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# TROUBLESHOOTING, MAINTENANCE AND PROTECTION OF AC ELECTRICAL MOTORS AND DRIVES



## **YOU WILL LEARN HOW TO:**

- Understand AC motor operation and construction
- Specify, select and install motors
- Specify protection requirements for motors
- Specify speed control requirements for motors
- Install and commission motors
- Fix faults on motors
- Interpret motor performance curves
- Interface control circuits of motors with PLCs/DCSs
- Reduce downtime on electrical motors
- Improve plant safety
- Improve plant throughput
- Reduce your spares usage and requirements

## **WHO SHOULD ATTEND:**

Anyone associated with the use of electrical motors in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

- Plant Engineers
- Instrument Technicians
- Operations Personnel
- Electrical Maintenance Technicians
- Instrument and Control Engineers
- Process Control Engineers
- Mechanical Engineers
- Service Technicians
- Maintenance Personnel
- Electrical Maintenance Supervisors

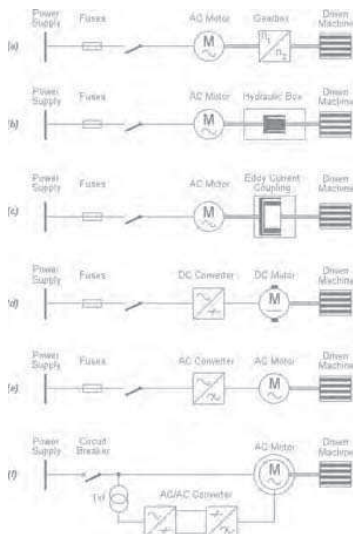
## The Workshop

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today. The cost of maintaining electrical motors can be a significant amount in the budget item of manufacturing and mining industries. This course gives you a thorough understanding of electrical motor's working, maintenance and failure modes and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the installation, operation and troubleshooting of electric motors. Typical applications of electric motors in mining, manufacturing, materials handling, process control are covered in detail. You will learn the basic steps in specifying, installing, wiring and commissioning motors. The concluding section of the course gives you the fundamental tools in troubleshooting motors confidently and effectively.

### Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.



## The Program

### INTRODUCTION

#### FUNDAMENTALS OF MOTOR TECHNOLOGY

- Basic principles of rotating electric machines
- Fundamental principles of speed control
- Efficiency, torque, inertia, horsepower/ power factor
- Torque-speed curves
- How the motor produces torque
- Types of motors

#### AC MOTOR THEORY, CONSTRUCTION AND MAINTENANCE

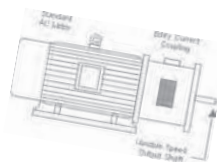
- Basic construction and physical configuration, windings
- Principles of operation and performance

#### THREE PHASE AC INDUCTION MOTORS

- Components
- Theory of operation
- Induction motor design
- Duty cycles
- Insulation and cooling requirements
- Starting methods
- Selecting motors
- Maintenance of AC machines
- Types of faults, fault finding and testing of AC machines
- Testing instrumentation

#### DETERMINATION OF LOSSES AND EFFICIENCY OF THREE PHASE AC INDUCTION MOTORS

- Standards
- Types of losses
- Tests for measurement and computation of losses and efficiency
- Dynamometers
- Principles of load application by braking
- Torque measurement basics
- Types of practical dynamometers
- Eddy current dynamometer and its characteristics
- DC and AC dynamometers and their working principles
- Testing of larger motors back-to-back test approach



### PROTECTION OF AC MOTORS

- Protective devices
- Thermal overload
- Over current / overload
- Under-voltage / over-voltage
- Under frequency
- Current unbalance or negative phase sequence
- Earth fault protection
- Pole slip / out of step
- Loss of excitation
- Inadvertent energization
- Over fluxing
- Stall protection / acceleration time / start up supervision (time between starts / starts per hour)
- Voltage controlled or restrained over current
- Protection settings

### SPEED CONTROL OF AC MOTORS

- Introduction to variable speed drives or power electronic converters
- Types, and designs of variable speed drives

### PROTECTION OF AC CONVERTERS AND MOTORS

- Frequency converter protection circuits
- Protection settings

### CONTROL SYSTEMS FOR AC VARIABLE SPEED DRIVES

- Control theory of VSDs explained

### THE SELECTION OF AC CONVERTERS FOR VARIABLE SPEED DRIVE APPLICATIONS

- Selection procedure
- Nature of the load
- Selection of correct size motor and converter

### INSTALLATION AND COMMISSIONING OF AC VARIABLE SPEED DRIVES

- General installation and environmental requirements
- Electrical connections and Earthing requirements
- Control wiring and pre-commissioning
- Commissioning tests

### NEW TECHNOLOGIES AND DEVELOPMENTS

### SUMMARY, OPEN FORUM AND CLOSING

