New IEEE standard provides guidance for motor protection for industrial and commercial applications

By Jim Bryan
EASA Technical Support Specialist

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The Institute of Electrical and Electronics Engineers (IEEE) has published a new standard, IEEE Std. 3004.8-2016, “Recommended Practice for Motor Protection in Industrial and Commercial Power Systems.” The “color books” are in the process of being reviewed, updated and their designations changed. Each of the thirteen books in the “IEEE Color Book” standards series deals with a different aspect of electrical power production, distribution, and utilization in industrial and commercial power systems; 3004.8 supersedes Chapter 10 of the “Buff” book, IEEE 242-2001.

IEEE Std. 3004.8 covers a broad spectrum of motor protection schemes including low and medium voltage AC, factors to consider, types of protection, adjustable speed drive (ASD) applications, DC motor protection and hazardous locations.

Work began on this process with the formation of a working group in September 2012 and ended with final IEEE approval December 6, 2016. The working group consisted of the Chair Lorraine K. Padden of Houston and 14 other engineers from around the globe. Dozens of others were involved in providing input and balloting the final version for approval. EASA was represented on the working group, and the EASA technical support staff provided substantial input including a complete new section on DC motor protection. The document became available for purchase on May 23, 2017, on the www.ieee.org website.

The document resulting from this painstaking process will provide guidance for motor protection for industrial and commercial applications. As motor service centers, the more we understand about the application and protection of motors in their applications, the better service we can offer to our customers.

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Following is a brief synopsis of each section:

Normative references

Standards from the American Petroleum Institute (API), IEEE, National Electrical Manufacturer’s Association (NEMA), National Fire Protection Association (NFPA) and Underwriter’s Laboratories (UL) are all used as reference material. The purpose is to bring motor protection information from these references to a central location for ease of access.

Definitions, abbreviations and acronyms

Technical terms and acronyms are part of our industry. There may be many terms around the world that refer to the same thing. For example, adjustable speed drives (ASDs) are also known as variable frequency drives (VFDs), pulse width modulated drives (PWM) or just “drives.” The section on definitions will clarify what the working group was considering when using any specific term.

Factors to consider in protection of motors

What are the motor’s characteristics? Speed, rated voltage, power rating (hp or kW), service factor, type of enclosure and so on. For instance the NEMA design letter defines the shape of the speed torque curve. A Design B motor will be fine for a pump or a fan but would not work well on a conveyor with multiple motors. A Design C motor would share the load of the conveyor more evenly and avoid damaging the motors.

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How a motor is started is also information that is crucial to its protection. Inrush current, multiple starts, wye-delta starting, part winding starting and ASD starting will each require consideration. Ambient conditions including temperature, altitude, ventilation, the driven equipment and power quality are factors.

The importance of the motor to the overall operation will determine the level of protection needed to avoid or mitigate the results of failure. Large motors are often considered to be critical due to their influence in the plant process and their cost to repair or replace. Note that a ½ hp (0.37 kW) lube oil pump motor supplying oil to the sleeve bearing of that large motor is just as critical.

Types of protection

Most of us are familiar with overcurrent (fuses, breakers), overload (starter heaters) or thermal (thermostats, RTDs) protection. These are basics some of which are required by governing agencies and codes. If a critical application requires additional protection there are many choices available. A few of them are:

1. Under or over voltage
2. Undercurrent (say a belt breaks)
3. Bearing temperature
4. Loss of field (very important for shunt wound DC motors)
5. Single phasing
6. Current or voltage balance
7. Number of starts
8. Vibration

Relays are available to be programmed for these and many other protection requirements. They can be included to provide an alarm and/or remove the motor from service if the set limits are exceeded for each parameter.

Low-voltage and medium-voltage protection

Low-voltage and medium-voltage protection are considered in separate sections. The principles are basically the same, but medium-voltage requirements are more demanding because of the physics of opening the circuit and the personnel and equipment protection necessary. Annex B lists more than 100 devices that can be employed to monitor, report and interrupt the circuit (if necessary) of the motor while in operation. Over-current, over-temperature, under-voltage, vibration and bearing protection devices are just a few of those listed. Smart devices can be programmed to monitor the motor’s current versus time during starting. If the current remains high for a period of time that could lead to motor damage, the device can intervene in a method prescribed by the user.

DC motor protection

A new section on DC motor protection was drafted by EASA Senior Technical Support Specialist Chuck Yung. This section covers protection for contamination, moisture, temperature and dielectric stress. Potential failure conditions and protection methods and devices unique to DC motors are covered.

Other pertinent standards reviews

Another standard was recently published, IEEE Std. 1068-2016, “Repair and Rewinding of AC Electric Motors in the Petroleum, Chemical & Process Industries.” The working group for this standard was chaired by Chuck Yung. Other standards updates currently under review by members of the EASA staff include:

IECex Technical Committee Explosive Atmospheres - Part 1: Equipment protection by flameproof enclosures "d" which deals with hazardous location motor and generator manufacturing (EASA Senior Technical Support Specialist Tom Bishop, P.E.).

NFPA 70B Electrical Equipment Maintenance (Tom Bishop, P.E.)


ASA ASC-S2 Work Group 15, “Shaft Alignment Methodology” (EASA Pump & Vibration Specialist Gene Vogel)

CSA C392 “Testing of Three-Phase Squirrel Cage Induction Motors During Refurbishment” (Tom Bishop, P.E.)

EASA staff participation in reviewing these standards helps reinforce our position as “The Electro-Mechanical Authority.” Members who are aware of and utilize these documents and others pertaining to the industry will be better able to help your customers meet the goal of improved reliability. This will be a significant advantage in today’s market and will bring customers back again and again.

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