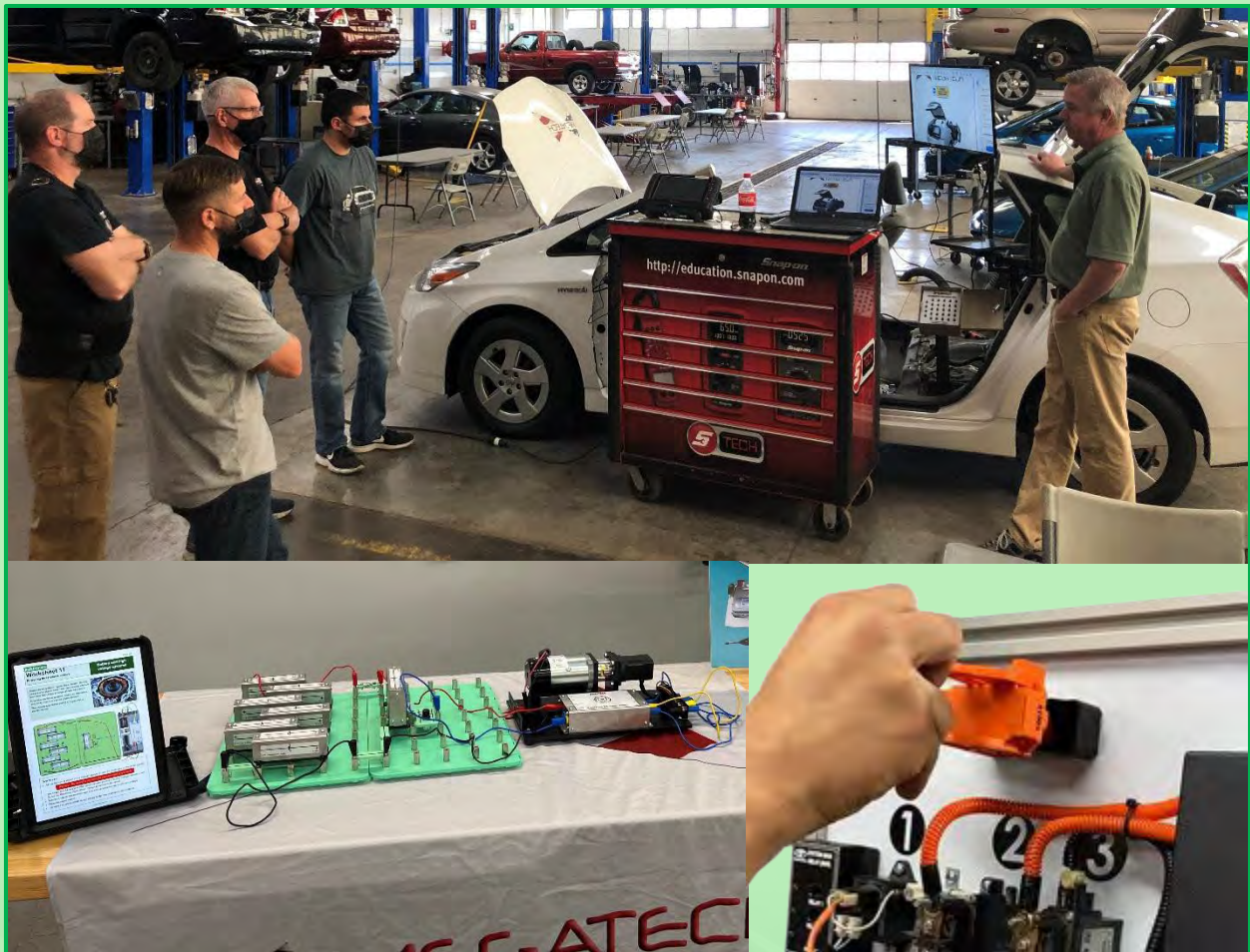




MEGATECH[®]

Hybrid/Electric Vehicle Lab Package

PLANNING GUIDE



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www.megatechcorp.com
978-937-9600





ASE Light Duty Hybrid/Electric Vehicle (L3) Certification Task List

A. Battery System

1. Perform high voltage disconnect procedure; reconnect/enable high voltage system.
2. Select, test, and use proper safety gloves.
3. Select, qualify, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, terminals, and fuses.
6. Diagnose high voltage (HV) battery pack malfunctions.
7. Remove and install high voltage battery pack.
8. Test, diagnose and repair high voltage leaks/loss of isolation.
9. Test, diagnose and repair high voltage battery pack heating and cooling systems.
10. Test, diagnose, repair, or replace high voltage battery pack internal components.
11. Test and diagnose charging problems when using electric vehicle supply equipment (EVSE).



B. Internal Combustion Engine

1. Retrieve and diagnose DTCs; determine needed repairs.
2. Determine if the internal combustion engine (ICE) is in CRANK mode or RUN mode.
3. Differentiate between drivability problems caused by the internal combustion engine and/or hybrid drive system.
4. Perform internal combustion engine cranking compression test.
5. Keep the internal combustion engine running during service.
6. Diagnose internal combustion engine no-crank condition.
7. Diagnose internal combustion engine cranks/no-start condition.
8. Interpret vacuum and compression readings on Atkinson cycle engines.
9. Identify engine start/stop strategy; diagnose malfunctions.
10. Service engine cooling system.

C. Drive Systems

1. Perform high voltage disconnect procedure; reconnect/enable high voltage system.
2. Select, test, and use proper safety gloves.
3. Select, qualify, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose driveline DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
6. Test, diagnose, and repair high voltage leaks/loss of isolation.
7. Remove and install rotor from stator.
8. Diagnose motor-rotor position sensor (Resolver or Encoder type).
9. Diagnose drive/traction motor-generator assembly for improper operation (such as an inoperative condition, noise, shudder, overheating, etc.).
10. Diagnose improper electrically actuated parking pawl operation; determine needed repair.
11. Identify transmission fluid and coolant fluid requirements; verify fluid levels.



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D. Power Electronics

1. Perform high voltage disconnect procedure; reconnect/enable high voltage system.
2. Select, test, and use proper safety gloves
3. Select, qualify, and use proper electrical testing equipment and leads.
4. Retrieve and diagnose DTCs; determine needed repairs.
5. Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
6. Identify procedures necessary to establish the proper vehicle operational power mode during service (OFF, ACCESSORY, POWER ON, READY TO DRIVE).
7. Diagnose the cause of a hybrid system warning displayed on the instrument panel and/or a drivability complaint.
8. Diagnose impact sensor problems; determine needed repair.
9. Diagnose AC/DC inverter overheating; determine needed repair
10. Diagnose AC/DC inverter failure; determine needed repair
11. Replace AC/DC inverter cooling pump
12. Remove and install AC/DC inverter
13. Diagnose failures in the data communications bus network; determine needed repair
14. Locate and test the voltage level of capacitors
15. Diagnose, locate and safely disable/enable safety interlocks.
16. Diagnose failed DC/DC converter; determine needed repair.
17. Remove and install DC/DC converter.
18. Test high voltage cable integrity and loss of isolation
19. Perform 12-volt battery testing.
20. Diagnose system main relay (SMR)/contactor malfunctions; determine needed repairs.

E. Hybrid Supporting Systems

1. Perform high voltage disconnect procedure; reconnect/enable high voltage system.
2. Select, test, and use proper safety gloves.
3. Select, qualify, and use proper electrical testing equipment and leads.
4. Diagnose problems caused by damaged or failed harnesses, connectors, and terminals.
5. Retrieve and diagnose DTCs; determine needed repairs.
6. Inspect, test, and diagnose EVAP emission system components; determine needed repairs.
7. Observe and interpret driver indicators, power flow display and energy monitor; determine necessary action.
8. Test and diagnose high voltage air conditioning compressor malfunctions; diagnose system problems; determine needed repairs.
9. Remove and install high voltage air conditioning compressor; identify and select proper system oil
10. Diagnose cabin heating system performance problems; determine needed repairs.
11. Diagnose and repair electric/electronic steering systems.
12. Diagnose brake system performance problems; differentiate between braking problems caused by hydraulic system and regenerative system malfunctions; determine needed repairs.
13. Deactivate brake system self-test prior to service.
14. Service liquid cooling system(s).



Required Equipment List for 100% Task Completion



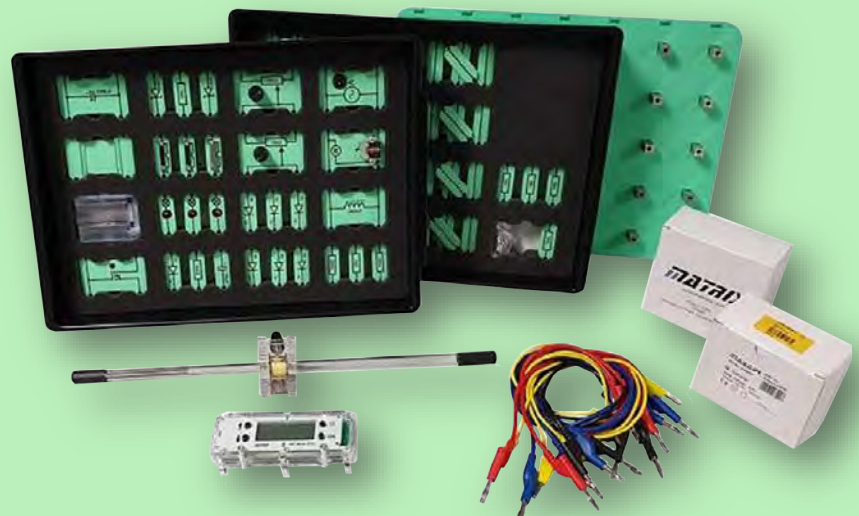
Automotive ECU Architecture and Logic Model: MEGLOC-1800

- Analog vs digital
- Driving output devices
- ECU structure
- NOT, AND, OR Functions
- PWM
- Fiber optics
- Reversing alarm
- Temperature alarm
- Heater fan control
- Automatic headlights
- Brake light alarm
- Includes baseboard, power supply and carriers
- Comprehensive worksheets are provided

Automotive Motors, Generators & Charging Systems Model: MEGLOC-2410

- Motor principles
- AC vs DC
- The AC and DC (Dynamo) generator
- Ripple voltage
- The Zener diode
- Voltage regulation
- Fault finding in charging systems
- Generating high tension
- Fault finding in high tension systems
- Includes baseboard, power supply and carriers
- Comprehensive worksheets are provided

* Requires HP2001



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Required Equipment List for 100% Task Completion (Cont'd)

USED AT TESLA TRAINING



Electric Vehicle/Hybrid High Voltage Batteries Model: MEGLOC-5281

- Sealed Lead Acid battery testing, charging, and faults
- Sealed Lithium-ion battery testing, charging, and faults
- Battery management
- Electric vehicle project
- Charging system faults
- Includes baseboard, power supply and carriers
- Comprehensive worksheets are provided
- Includes HP2001



DC motor/Brushless Motor Pair Model: HP2001

- Permanently coupled Brushless and DC motor
- Acts as a three-phase generator for Electric Vehicle motor application and demonstration





MEGATECH[®]

Hybrid Engine Performance Trainer

Model: MEG007-HYB

- Fully Operational, Roof Removed
- Breakout Box / Fault Insertion (12 Faults)
- Safety Cover w/ Key Over High Voltage Battery
- NATEF based worksheets for each fault
- Custom School Logo on Hood
- OEM/HVAC
- Full Dash
- Steering/Suspension Included
- Brakes Included
- Full Lighting & Stereo System
- Mobile Casters
- Digital Copy of Service/Maintenance Manuals



**MEG007-HYB:
Toyota Prius**



**MEG007-HYB:
Ford Fusion**



**MEG007-HYB:
Honda Accord**

Electric Vehicle Performance Trainer

Model: MEG007-E

- Fully Operational, Roof Removed
- Breakout Box / Fault Insertion (12 Faults)
- Safety Cover w/ Key Over High Voltage Battery
- ASE based worksheets for each fault
- Custom School Logo on Hood
- OEM/HVAC
- Full Dash
- Steering/Suspension Included
- Brakes Included
- Full Lighting & Stereo System
- Mobile Casters
- Digital Copy of Service/Maintenance Manuals

OTHER MAKES AVAILABLE



**MEG007-E:
Nissan Leaf**



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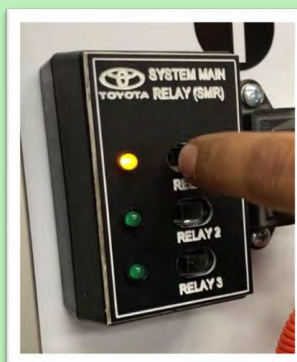


MEGATECH®



Hybrid/Electric Vehicle System Main Relay Demonstrator Model: MEG-SMR

- a SAFE training unit to demonstrate and test the high voltage battery application of Toyota Prius Inverter Converter
- Uses actual SMR components
- Prismatic hybrid battery cells operate at a max of 14 VDC to ensure student safety
- Allows for full ECU function simulation



MEG-EMF-REGEN

- simulated traction motor
- AC to DC rectification
- Amps, Volts, and Scope



MEG-J1772 EVC

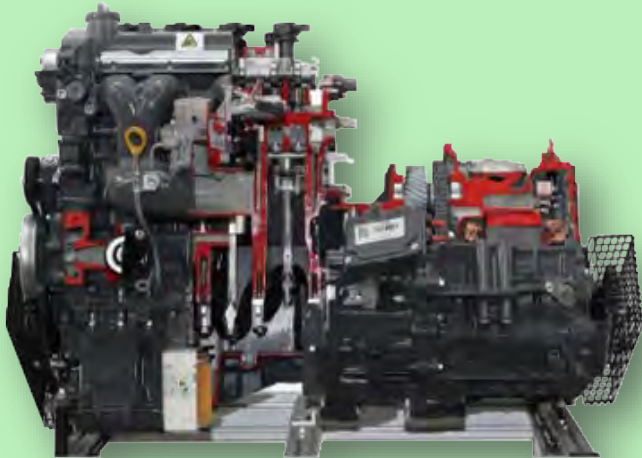
- Resistance, continuity
- OEM parts
- Proximity pilot



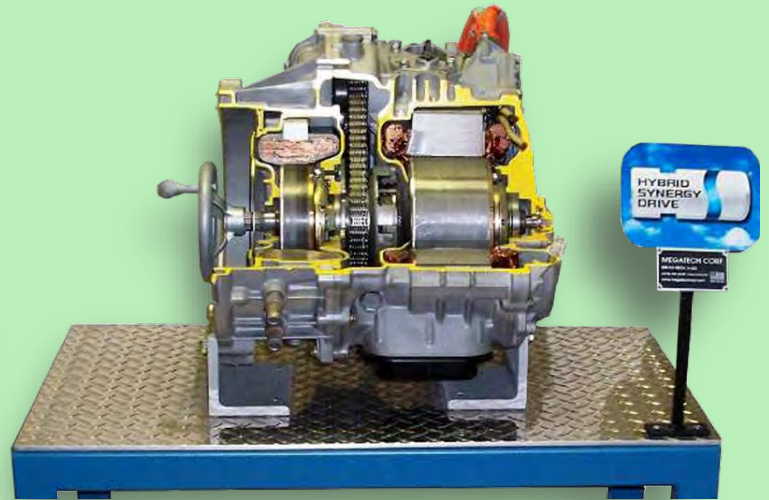


MEGATECH[®]

Cutaways



MEGART34500
Hybrid Engine / Generator Cutaway



MEG-MG1/MG2
Toyota Hybrid Drive



MEGART-IMA
Honda Integrated Motor Assist



MEG-AC-HYB
Hybrid Electrical A/C
Compressor Cutaway
(Prius)

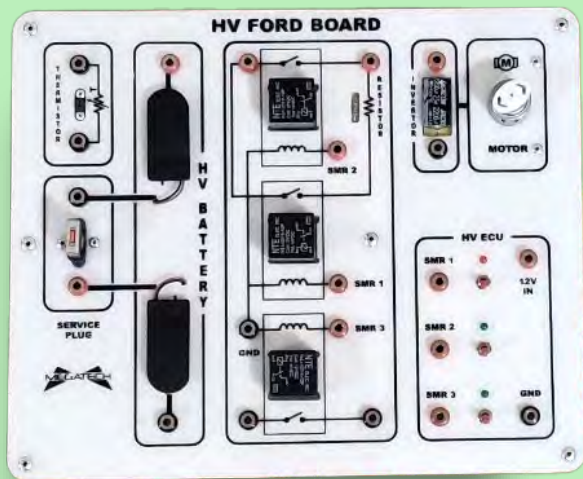


MEG-INV-GENII
Gen II Prius Inverter

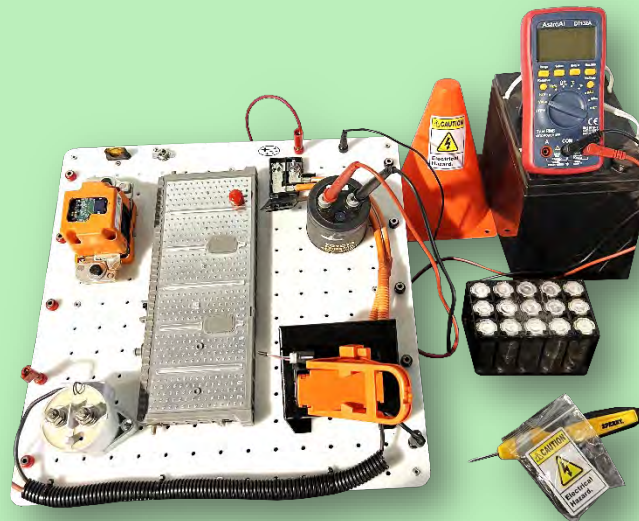




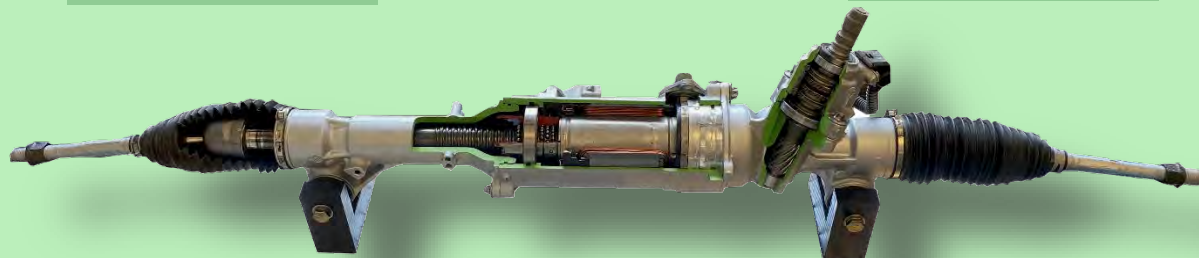
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MEG-Ford-HV
HV Ford Board



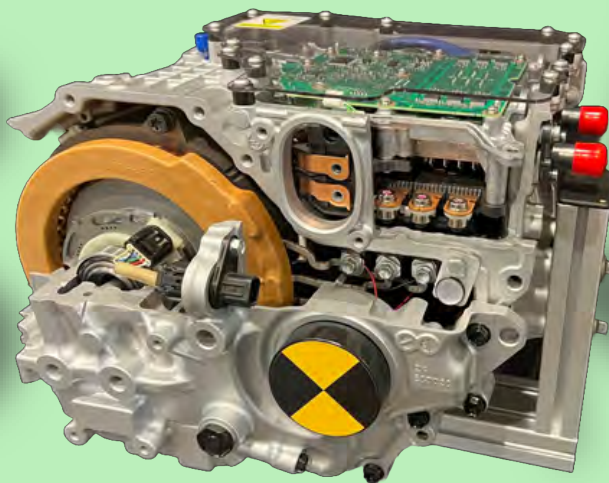
MEG-HV-OEM
OEM HV/EV Test Kit



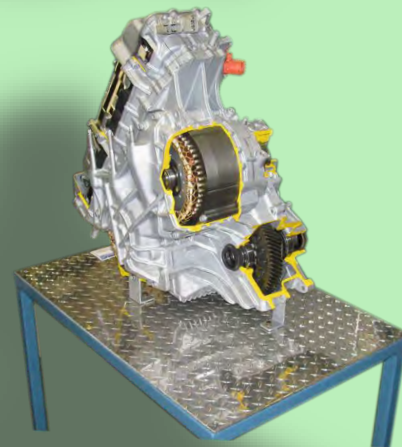
MEGART-PS-HYB
Hybrid Power Steering



MEGART-N-EV
Nissan Leaf Drive



MEGART-Ford-HYB
Ford Hybrid Drive



NEW MEGART- E AXLE DRIVE
BUILT FOR SUBARU!



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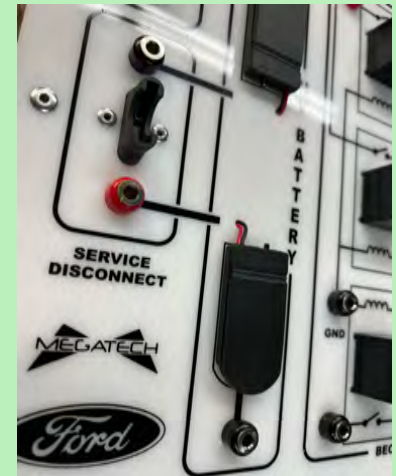
Course Structure

I. Applied Lab Work

Automotive ECU Architecture and Logic (MEGLOC-1800)

Activity 1 - Analogue vs digital
 Activity 2 - Driving output devices
 Activity 3 - ECU structure
 Activity 4 - The NOT function
 Activity 5 - The AND function
 Activity 6 - The OR function
 Activity 7 - PWM

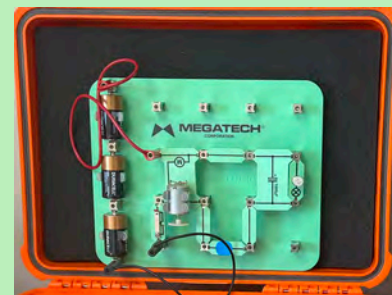
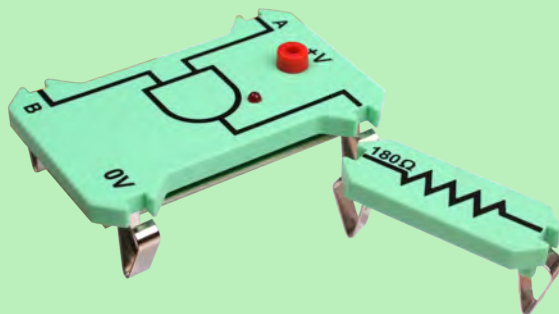
Activity 8- Fibre optics
 Activity 9 - Reversing alarm
 Activity 10 - Temperature alarm
 Activity 11 - Heater fan control
 Activity 12 - Fault-finding project 1
 Activity 13 - Automatic headlights
 Activity 14 - Brake light alarm
 Activity 15 - Fault-finding project 2



Automotive Motors, Generators & Charging Systems (MEGLOC-2410)

Activity 1 - Generating electricity
 Activity 2 - Understanding AC
 Activity 3 - AC vs DC
 Activity 4 - Half wave rectifier
 Activity 5 - Full wave rectifier
 Activity 6 - Ripple voltage
 Activity 7- Motor principles
 Activity 8 - The electric motor
 Activity 9 - The DC motor

Activity 10 - The brushless DC motor
 Activity 11 - The AC generator
 Activity 12 -Three phase rectification
 Activity 13 - The DC generator or 'dynamo'
 Activity 14 - The Zener diode
 Activity 15 - Voltage regulation
 Activity 16 - Fault finding in charging systems
 Activity 17 - Generating high tension
 Activity 18 - Fault finding in high tension systems



Electric Vehicle/Hybrid High Voltage Batteries (MEGLOC-5281)

Activity 1 - Testing Sealed Lead Acid batteries
 Activity 2 - Charging Sealed Lead Acid batteries
 Activity 3 - Testing Li-ion cells
 Activity 4 - Charging Li-ion cells
 Activity 5 - Building larger batteries
 Activity 6 - Li-ion battery faults
 Activity 7 - SLA battery faults

Activity 8 - Battery management
 Activity 9 - Voltage converters
 Activity 10 - Powering DC motors
 Activity 11 - Powering three-phase motors
 Activity 12 - Three-phase generators
 Activity 13 - Isolation relays
 Activity 14 - Electric vehicle project
 Activity 15 - Charging system faults



Course Structure (Cont'd)

II. Shop / Bay

E Machine Performance Trainer (MEG007-Platforms)

Models built by Megatech: Prius Prime, Nissan Leaf, Kia Soul, Ford Fusion, Hyundai Ionic

LEVEL ONE

Prerequisite Review
High Voltage Safety
Battery System Warnings
High Voltage Hazards
Electrical Accidents
Driver Response to Accident
Accident Prevention
First Aid Procedures
Fire Prevention
Emergency Responder Guides
Activity 1 - Hybrid Component Location and Function
Activity 2 - High Voltage Safety Quiz
Activity 3 - Hybrid Brake Service
Activity 4 - Hybrid High Voltage Service
Activity 5 - Hybrid Diagnostic Procedures (Part 1)
Activity 5 - Hybrid Diagnostic Procedures (Part 2)



LEVEL TWO

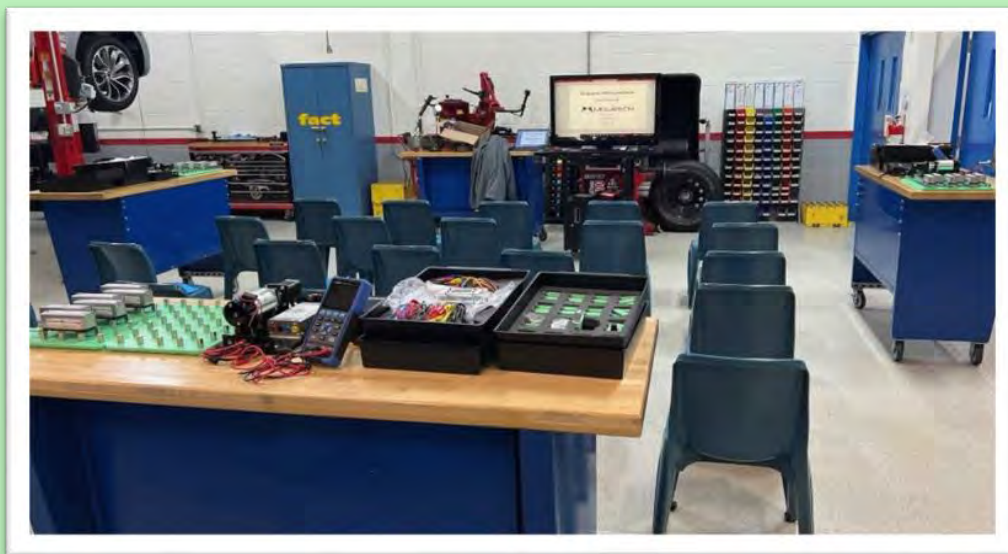
Demonstration Hybrid Vehicle Diagnostics
Activity 1 - IDS Hybrid Diagnosis (Part 1)
Activity 1 - Hybrid Diagnostic Procedures (Part 2)
Activity 2 - Diagnostic Procedures
Activity 3 - Hybrid Diagnostic Procedures (Part 1)
Activity 3 - Hybrid Diagnostic Procedures (Part 2)



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