



## HT Motors and Protection Methods For Future Training

### Description

#### Course Description

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 valuable insight into the selection of the protection necessary to ensure your motors are protected against fault conditions, so as to ensure reliability and long life. Typical applications of electric motors in mining, manufacturing, materials handling and 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.

#### Course Objective

This course is designed to enable participants to:

- Understand AC motor operation and construction.
- Overview different types of motor duties.
- Read & explain the motor NP data.
- Motor de-rating factors.
- Specify, select and install motors.
- Specify speed control requirements for motors.
- Interpret motor performance curves
- Electrical motors in Hazardous area.
- Install and commission motors
- Fix faults on motors.
- Specify protection requirements for HV motors.

## Course Outline

### Review of Fundamentals/Basics

- Resistors, Ohm's Law, Capacitors, dielectrics, magnetic field, Ampere's law, Faraday's law, inductance, and alternating currents.

### Introduction to Different Types of Electric Motors

- DC motors.
- AC motors (1-Ph & 3-Ph).
- Induction Motors.
- Synchronous motors.
- International Codes and Standards.

### Fundamentals of Motor Technology

- Basic construction and physical configuration, windings.
- Principles of operation and performance.
- How the motor produces torque.
- Theory of operation.
- Basic principles of rotating electric machines.
- Fundamental principles of speed control.
- Efficiency, torque, inertia, horsepower/power factor.
- Torque-speed curves.
- Motor Losses & Efficiency.
- Induction motor design.
- Duty cycles.
- Insulation and Cooling requirements.
- Selecting motors.
- Classified Ex motors.
- De-rating Factors (Temperature, altitude, ...).
- Voltage unbalance.
- Power Factor Improvement.

## Condition Monitoring And Diagnostics

- Partial Discharge
- Insulation Resistance Monitoring
- Correction for Winding Temperature
- Insulation Contamination
- IR Test Connections
- Typical IR Testing Program
- DC HI-POT TEST
- Maximum Allowable Test Voltage
- Measuring Insulation Degradation
- Capacitive Charging Current
- Resistive Leakage Current
- Insulation Power Factor
- Insulation Power Factor Standards
- Power Factor Test Sets
- Outage for Scheduled Maintenance
- On Line Measuring Partial Discharge Activity (PDA) For Insulation
- Motor Current Signature Analysis (MCSA)

## Maintenance of HT Induction Motors

- Maintenance Requirements
- Cleaning Motors
- Care of Stator Windings
- Care of Rotor Winding
- Motor Shaft Currents
- Inspecting Motor Bearings.
- Different Electrical Testing.
- Electrical Preventive Maintenance Work Instructions.
- Troubleshooting Electric Motors.
- Motor Failures
- Insulation failure
- Over-current/overloading
- Cable box failure
- Rotor burnout
- Bearings
- Vibration
- Induction Motors Troubleshooting Guide
- Motors and Electrical safety

## HT Motor Protection

- Introduction
- Motor characteristics involved in protection
- General motor protection
- Phase Fault Protection

- Differential Protection
- Ground-Fault Protection
- Thermal And Locked-Rotor Protection
- Locked-Rotor Protection For Large Motors (21)
- System Unbalance And Motors
- Unbalance And Phase Rotation Protection
- Under-voltage Protection
- Repetitive Starts And Jogging Protection
- Multifunction Microprocessor Motor Protection Units
- Practical Considerations Of Motor Protection
- Effect On System Of Starting A Large Motor

## Repeated starting

## Motor Starting Currents

- Achieving Short-Circuit Protection
- Motor Damage
- Motor Operation at Reduced Voltage
- De-rating due to unbalanced currents
- Determination of sequence currents
- Unbalanced supply voltages and single phasing.

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