Diesel Technology: Electrical and Electronic Systems

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 1: Introduction to Diesel Electrical and Electronic Systems

1. Terms and definitions
2. Composition of atoms
3. Electrical charges in atoms
4. Terms relating to electron flow and their definitions
5. Direction that current flows in relation to its electromotive force
6. Two theories on current flow
7. Description of current
8. Two factors that determine the amount of current flowing through a conductor
9. Two types of current and their voltage sources
10. Description of voltage
11. Two sources of voltage in vehicle electrical systems
12. Description of resistance
13. Five factors that influence resistance as current moves through a circuit
14. Two results of resistance as current moves through a conductor
15. Ohm's law
16. Formulas for calculating current, voltage, and resistance in a conductor
17. Description of power

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
Unit 1: Introduction to Diesel Electrical and Electronic Systems (continued)	
18. Two ways electrical devices can be rated	25. Calculate current using Ohm's law
19. Two common electrical devices that are rated in watts	26. Calculate voltage using Ohm's law
20. Three kinds of magnets and their definitions	27. Calculate resistance using Ohm's law
21. Facts about magnets	28. Predict changes in voltage, current, and resistance in a circuit
22. Terms relating to magnetism and electromagnets and their definitions	
23. Four properties of electromagnets that make them useful in a vehicle's electrical system	
24. Three vehicle electrical components that use electromagnetism	
Unit 2: Understanding Circuits and Circuit Devices	
1. Terms and definitions	
2. Six circuit elements on an illustration of a basic vehicle electrical circuit	
3. Four types of commonly used circuits	
4. Two power sources for vehicle electrical circuits	
5. Why and where electrical circuits are grounded	
6. Wiring diagram symbols that indicate a battery and a ground	
7. Common control devices, their illustrations, wiring diagram symbols, current factor controlled, and the type of control each has on voltage or resistance in a circuit	
8. Common protection devices, their illustrations and wiring diagram symbols	
9. Size categories of blade fuses	
10. How fuses, fusible links, and circuit breakers protect the circuits on which they are installed	
11. Common loads, their illustrations, wiring diagram symbols, and the form of energy into which each converts current	

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Unit 2: Understanding Circuits and Circuit Devices (continued)

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12. How a device that is electronic is different from a device that is electric	22. Explain what the color bands found on resistors represent, and use the color bands on a resistor to determine its resistance value
13. P-type semiconductors and N-type semiconductors	23. Determine correct replacement fuses
14. Advantages and disadvantages of using eletronic devices as circuits	24. Use wire color and circuit identification codes to locate circuit information
15. Common electronic circuit devices, their illustrations, wiring diagram symbols, and functions in a circuit	25. Use wiring diagrams to locate information about circuits
16. Common conductors, their illustrations and wiring diagram symbols	26. Use knowledge of electric/electronic theory and circuit devices to predict changes in current, voltage, and resistance in a series circuit
17. Four types of material that are commonly used as insulators in vehicle electrical systems	27. Inspect, test, and replace spike suppression diodes/resistors
18. Purpose of a wire shield	
19. Three purposes of wiring hardware	
20. Common circuit features and their wiring diagram symbols	
21. Types of wiring diagrams	

Unit 3: Developing Basic Diagnosis and Repair Skills

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
1. Terms and definitions	8. Identify types of circuits and circuit devices on a circuit
2. Types of common circuits and their electrical characteristics	9. Perform calculations using units of electrical measurement
3. Common problems with electrical circuits (types, symptoms, causes)	10. Prepare to measure current, voltage, resistance, and frequency with a multimeter
4. Types of electrical diagnostic instruments (names and illustrations, usage, calibrated vs. tested requirements)	11. Calculate resistance in sample circuits
5. Steps in electrical troubleshooting	12. Calculate current in sample circuits
6. Steps in soldering	13. Calculate voltage drop in sample circuits
7. Guidelines for soldering	14. Calculate voltage in sample circuits
	15. Calibrate and make functionality tests on electrical diagnostic instruments
	16. Check electrical/electronic circuits with jumper cables
	17. Check electrical circuits with a test light

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Unit 3: Developing Basic Diagnosis and Repair Skills (continued)

18. Check voltage in electrical/electronic circuits with a multimeter
19. Check voltage drops in electrical/electronic circuits with a multimeter
20. Check current flow in electrical/electronic circuits and components with a multimeter
21. Check continuity and resistance in electrical/electronic circuits and components with a multimeter
22. Find shorts, grounds, opens, and high resistance problems in electrical/electronic circuits
23. Tin a soldering iron or gun
24. Inspect, test, repair, and replace switches, connectors, temrinals, and wires of electrical/electronic circuits
25. Inspect, test, and replace fusible links, circuit breakers, and fuses

Unit 4: Understanding Vehicle Computer Controls

1. Terms and definitions
2. Functions of the basic components of a computer system
3. Common computers (microprocessors) in a vehicle
4. Types of sensors
5. Types of actuators
6. Analog and digital signals
7. Serial data transfer and parallel data transfer
8. Flow of data through a simplified computer system
9. Ways to retrieve diagnostic information from vehicle computers
10. SAE fault code identifiers
11. Demonstrate how a potentiometer functions as a sensor
12. Interpret SAE fault code identifiers
13. Use a DVOM to measure reference voltage output from the electronic control module
14. Access vehicle fault codes using the vehicle's computerized diagnostic system; determine needed repairs

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Unit 5: Battery Diagnosis and Servicing

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
1. Terms and definitions	9. Evaluate factors in selecting the appropriate battery for a vehicle
2. Battery service tools	10. Maintain and restore electronic memory functions
3. Five functions of the battery	41. Inspect, clean, fill, and replace a battery, battery cables, connectors, clamps, battery box, and hold-downs
4. Types of vehicle batteries and their descriptions	12. Make a battery state-of-charge test
5. Ratings of batteries and their descriptions	13. Make a battery capacity (load) test
6. Factors affecting correct battery selection	14. Determine battery state-of-charge using an open circuit voltage test
7. Safety rules for working with batteries	15. Slow and fast charge a battery
8. Connecting batteries in series, parallel, and series-parallel	16. Diagnose parasitic (key-off) battery drain problems
	17. Connect batteries in series, parallel, and series-parallel
	18. Jump-start a vehicle

Unit 6: Starting Systems Diagnosis and Repair

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
1. Terms and definitions	
2. Types of starting aids	
3. Parts of a starting system and descriptions of their functions	
4. Major parts of a starting motor	
5. Component parts and descriptions of their functions	
6. Steps in a starting system operation	
7. Conversion of electrical energy in mechanical energy	
8. How a starting motor is kept running	
9. Types of starter field circuits	
10. Types of starter field circuits and current flow	
11. Types of starting motor switches	
12. Engaging starter drives	

Instructional/Task Analysis

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Unit 6: Starting Systems Diagnosis and Repair (continued)

13. Types of electromagnetic or lever shift drives
14. Operation of a series-parallel switch
15. Operation of a transformer-rectifier unit
16. Starting system test
17. Starting system test equipment and their connections
18. Diagnose starting system problems
19. Make a no-load starter current draw test
20. Make starter circuit voltage drop tests
21. Inspect, test, and repair or replace switches, connectors, and wires of starter control circuits
22. Inspect, test, and replace starter relays and solenoids
23. Remove and replace starter

Unit 7: Charging Systems Diagnosis and Repair

1. Terms and definitions
2. Purpose of a charging system, an alternator, and charging system output tests
3. Alternator charging circuit components and functions
4. Major parts of an alternator
5. Construction of stator windings
6. Types of alternator circuits
7. Characteristics of a brushless alternator
8. Operation of a brushless alternator
9. Operation of a transistorized regulator
10. Safety rules for working with alternator charging circuits
11. Names of charging system tests with descriptions of the conditions evaluated by the tests
12. Charging system test equipment and their connections
13. Diagnose charging system problems that cause an undercharge, a no-charge, or an overcharge condition
14. Inspect, adjust, and replace alternator drive belts, pulleys, and tensioners
15. Make a charging system output test; determine needed repairs
16. Make a charging circuit voltage drop test; determine needed repairs
17. Test an S.I. series alternator
18. Inspect, repair, or replace connectors and wires of charging circuits
19. Remove, inspect, and replace an alternator

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Unit 8: Lighting Systems Diagnosis and Repair

1. Parts of a headlight and daytime running lights circuit and descriptions of their functions
2. Parts of a parking lights, taillights, clearance lights and marker lights circuit and descriptions of their functions
3. Parts of a stoplight (brake light) circuit and descriptions of their functions
4. Parts of a turn signal and hazard lights circuit and descriptions of their functions
5. Parts of a backup lights circuit and descriptions of their functions
6. Parts of an instrument lighting circuit and descriptions of their functions
7. Parts of a courtesy lights circuit and descriptions of their functions
8. Parts of a tractor-to-trailer multi-wire connector
9. Diagnose the cause of headlights and daytime running lights problems
10. Diagnose the cause of parking lights, clearance lights, and taillights problems
11. Diagnose the cause of stoplight (brake light) problems
12. Diagnose the cause of turn signals and hazard lights problems
13. Diagnose the cause of back-up lights problems
14. Diagnose the cause of instrument lighting problems
15. Diagnose the cause of courtesy lights problems
16. Inspect, replace, and aim headlights/bulbs
17. Inspect, test, and replace light bulbs and test sockets
18. Inspect, test, repair and replace the components of a headlights and daytime running lights circuit
19. Inspect, test, repair and replace the components of a parking light, clearance light and taillight circuit
20. Inspect, test, repair and replace the components of a stoplight (brake light) circuit
21. Inspect, test, repair and replace the components of a turn signal and hazard lights circuit
22. Inspect, test, repair and replace the components of a back-up lights circuit
23. Inspect, test, repair and replace the components of an instrument lighting circuit
24. Inspect, test, repair and replace the components of a courtesy lights circuit
25. Inspect, test, repair and replace the components of tractor-to-trailer lights circuit

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Unit 9: Driver Information Systems Diagnosis and Repair

1. Basic categories of gauges and descriptions of their operations
2. Types of gauges and descriptions of their operations
3. Types of gauge sending units and descriptions of their operation
4. Parts of a gauge circuit
5. Parts of a gauge circuit and descriptions of their functions
6. Parts of an electronic instrument cluster, warning light, indicator light, and driver information circuits
7. Parts of an electronic instrument cluster, warning light, indicator light, and driver information circuits, and descriptions of their functions
8. Types of driver information commonly given by audible warning devices
9. Parts of an audible warning devices circuit
10. Outputs of an audible warning device circuit and descriptions of their functions
11. Diagnose the cause(s) of faulty gauge readings
12. Diagnose the cause(s) of the faulty operation of an electronic instrument cluster, warning light, indicator light, and driver information circuit
13. Diagnose the cause(s) of the faulty operation of audible warning devices
14. Inspect, test, repair, and replace the components of a gauge circuit
15. Inspect, test, repair, and replace the components of an electronic instrument cluster, warning light, indicator light, and driver information circuit
16. Inspect, test, repair, and replace components of audible warning device circuits
17. Inspect, test, replace and calibrate electronic speedometer, odometer, and tachometer circuits

Unit 10: Related Electrical Components

1. Parts of a horn circuit and descriptions of their functions
2. Parts of a wiper circuit
3. Parts of a wiper circuit and descriptions of their functions
4. Parts of a windshield washer circuit
5. Parts of a windshield washer circuit and descriptions of their functions
6. Parts of a heater circuit
7. Parts of a heater circuit and descriptions of their functions
8. Major and secondary components of an expansion valve type A/C system

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
Unit 10: Related Electrical Components (continued)	
9. Parts of an air conditioning circuit and descriptions of their functions	11. Diagnose the cause of horn problems
10. Types of engine block heaters and descriptions of their operations	12. Diagnose the cause of wiper problems
	13. Diagnose the cause of windshield washer problems
	14. Diagnose the cause of heater problems
	15. Diagnose the cause of air conditioning problems
	16. Inspect, test, repair, and replace the components of a horn circuit
	17. Inspect, test, repair, and replace the components of wiper circuits
	18. Inspect, test, repair, and replace intermittent (pulsing) wiper controls
	19. Inspect, test, repair, and replace the components of a windshield washer circuit
	20. Inspect, test, repair, and replace the components of a heater circuit
	21. Inspect, test, repair, and replace the components of an air conditioning circuit
	22. Inspect, test, repair, and replace the components of an engine block heater
Unit 11: Miscellaneous Electrical Accessories	
1. Parts of a power window	
2. Parts of a power window and descriptions of their functions	
3. Parts of a heated, lighted, and electrically operated mirror and descriptions of their functions	
4. Parts of an electric door lock	
5. Parts of an electric door lock and descriptions of their functions	
6. Parts of a keyless and remote lock/unlock device	
7. Parts of a keyless and remote lock/unlock device and descriptions of their functions	

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
Unit 11: Miscellaneous Electrical Accessories (continued)	
8. Parts of an anti-theft system and descriptions of their functions	14. Diagnose the cause of power window problems
9. Parts of a sound system	15. Diagnose the cause of heated, lighted, and electrically operated mirror problems
10. Parts of a sound system and descriptions of their functions	16. Diagnose the cause of electric door lock problems
11. Parts of an airbag system	17. Diagnose the cause of radio reception problems
12. Parts of an airbag system and descriptions of their functions	18 Diagnose the cause(s) of the airbag warning light staying on or flashing
13. Steps to take to prevent the accidental deployment of an airbag	19. Inspect, test, repair, and replace the parts of a power window
	20. Inspect, test, repair, and replace the parts of a heated, lighted, and electrically operated mirror
	21. Inspect, test, repair, and replace the parts of an electric door lock
	22. Inspect, test, repair, and replace the parts of anti-theft systems
	23. Inspect, test, repair, and replace the parts of a sound system
	24. Remove and reinstall audio system components (unit)
	25. Inspect, test, repair, and replace the parts of an airbag system
	26. Inspect, test, repair, and replace the parts of a cigar lighter/auxiliary power outlet
	27. Inspect, test, repair, and replace the parts of a clock