower output voltages. When one attempts to use these transformers in reverse the transformer will not be harmed; however, the output voltage will be lower than is indicated by the nameplate.

Three phase transformers below 15 KVA, are "T" connected transformers and not an actual delta-delta or delta-wye connection. A three phase 3, 6 and 9 KVA unit with a 208/120 volt "T" secondary can be reverse connected, but the neutral must **not** be connected to the supply line neutral. If the neutral wire is connected to the supply line neutral, the transformer will try to balance the supply transformer which it cannot do because of the great differences in size, and consequently a burn-out will occur.

Those three phase units with a 240 volt "T" secondary can be reverse connected without special instructions as there is no neutral conductor present on the secondary. Refer to for schematics of "T" connected transformers.

10. Can a Single Phase Transformer be Used on a Three Phase Source?

ANSWER: Yes. Any single phase transformer can be used on a three phase source by connecting the primary leads to any two wires of a three phase system, regardless of whether the source is three phase 3-wire or three phase 4-wire. The transformer output will be single phase.

11. Can Transformers Develop Three Phase Power from a Single Phase Source?

ANSWER: No. Phase converters or phase shifting devices such as reactors and capacitors are required to convert single phase power to three phase.

12. How Do You Select Transformers?

ANSWER:

(1) Determine primary voltage and frequency

(2) Determine secondary voltage required

(3) Determine the capacity required in volt-amperes

This is done by multiplying the load current (amperes) by the load voltage (volts) for single phase. For example: If the load is 40 amperes, such as a motor, and the