

Electrical Systems Training Training Topics



© Copyright The RFA Group. However, neither

The RFA Group nor its authors guarantee the accuracy or completeness of any information published herein and neither

The RFA Group nor its authors shall be responsible for any errors, omissions, or damages arising out of the use of this information.

Electrical System Training Topics

The following is a summary of potential training topics that can be delivered to suit your company's or organization's specific requirements. Customization may include unique circuits, materials or conditions, particular problems, or other topics the client provides.

Course 1: Electrical System Design for Mechanical Engineers & Technicians (8 hrs)

Module 1: Introduction to Electrical System Components

- *Passive Electrical Components – Analogies to Hydraulic Systems*
 - *Diodes vs. Check Valves*
 - *Capacitors vs. Accumulators*
 - *Resistors vs. Flow Restriction*
 - *Inductors vs. Vane Pumps*
- *Simple Electrical Control*
 - *Manual Switches*
 - *Relays / Solenoids / Contactors*
 - *Relay Terminology*
 - *Relay Operations Example*
- *Electrical Circuit Protection / Distribution*
 - *Automotive Fuses*
 - *Fuse Holders*
 - *Fuse Operation*
 - *Over / Under Fusing*
 - *Fuse Selection – Time to Blow*
 - *Fuse Selection – Temp Deration*
 - *Automotive Circuit Breakers*
 - *Fuse Holders*
 - *Power Distribution Modules (PDMs)*
 - *Considerations for PDMs*
- *Electrical Power Generation*
 - *Low Voltage Alternators*
- *Electrical Power Storage*
 - *Lead Acid Battery Construction*
 - *Lithium Battery Construction*
 - *Lithium vs. Lead Acid Batteries*
 - *Battery Chemistry*
 - *Regular vs. Deep Cycle Battery*
- *Electrical Control Components*

Module 2: Basic Electrical System Calculations

- *Determining Line Resistance / Kirchoff & Ohm's Law*
- *Simple AC Circuit Calculations*
- *Simple DC RL Circuit Response*
- *Damped Pendulum Analogy*
- *Common Electrical Waveforms*
- *Power Calculations*
- *System Efficiencies*

Module 3: Introduction to Electrical Systems Architecture

- *Mobile Machinery Electrical System Design*
- *Typical Electrical System Controls Breakdown*
- *Centralized / Distributed Electro-Hydraulic Control Systems*
- *Mobile Power Distribution Systems*
- *Typical Electrical System Circuit Busses*

Electrical System Training Topics

Module 4: Introduction to Routed System Design

Section A:

- *High & Low Voltage Wire Selection*
 - *Wire Material Comparison*
 - *Specification Examples*
- *Battery Cable Selection*
- *Bus Bar Connection System*
- *Electrical Termination Designs*
 - *Solid / Stamped & Formed Contacts*
 - *Simple Terminals*
 - *Eyelets, Battery Lugs*
 - *Terminal Construction*
- *Electrical Connector Designs*
 - *Connector Basics*
 - *Pull & Push to Seat Insertion*
 - *Connector Features*
- *Harness Retention Design Options*

Section B:

- *Wire / Cable Sizing*
- *Wire Color Key*
- *Connector Selection / Application*
- *Electrical System Environmental Considerations*
- *Harness Protection Types*
- *Material Specifications – Ingress*
- *Material Specifications – Flammability*
- *Electrical Magnetic Interference (EMI)*
 - *What is it*
 - *Means to reduce victim impact*

- *Cable Shielding Options*
- *Shielding Specification Example*
- *SAE J1939-73 Physical Layer*
 - *Quick Overview*
 - *Wire / Cable Requirements*
 - *Topology*
 - *Terminating Resistors*
 - *1939-11 vs. 1939-15 Requirements*

Section C:

- *Harness Failure Modes*
 - *Short Circuits*
 - *Open Circuits*
 - *Intermittent Circuits*
- *Electrical Bolted Joint Connections*
- *Cable / Routing Assembly Design Considerations*
 - *Abrasion Protection*
 - *Motion & Flexibility*
 - *Tension*
 - *Wire Splicing*
 - *Drip Loops*
 - *Environmental Concerns*
 - *Accessibility / Serviceability*
 - *Harness Retention Recommendations*
 - *Cable Routing & Assembly*
 - *Manufacturing Design Takeaways*
- *Optional Capstone Project: Electrical System Design Auxiliary Light Circuits*

Electrical System Training Topics

Course 2: Intro to High Voltage Electrical System Design **(4 hrs)**

Module 1: Introduction to High Voltage Electrical Components & Calculations

- HV Electrical Power Generation
 - Generators
- HV Electrical Power Storage
 - Lithium Battery Construction
 - Lithium vs. Lead Acid Batteries
 - Power vs. Energy Cells
- HV Battery Sizing Calculations
- HV Battery System Architecture
 - HVIL Manual Disconnects
 - HV Bus Bar Systems
- HV Battery Management Systems
- HV Battery Thermal Management
- HV Battery Charging
 - Charging Connection System
- HV Electrical Power Transformation
- Electric Power Conversion Components
 - Inverters
 - Motors
 - Electrical Regeneration Ex.
 - Pump / Pump Drives
 - Power Drive Units
- HV Power Conversion Calculations
- Optional: HV Machine Configuration Lab

Module 2: Introduction to High Voltage Electrical System Architecture

- Mobile Machinery Electrical System Design
- Common High Voltage Standards
- Hybrid Electrical Machine Architecture
- Plug-In Electrical Machine Architecture
- Battery Electrical Machine Architecture
- Battery Electrical Machine Charging
- Swappable BEV Systems
- Tethered Electrical Machine Architecture

Module 3: High Voltage Routed Systems Manufacturing & Test

- Typical Fabrication Processes
- Harness / Cable Fabrication Automation
- Ultrasonics Crimping & Splicing
- Harness & Cable Testing
 - Hi-Pot Testing
 - DC Milli-Ohm Testing
 - Mechanical Testing
 - Testing Requirements Example
 - Environmental Testing
- HV Harness Fabrication / Test Safety Reminders

Module 4: Emerging Consensus Standards for High Voltage Systems

- Emerging Consensus Standards Overview
- Sample NA Standards
- High Voltage Equipotential Bonding / Grounding (ISO 14990)
- California AB1346 (SORE Standard)