



PRACTICAL MOTOR PROTECTION, TESTING, Control & Maintenance

Course Introduction:

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today (and this figure increases to 70% if you only consider industry). The cost of maintaining electrical motors can be a significant amount in the budget item of manufacturing and mining industries. This workshop gives you a thorough understanding of electrical motor's protection, control and maintenance and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the protection, control and maintenance of electric motors and drives. Typical applications of electric motors in mining, manufacturing, materials handling and process control are covered in detail. The concluding section of the workshop gives you the fundamental tools in troubleshooting motors confidently and effectively.

Course Objectives:

Upon completion of the course, participants will be able to:

- Specify protection requirements for motors
- Maintain electrical motors
- Specify speed control requirements for motors
- Understand essential of motors and drives
- Detail the main issues with testing of motors
- Prevent or at least minimize motor bearing failure
- Troubleshoot and fix faults on motors and drives
- Surface control circuits of motors with PLCs/DCSc
- 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 systems design as well site commissioning, maintenance and troubleshooting.

Typical personnel who could benefit are:

- Plant Engineers
- Instrument Technicians
- Engineering and Design Personnel
- Operations Personnel

- Electrical Maintenance Technicians
- Instrument and Control Engineers
- Electrical Contractors
- Electrical Consulting Engineers
- Mechanical Engineers
- Service Technicians
- Maintenance Personnel

Course Outline:

INTRODUCTION AND OUTLINE OF COURSE OBJECTIVES

FUNDAMENTALS OF MOTOR TECHNOLOGY AND CONSTRUCTION

- Basic principles of rotating electric machines
- Fundamental principles of speed control
- Efficiency, torque, inertia, horsepower/power factor
- Torque-speed curves
- Induction/synchronous/wound rotor types
- 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
- Types of faults, fault finding and testing of AC machines
- Testing instrumentation

ENERGY LOSSES AND EFFICIENCY OF THREE PHASE AC INDUCTION MOTORS

- Standards
- Types of Losses
- Tests for measurements and computation of losses and efficiency
- Dynamometers
- Principles of load application by braking
- Torque measurement basics
- Types of practical dynamometers

MOTOR FAILURE ANALYSIS

- Frequent starts
- High inertia
- Inadequate cooling
- Congestion on fan cover
- Improper spacing at end of motor
- Incorrect belt alignment
- Solid belt guards
- Excessive loading causing bearing clearance problems
- Insulation failures
- Bearing current problems

TESTING

- Insulation life and resistance
- Polarization index
- Hipot
- DC ramp test
- AC hipot
- Capacitance test
- Dissipation factor
- Partial Discharge
- Surge test
- Mechanical testing
- Online Testing

BEARING FAILURE ANALYSIS

- Bearing Failures
- Grease and greasing
- Belt Drive aspect
- Balance
- Storage issues
- Service factor loading

PROTECTION OF MOTORS

- Thermal overload
- Time constraints
- Early relays and new digital relays
- Starting and stalling conditions
- Over Current / Overload
- Under-voltage / Over –voltage

- Under frequency
- Pole slip / out of step
- Loss of excitation
- Inadvertent energization
- Over Fluxing
- Stall protection / acceleration time / Start up supervision / Time between starts
- Unbalanced supply voltages
- Negative sequence currents
- De-rating factors
- Earth faults – core balance, residual stabilizing resistor
- Calculation of protective relay settings

MOTOR CONTROL

- Power Circuit
- Control Circuit
- Full Online voltage starting
- Reduced voltage starting
 - Delta-star
 - Resistance
 - Reactor
 - Autotransformer
 - Soft Start
- Braking
- Speed Control
- Reversing



CONTROL SYSTEMS FOR AC VARIABLE SPEED DRIVES

- Overall control system
- Power supply for the control system
- Dc Bus charging system
- VSD control loops (Open Loop/Closed loop)
- Vector control
- Current feedback in ac variable speed drives
- Speed feedback from motor

INSTALLATION AND FAULT FINDING

- General installation and environmental requirements
- Power supply connections and earthing
- Where to install contractors in power circuit
- Installation of ac converters into metal enclosures

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Fees:

To be advised as per course locations. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee / Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee / Tea / Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Lunch Break & Prayer Break
13:30 - 15:00	Last Session