

## Real-world challenge The air handler and NFPA 70B

### Application Note

By Randy Barnett

#### Out of the classroom and into the field: opening a three-phase disconnect and clamping onto an energized 480 volt conductor

Hands-on training generally provides the best opportunities for electricians and technicians to learn. It also identifies some of the most important real-world challenges found in the field. Talking about routine maintenance and troubleshooting in a classroom is much different from opening a three-phase disconnect and clamping onto an energized 480 volt conductor to measure current. Safety is paramount!

In an 80,000-square-foot (7,432-square-meter) commercial office building in suburban Denver, Colorado, American Trainco was called on to conduct a hands-on class for maintenance technicians covering various aspects of NFPA 70B, Recommended Practice for Electrical Equipment Maintenance.

Coordinating with the facility to use one of the building air handlers provided an excellent opportunity. The air handler was in operation and could only be shut down for very short periods. The variable frequency drive (VFD) for the ventilation fan and the 200 amp disconnect for the refrigeration compressor allowed participants to observe different aspects of NFPA 70B maintenance requirements.

Even with observing the safety precautions of NFPA 70E, Standards for Electrical Safety in the Workplace 2009 Edition, challenges began to arise. The maintenance technicians generally carry a Fluke T5 Tester for taking voltage and clamp-on ammeter readings. Though certainly a versatile and convenient digital meter to have on the tool belt, the clamp could not fit around the 250 kcmil compact

stranded conductors supplying the disconnect (see **Figure 1**). Obviously, there are many other clamp-on ammeter choices that could be used to accomplish the task. For all of the voltage and current measurements for this training class a Fluke 381 Remote Display True-rms AC/DC Clamp Meter with iFlex™ was used. The true-rms functions of the meter, as well as the design of the iFlex™ clamp, would prove to be assets in getting not only accurate, but safe readings.

#### How to record and verify the current drawn by the VFD?

One of the first challenges we encountered was recording the current drawn by the VFD under varying load conditions and verifying that it did not exceed nameplate data. Voltage must also be recorded, ensuring that voltage levels are within the  $\pm 10$  percent specification of the nameplate and that phase voltages are properly balanced. This particular VFD did not pose any special hazards, but original installation had made it difficult to clamp on supply conductors and check the current to the drive.



**Figure 1.** Selecting the proper test equipment for the job is a basic requirement for electrical maintenance, and is identified as such in NFPA 70B. Here we quickly determine that the Fluke T5 is too small for the 250 kcmil conductors. On-the-job training, as well as actual maintenance, requires a meter that will provide accurate readings and enhance safety.



**Figure 2.** One advantage of the iFlex™ probe is its ability to pass through and around conductors with little disturbance to the conductors. Here the Fluke 381 is lying in the bottom of the AHU VFD cabinet and is connected to read current to the drive. The remote display unit has been removed to allow readings to be taken with the enclosure door closed.



**Figure 3.** The Fluke iFlex™ probe has been placed around the incoming 480 V conductor and the disconnect door closed, though not latched. The Fluke 381 clamp meter lies on the floor beneath the disconnect. With the remote display unit removed from the meter, the instructor is able to remain well outside of protective boundaries to observe, demonstrate, and discuss readings.

The 480 volt supply conductors had been taped together inside the VFD cabinet to make a neat installation. Separating the conductors to take clamp-on ammeter readings would require removing tape and tugging on the conductors. While mostly just a slight inconvenience, the tape had been on for many years and its removal would require firm tugs on both tape and conductors. Extreme care would have to be taken since the conductors were energized. Any movement of such conductors must be minimized, if not completely eliminated.

Since the Fluke 381 with the iFlex™ probe was readily available we decided to leave the conductors in place and see if it really made much difference to use the meter with its flexible clamp. The answer was simply, “Yes.” Slipping the clamp in between the supply conductors was quick and safe. Even with Class 0 voltage-rated gloves and protectors the flex probe was easy to handle and feed around conductors (see **Figure 2**). We needed a true-rms meter since values were measured directly at the supply into the VFD. Variable speed drives are known for producing harmonic currents, and an averaging meter could have been expected to read considerably lower than actual.

### Reading voltage safely at the refrigeration compressor

The Fluke 381 became invaluable when the training session moved to the 600 volt, 200 amp disconnect used to supply the refrigeration compressor portion of the air handler. Attempting to read voltage with the T5 could be done, but the remote display feature of the 381 proved to outperform any clamp meter without this feature.

Reading phase-to-phase voltage at the top of the disconnect was inconvenient. The temptation was to stand on your toes in front of the live disconnect to look at the meter indication. Such inconvenience also brings about severe safety concerns. By using the Fluke 381, one technician was able to comfortably stand back away and to the side of the live terminals and sequentially place the meter test leads to read phase-to-phase and phase-to-ground voltages. Another person had already removed the remote display unit from the meter and was able to stand well outside the flash protection boundary to safely and easily record readings.

### Measuring current values

Using the flexible clamp feature in combination with the remote display was ideal for measuring current values. The conventional clamp of the meter could be used in this case as conductors were fairly easy to clamp around. However, the flexible clamp could easily be threaded around the 250 kcmil conductors and extended the range of the meter from 999 amps to 2500 amps to ensure inrush current could be measured. No “probing” or twisting and turning of a clamp so as to move conductors out of the way (as is often required with a conventional clamp) was necessary.

We took the remote display to the opposite side of the air handler to observe readings.

The disconnect door cover was partially closed and the instructor was able to stand twenty feet from the disconnect and use the shielding of the large air handler for additional protection. By depressing the “Inrush” button on the meter, the Fluke 381 was able to accurately capture the inrush current of the motor as it is started. The “Min/Max” mode on the remote display was used to observe average running current over a period of time (see **Figure 3**).

### The need for accurate readings and the need for safety

The Fluke 381 Remote Display True-rms AC/DC Clamp Meter with iFlex™ solved two problems in this realistic training setting: The need for accurate readings and the need for enhancing safety. NFPA 70B states, “Personnel safety is a primary consideration in system design and in establishing safety-related work practices where performing preventative maintenance for electrical, electronic, and communication systems and equipment.” 70B also states that the proper test equipment must be used. The Fluke 381 clamp meter successfully accomplished both. As one student put it, “Why didn’t somebody think of this meter a long time ago?”

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