

## **HEAVY EQUIPMENT AND TRUCK TECHNOLOGY**

### **INTRODUCTION OF DIESEL ELECTRICAL AND ELECTRONIC SYSTEMS**

Calculate current using Ohm's law  
Calculate voltage using Ohm's law  
Calculate resistance using Ohm's law  
Predict changes in voltage, current, and resistance in a circuit

### **UNDERSTANDING CIRCUITS AND CIRCUIT DEVICES**

Explain what the color bands found on resistors represent, and use the color bands on a resistor to determine its resistance value  
Determine correct replacement fuses  
Use wire color and circuit identification codes to locate circuit information  
Use wiring diagrams to locate information about circuits  
Use your knowledge of electric/electronic theory and circuit devices to predict changes in current, voltage, and resistance in a series circuit  
Inspect, test, and replace spike suppression diodes/resistors

### **DEVELOPING BASIC DIAGNOSIS AND REPAIR SKILLS**

Identify types of circuits and circuit devices on a circuit  
Perform calculations using units of electrical measurement  
Prepare to measure current, voltage, resistance, and frequency with a multimeter  
Calculate resistance in sample circuits  
Calculate current in sample circuits  
Calculate voltage drops in sample circuits  
Calculate voltage in sample circuits  
Calibrate and make functionality tests on electrical diagnostic instruments  
Check electrical/electronic circuits with jumper wires  
Check electrical circuits with a test light  
Check voltage in electrical/electronic circuits with a multimeter  
Check voltage drops in electrical/electronic with a multimeter  
Check current flow in electrical/electronic circuits with a multimeter  
Check continuity and resistance in electrical/electronic circuits and components with a multimeter  
Find shorts, grounds, opens, and high resistance problems in electrical/electronic circuits  
Tin a soldering iron or gun  
Inspect, test, repair, and replace switches, connectors, terminals, and wires of electrical/electronic circuits  
Inspect, test, and replace fusible links, circuit breakers, and fuses

### **UNDERSTANDING VEHICLE COMPUTER CONTROLS**

Demonstrate how a potentiometer functions as a sensor  
Use a DVOM to measure reference voltage output from the electronic control module

## **BATTERY DIAGNOSIS AND SERVICING**

Evaluate factors in selecting the appropriate battery for a vehicle

Maintain and restore electronic memory functions

Inspect, clean, fill, and replace a battery, battery cables, connectors, clamps, battery box, and hold-downs

Make a battery state-of-charge test

Make a battery capacity (load) test

Determine battery state-of-charge- using an open circuit voltage test

Slow and fast charge a battery

Diagnose parasitic (key-off) battery drain problems

Connect batteries in series, parallel, and series-parallel

Jump-start a vehicle

## **STARTING SYSTEMS DIAGNOSIS AND REPAIR**

Diagnose starting system problems

Make a no-load starter current draw test

Make starter circuit voltage drop tests

Inspect, test, and repair or replace switches, connectors, and wires of starter control circuits

Inspect, test, and replace starter relays and solenoids

Remove and replace starter

## **CHARGING SYSTEMS DIAGNOSIS AND REPAIR**

Diagnose charging system problems that cause an undercharge, a no-charge, or an overcharge condition

Inspect, adjust, and replace alternator drive belts, pulleys, and tensioners.

Make a charging system output test; determine needed repairs

Make a charging circuit voltage drop test; determine needed repairs

Test an S.I. series alternator

Inspect, repair, or replace connectors and wires of charging circuits

Remove, inspect, and replace an alternator

## **LIGHTING SYSTEMS DIAGNOSIS AND REPAIR**

Diagnose the cause of headlights and daytime running lights problems

Diagnose the cause of parking lights, clearance lights, and taillights problems

Diagnose the cause of stoplight (brake light) problems

Diagnose the cause of turn signals and hazard lights problems

Diagnose the cause of back-up lights problems

Diagnose the cause of instrument lighting problems

Diagnose the cause of courtesy lights problems

Inspect, replace, and aim headlights/bulbs

Inspect, test, and replace light bulbs and test sockets

Inspect, test, repair and replace the components of a headlights and daytime running lights circuit

Inspect, test, repair and replace the components of a parking light, clearance light and tailgate circuit

Inspect, test, repair and replace the components of a stoplight (brake light) circuit  
Inspect, test, repair and replace the components of a turn signal and hazard lights circuit  
Inspect, test, repair and replace the components of a back-up lights circuit  
Inspect, test, repair and replace the components of an instrument lighting circuit  
Inspect, test, repair and replace the components of a courtesy lights circuit  
Inspect, test, repair and replace the components of tractor-to-trailer lights circuit

### **DRIVER INFORMATION SYSTEMS DIAGNOSIS AND REPAIR**

Diagnose the cause(s) of faulty gauge readings  
Diagnose the cause(s) of the faulty operation of an electronic instrument cluster, warning light, indicator light, and driver information circuit  
Diagnose the cause(s) of the faulty operation of audible warning devices  
Inspect, test, repair, and replace the components of a gauge circuit  
Inspect, test, repair, and replace the components of an electronic instrument cluster, warning light, indicator light, and driver information circuit  
Inspect, test, repair, and replace components of audible warning device circuits  
Inspect, test, replace, and calibrate electronic speedometer, odometer, and tachometer circuits

### **RELATED ELECTRICAL COMPONENTS**

Diagnose the cause of horn problems  
Diagnose the cause of wiper problems  
Diagnose the cause of windshield washer problems  
Diagnose the cause of heater problems  
Inspect, test, repair, and replace the components of a horn circuit  
Inspect, test, repair, and replace the components of wiper circuits  
Inspect, test, repair, and replace intermittent (pulsing) wiper controls  
Inspect, test, repair, and replace the components of a windshield washer circuit  
Inspect, test, repair, and replace the components of a heater circuit  
Inspect, test, repair, and replace the components of an engine block heater

### **MISCELLANEOUS ELECTRICAL ACCESSORIES**

Diagnose the cause of power window problems  
Diagnose the cause of heated, lighted, and electrically operated mirror problems  
Diagnose the cause of electric door lock problems  
Inspect, test, repair, and replace the parts of a power window  
Inspect, test, repair, and replace the parts of a heated, lighted, and electrically operated mirror  
Inspect, test, repair, and replace the parts of an electric door lock  
Inspect, test, repair, and replace the parts of a cigarette lighter/auxiliary power outlet

### **INTRODUCTION TO BRAKES**

Diagnose and determine possible causes of general brake problems  
Identify features for assigned vehicle  
Move vehicle and prepare for service

Check brake fluid level and condition and inspect for leaks

### **ANTILOCK BRAKE SYSTEMS**

Diagnose and determine possible causes of ABS problems

Inspect, test, and service an antilock brake system

Troubleshoot antilock brake system problems

### **HYDRAULIC FOUNDATION DRUM BRAKES**

Remove, clean, inspect, and measure a brake drum

Remove, inspect, and replace brake shoes and related hardware

Replace brake drum and adjust brake clearance

### **HYDRAULIC FOUNDATION DISC BRAKES**

Remove, clean, and inspect a caliper and pad assembly

Inspect, measure, remove, and reinstall a rotor assembly

Reinstall caliper and pad assembly and check brake operation

### **HYDRAULIC SYSTEM**

Interpret hydraulic system diagrams

Interpret brake light system circuit diagrams

Test hydraulic system and inspect for leaks; determine needed repairs

Bleed and/or flush the hydraulic brake system

Remove, inspect, and repair or replace the master cylinder

Create flare and double flare fittings

Remove and repair or replace the wheel cylinder

Check operation of brake light switch; adjust or replace as needed

### **POWER ASSIST UNITS AND RELATED COMPONENTS**

Check operation of brake failure lights and braking warning devices; repair or replace as needed

### **AIR FOUNDATION BRAKES**

Inspect, service, and adjust slack adjuster on front axle

Inspect, test, service, and replace service brake chamber

Inspect, test, service, and replace brake shoes, drum, and hardware for s-cam drum foundation brakes

### **AIR SUPPLY SYSTEM**

Identify and connect components in an air supply system

Service the reservoir and check valve function, build-up time, and cut-out pressure

Inspect and service belt-driven compressor and associated lines

Inspect, service, and time gear-driven compressor, valves, and associated lines

Inspect and service air dryer system; repair or replace as needed

## **AIR SERVICE CIRCUITS**

Identify and connect components in the air service circuits

Inspect and test brake application (foot) valve, fittings, and mounts; adjust or replace as needed

Inspect and test stop light circuit switches, wiring and connectors; repair or replace as needed

Inspect and test relay valve; replace as needed

Inspect and test quick release valve; replace as needed

## **SPECIAL CIRCUITS**

Identify and connect components in a truck brake system

Identify and connect components in a tractor brake system

Inspect and test parking brake hand (control) valve; replace as needed

Inspect and test inversion valve; replace as needed

Inspect and test anti-compounding circuit equipped with Quick Release (QR) 1-C; replace as needed

Inspect and test trailer air supply valve; replace as needed

Inspect and test tractor protection valve; replace as needed

Check operation of parking brake; remove, inspect, and replace parking brake (spring brake) chamber as needed

## **TRAILER AIR BRAKE SYSTEMS**

Identify and connect components of a trailer full function air brake system

Inspect and test tractor trailer gladhands; repair or replace as needed

## **CAB COMPONENTS**

Inspect, test, and adjust cab air suspension components and determine needed repairs

Inspect, test, and adjust driver's air seat components and determine needed repairs

## **TIRES, RIMS, AND WHEELS**

Diagnose unusual tire wear patterns, check tire pressure, and measure and match tires

Diagnose tire/wheel vibration, inspect mounting hardware, and check tire/wheel runout and balance

## **CHASSIS COMPONENTS**

Inspect and install or repair frame, hangers, brackets, and cross members

Check and inspect vehicle frame alignment

Inspect and service fifth wheel assemblies, pintle hitch, kingpin, and trailer plate

Couple and uncouple fifth wheel

## **POWER STEERING SYSTEMS**

Diagnose, test, and troubleshoot problems on a power steering system

Remove and repair/replace power steering gear

Rebuild power steering

Remove and replace power steering pump; adjust belt if used

Inspect, clean, disassemble, and rebuild power steering pump; replace worn parts

Test and repair/replace flow control/pressure relief valve(s) on power steering pump

### **STEERING AXLE COMPONENTS**

Select wheel bearings and seals  
Remove, inspect, clean, replace and adjust wheel bearings and seals  
Repair or replace a steering knuckle assembly  
Inspect and replace tie rod ends  
Diagnose and troubleshoot the steering axle assembly

### **CYLINDER BLOCKS AND LINERS**

Disassemble and clean a cylinder block  
Inspect a cylinder block  
Install new camshaft bushings  
Clean and inspect cylinder bores  
Install cylinder liners and set liner protrusion

### **CRANKSHAFTS AND BEARINGS**

Remove, clean, and inspect a crankshaft  
Install main bearings and crankshaft  
Perform an in-frame bearing roll-in  
Inspect viscous vibration damper/harmonic balancer  
Inspect bonded vibration damper/harmonic balancer  
Inspect flywheel

### **PISTONS AND CONNECTING RODS**

Remove, disassemble, and inspect a piston and connecting rod assembly  
Measure piston-to-cylinder wall clearance and ring end gap  
Assemble and install piston and connecting rod assembly

### **CAMSHAFTS, TRAINS, AND TIMING**

Remove, clean, and inspect a camshaft  
Remove, inspect, and install cam bushings  
Install a camshaft and set cam timing

### **CYLINDER HEAD ASSEMBLIES**

Locate and label intake and exhaust valves  
Clean and inspect a cylinder head  
Recondition a cylinder head  
Install a cylinder head assembly and adjust valves

### **AIR INDUCTION AND EXHAUST SYSTEMS**

Inspect and test air/induction system  
Inspect and service turbo/supercharger and related components  
Clean and test jacket water intercooler  
Clean and test air-to-air intercooler  
Inspect and test exhaust system

Inspect starting preheater controls

### **ENGINE BRAKES AND RETARDERS**

Remove, inspect, install, and adjust a Jacobs Engine Brake

### **BASIC FUEL SYSTEMS AND COMPONENTS**

Trace fuel flow through basic fuel systems

Check fuel level, quality, and consumption

Inspect and service basic fuel supply components

### **MECHANICAL FUEL INJECTION DIAGNOSIS AND REPAIR**

Isolate, remove, test, rebuild or replace, and reinstall injection nozzles

Isolate, remove, test, and reinstall or replace mechanical unit injectors

Inspect, test, adjust, and time a distributor-type (rotary) injection pump; determine needed repairs

Inspect, test, adjust, and time in an-line injection pump; determine needed repairs

Inspect, test, and adjust a PT injection pump and time the injectors; determine needed repairs

### **ELECTRONIC FUEL INJECTION DIAGNOSIS AND REPAIR**

Inspect and test power and ground circuits and connections; determine needed repairs

Check diagnostic trouble codes using electronic diagnostic equipment and technical information; determine needed repairs

Inspect and replace electrical connectors, terminals, seals, and locks

Access engine parameters; monitor or change as requested by customer

Remove, inspect, and rebuild or replace a fuel transfer pump

Remove, inspect, reinstall, and adjust electronic unit injectors; determine needed repairs

### **EMISSIONS**

Check vehicle for presence and operation of emission control devices

Check vehicle for fuel type and appropriate application

Test vehicle for excessive exhaust smoke

Check vehicle for noise abatement devices

### **GENERAL ENGINE DIAGNOSIS**

Conduct an operator survey for engine diagnosis

Interpret SAE code identifiers

Check air intake system for restrictions

Check exhaust back pressure

Check crankcase pressure

Check oil pressure

Load test an engine with a dynamometer

Locate a misfiring cylinder

Locate an active fault code

## **PREVENTIVE MAINTENANCE AND TUNE-UP**

- Determine maintenance needed for given situations
- Interpret maintenance troubleshooting charts
- Inspect engine coolant level and condition
- Pressure test coolant system and radiator cap
- Take oil sample, and change oil and filter(s)
- Inspect and test indicator system components
- Perform a daily preventative maintenance check
- Perform a mileage preventive maintenance check
- Perform an engine tune-up

## **ENGINE OPERATING PRINCIPLES**

- Identify companion cylinders
- Locate and record engine specifications
- Identify valve and piston position during each stroke
- Locate TDC for #1 piston
- Measure bore and stroke and compute engine displacement

## **DISSASSEMBLY PROCEDURES AND ANALYSIS**

- Determine required tools for various tasks
- Evaluate worn engine components
- Determine possible causes of engine component failures
- Steam clean an engine
- Remove engine accessories and external lines
- Remove engine and mount on an engine stand
- Engine disassembly: Remove cylinder head
- Engine disassembly: Remove gear train and camshaft
- Engine disassembly: Remove pistons and connecting rods
- Engine disassembly: Remove cylinder liners
- Engine disassembly: Remove crankshaft

## **LUBRICATION SYSTEMS**

- Service and install oil pump and oil pump drive components
- Service and inspect lubrication system screens and pipes
- Service and inspect oil pressure regulator valve and bypass valve
- Service and inspect oil cooler and lines
- Pressure test oil cooler

## **COOLING SYSTEMS**

- Flush, refill, and bleed coolant system
- Inspect water pump, belts, and hoses
- Check operation of fan assembly and controls
- Test operation of thermostat installed in engine
- Test operation of thermostat on the bench
- Check operation and accuracy of temperature indicating system

Pressure test radiator

### **FRONT SUSPENSION**

Inspect front suspension components

Remove and replace front spring suspension components

Pretest

### **REAR SPRING SUSPENSION**

Inspect rear spring suspension components

Replace rear spring suspension components

Pretest

### **REAR AIR SUSPENSION**

Inspect, test, and replace an air spring

Inspect and test an air suspension system, replace the leveling valve, and adjust frame (ride) height

Pretest

### **VEHICLE ALIGNMENT**

Perform pre-alignment tests

Check camber and kingpin inclination; determine needed repairs

Check caster; adjust or repair as needed

Check toe; adjust as needed

Check rear axle alignment; adjust or repair as needed

Measure and adjust pinion angle

Pretest