



AC Drive Electric Vehicle Technology



Module 1: A History of Electric Transportation

Unit A. Electric Vehicles Through History

1800's to Early 1900's, The First Cars

The 1910's

The 1920's

Mid Century

1990-2000

Unit B. The Evolution of Manufacturers

Manufacturers, Popularity, and Decline

Infrastructure

Today's Hybrids and Electrics

Today's Fuel Cell Vehicles

Unit C. Advantages of the Electric Drive Train

Assembly

Performance

Integration - How the Parts Work Together

Maintenance

Environmental Impact

Module 2: Politics and Planning For the Future of Alternative Transportation

Unit D: Energy and the Environment

Overview

Where Is Oil Used?

Energy-Related Web Resources

Oil Demand

Options to Internal Combustion

Sustainability

Transportation Policy

Unit E: Fuel, Maintenance & Development Costs

Overview

Fuel Costs

Utility Involvement

Maintenance Costs

Calculations and Comparisons to Existing Technology

Social Implications

Battery Charging Infrastructure

Solar Charging

Public Parking/Charging Interfaces

Unit F: The Potential of Today's Technology

Overview

Low Emission Vehicle

Zero Emission Electric Vehicle

DC Drive Electric Vehicles

AC Drive Electric Vehicles

Hybrid Electric Vehicles

Other Electric Vehicles

Module 3: The Basics of Physics & Power

Unit G: Mechanics of Power and Work

Overview

Electrical Energy

Energy and Power Conversion

Energy Efficiency

Mechanical Work

Force

Distance

Velocity

Mechanical Work

Torque

Gear Ratio

Power

Range

Unit H: Turning Electricity Into Motion

Overview

Joule

Electron

Voltage

Amperage

Wattage

Conductors & Insulators

Resistance

Electrical Circuit

EV Power

Unit I: Work, Energy & Power

Overview

Work

Energy

Simple Machines

Power

Moving a Vehicle

Storing Power

Unit J: Energy Storage

Overview

Storing Electrical Power

Battery Configuration

Watt Hour

Energy-to-Weight Capacity

Energy-to-Volume

Power-to-Weight

Self-Discharge

Cost Comparisons

Pack Voltage Determination

Battery Ventilation and Cooling

Battery Internal Temperature

Top & Bottom Cell Balancing

Battery Isolation

Battery Pack Design Calculations

Battery Pack Weight Distribution

Battery Pack Structural Location & Rack Design

Structural Considerations (Automobile)

Structural Considerations (Truck)

Structural Considerations (SUV)

Disconnect Switch

Fusing

Battery Storage Technologies

Battery Equalization

Gassing or Boiling

Recycling

Carbon Batteries

Alkaline Batteries

Nickel Cadmium Batteries

Nickel Metal Hydride Batteries

Lithium Iodide Batteries

Lithium Ion Batteries

Prismatic Batteries

Silver Zinc Batteries

Zinc Air Batteries

Zinc Mercury Batteries

Module 4: AC Conversion Components

Unit K: The Electric Motor

Overview

DC Series-Wound Electric Motor

DC Shunt-Wound Electric Motor

AC Electric Motor

Hybrid Electric Motor Interface

Motor Horsepower

Motor Operation

Motor Over-Voltage / Under-Voltage

Diagnosing Motor Problems

Motor Coupler

Coupler Taper Lock

Coupler Key

O-Ring Adaptor

Adaptor Plate

Motor Mount

Free Rev

Motor Specs

Drive Linkages

Multi-Speed Transmission Interface

Single-Speed Transmission Interface

Direct Interface

Unit L: Controller & Control Enclosure Subassembly

Overview

DC Motor Controller

AC Motor Controller

Other Controller Types

Heat Sink

Potentiometer

Throttle Microswitch

Throttle Return Line

Control Box Enclosure

Main Contactors

Coil Suppression Diode

High Voltage Fuse & Fuse Holder

KSI Switch

Volt Terminal Strips

Multi-position Fuse Holder

Unit M: Battery System

Overview

Working with Batteries

Traction Battery Pack

Battery Life

Battery Capacity

Battery Cycles

Battery Ratings

Battery Voltage

Battery Current

Battery Boxes

Battery Cables

Battery Cable Runs

Battery Terminals

Battery Ventilation

Current Leakage

Storing Batteries

Recycling Batteries

Unit N: Battery Charger

Overview

Stages of Charging

GFI, Safety Regulations and Requirements

Installing the Charger

DC-DC Converter

The “Smart” Electrical Grid

Unit O: Wheels & Tires

Overview

Ratings and Rolling Resistance

Tire Pressure and Wear

Unit P: Braking

Overview

Safety and Brake Wear

Power Brake Vacuum System

Vacuum Reservoir

Vacuum Switch & Control Sensor

Vacuum Alarm

Parking Brake

Regenerative Braking

Unit Q: Suspension

Overview

Weight (GVWR)

Curb Weight (GVWR)

Spring Force

Spring Rate

Suspension Travel

Shock Absorbers

Struts

Ground Clearance

Aerodynamics

Unit R: Gauges & Instruments

Overview

Fuel Gauge

Voltmeter and Ammeter Package

Speedometer

Charger Power Relay / Charger Door Ajar

Unit S: Accessories & Safety Features

Overview

Original ICE Accessories

Stock Wiring Harness

Lights

Power Steering

Air Bags

Fusing

Modified ICE Accessories

Air Conditioning

Heater

EV-Specialized Accessories

Fire Extinguisher

Voltage Isolation

Warning Labels

Emergency Shut-off

Inertia Switching

Charging Cords

Module 5: The AC Drive Conversion Sequence

Unit T: Work Area Safety

Overview

Tools

Parts

General Safety Rules

Work Area

Insulating Tools

Directions and Instructions

Unit U: The Conversion Sequence

Shop Checklist 1: Preliminary Checklist, Preparing for ICE Removal

- Shop Checklist 2: Labels and Fuel System Removal**
- Shop Checklist 3: Measure Transmission Geometry**
- Shop Checklist 4: Remove AC, Radiator, Hoses, Driveshaft**
- Shop Checklist 5: Remove Engine & Transmission**
- Shop Checklist 6: Remove Rear-end Parts & Chassis Cleaning**
- Shop Checklist 7: Electric Motor and Drive Assembly**
- Shop Checklist 8: Motor & Transmission Connection**
- Shop Checklist 9: Install Electric Motor & Transmission into Vehicle**
- Shop Checklist 10: Install Side Battery Assembly**
- Shop Checklist 11: Install Rear Battery Assembly**
- Shop Checklist 12: Install Chassis Mounting Connections**
- Shop Checklist 13: Install Main Cable Runs**
- Shop Checklist 14: Install Control Circuit Enclosure**
- Shop Checklist 15: Install Gauges & Wiring**
- Shop Checklist 16: Install Vacuum Pump Assembly**
- Shop Checklist 17: Install Front Battery Assembly**
- Shop Checklist 18: Install Side & Rear Batteries**
- Shop Checklist 19: Perform Initial System Check**
- Shop Checklist 20: Perform Test Drive and Safety Check**

Module 6: Using the AC Drive Vehicle

Unit V. Driving & Daily Commuting

Overview

EV Data Log

Monitor Performance

EV Specs

Unit W. Licensing & Maintaining Your EV

Licensing

Good Charging Habits

Battery Voltage & Specific Gravity

Inspection & Cleaning Battery Terminals

Battery Maintenance

Module 7: Promotion, Competition and Careers

Unit X: Events

Overview

National Performance Events & Races

Local Demonstrations

Unit Y: Continuing Education & Careers

Overview

Continuing Education

Planning the Electric Vehicle Career Path

Electric Vehicle Engineer

Project Engineer

Electric Vehicle Technician Job Descriptions

Module 8: Final Conclusions

Final Conclusions

Overview

Transportation Policy

Showrooms of 2010

Hybrids

ZEVs

Appendix A: Shop Checklists

Appendix B: Tools

Appendix C: Bill of Materials

Appendix D: MSDS Sheets

Appendix E: Wiring & Schematics

Appendix F: Motor Specifications & Performance

Appendix G: Parts Quiz

Appendix H: Troubleshooting

Appendix I: Daily Commute Audit