Let's Talk Three-Phase

By MIKE TWITTY, Ad

OK, you've had enough discussions at chapter meetings and on chat forums about bonded neutrals, main and sub-panel wiring requirements, HVAC wire and breaker sizes, double taps, etc., and you're feeling pretty good about what you have learned. Right? Got it, right? Not so fast!

JUST WHEN YOU THOUGHT you had this electrical gig kinda figured out, someone has to put a fly in the ointment and start talking about that three-phase stuff!

Well, chances are, sooner or later, you are going to be confronted with a three-phase service. More inspectors are doing commercial inspections where three-phase is a common system. Even some residential inspections will involve a three-phase service from time to time for wood shops, pottery hobbies, etc.

The ASH! Standards Practice requires an inspection of the service and internal components of the service panel, and a description of the amperage and voltage rating. There is no specific requirement For determining between single-phase and three-phase; however, the ability to identify and understand a three-phase system is a great asset For an inspector. But until you are comfortable with these systems, it's PK to say you are not familiar with the system and refer for further

The good news is that, with some training, most experienced spectors can become qualified to properly inspect and describe a ree-phase service. Most of the primary issues you'll need to look rare the same ones you look for in a single-phase service: conductor :e, over-current protection, bonding and grounding and so on. The Iferences between the single- and the three-phase service are the tmber of service entrance conductors (normally three ungrounded done grounded as opposed to two and one), the presence of 3-pole eakers and common voltages of the systems.

In a standard single-phase system, we usually describe the voltage a 240/120-volt system. The 240 volts is the measurement from line line and the 120 volts is measured from either line to the neutral grounded conductor.

A typical three-phase service could be a **208/120-volt wye system,** rich would be 208 volts from any line conductor to either of the aer two line conductors and 120 volts is measured from any of the line conductors to the neutral or grounded conductor. Another standard configuration is a 480/277-volt wye **system.** The 480 volts is usually for motors and some appliances and the 277 volts is used for lighting. A transformer is needed in these systems to obtain 120 volts for receptacles.

The mathematical formula for a single-phase service is to divide the ungrounded conductor voltage line to line by 2 to arrive at the one line to neutral voltage (240/2 =120).

A three-phase system uses 1.732 (square root of 3) as the divider (480/1.732 = 277.14). It is important to note that single-phase power is available from any three-phase system. Most single-phase appliances, motors and HVAC systems are rated at 208/230/240 volts. The full load-amp rating will adjust, depending on which voltage is used. As the voltage goes down, the amperage rises, which could affect wire size and over-current rating. 208 volts is used to obtain the common voltage of 120 volts for receptacles and lights. Using the formula in reverse: 120 x 1.732 = 207.84

3-Phase Wye System

. 3 wires Connect all at a common point which is grounded

End points become the connection points for the 3 phases

Y system - wye

2 separate voltages
- Phase to Phase
Phase to Ground

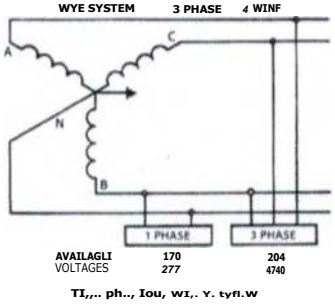

Photo: Atypical 208Y1120 volt 3-phase 225 amp sub panel.
PHOTO COURTESY OF MIKE TWITTY

The previously described three-phase systcm s are the most common ones that home insl ectors will encounter. They are known as ye-type systems, which is a reference to t ic configuration of the power company tra sformcr windings.

less common configuration is known as a delta hookup. This type of system is generally older and less often found, but they still exis . One advantage of a delta system is that a 240/120 voltage is available. Two of the line to-neutral voltage is 120 volts. The main disavantage in this system is that the third line to-neutral voltage will be 208 volts and is kno n as the "high leg." This voltage is basicall useless in single-phase applications unless con cited to 120 volts with a transformer.

Tic NEC requires identification of the "hig leg" phase with orange labeling. Some three-phase services have no neutral, which then would have only a three-wire service. Ung ounded three-phase systems are also available. These most often are seen in industrial plants. Three-phase power is used in industry and commercial facilities because it is more efficient than single-phase, particularly in applications with large inductive loads such as mnors.

Multi-unit buildings such as apartment buildings commonly use three-phase power for *supply.* At each individual unit, a single-phas panel is installed. This could confuse an inspector who is not familiar with three-phase systems because the line-to-neutral voltage will be the normal 120 volts and the line-to-line voltage will be only 208 volts,

It is not necessary for a home inspector to fully understand the characteristics of all electrical systems, but being able to identify unique systems or less common systems gives our profession more credibility. Continuing education never stops in learning about all building systems and components. The more we learn, the better we are as a profession.

This is a brief, general overview of three-phase power. For those who would like to review a detailed, in-depth explanation of three-phase systems, there are many excellent sites on the Internet. A recommended electrical reference for inspectors is the Ugly's book. It has many common formulas and diagrams in a pocket-size book. If you don't already have one, cry it. I think you'll like it! www.uglysbook.com **.0**

ASH! Certified Inspector Mike Twitty is the owner of Homescan Property Inspections in Mt. Juliet, Tennessee. He began his home inspection business after retiring from a 30-year-career at Ford Motor Company, where he was an industrial electrician. He is a Tennessee-licensed electrician and is a certified-residential building inspector and residential-electrical inspector by the International Code Council.