Diesel Technology: Engines

Instructional/Task Analysis

Section A: Introduction to Engine Principles and Procedures

Unit 1–A: Engine Operating Principles

1. Terms and definitions
2. Basic engine systems and their functions
3. Basic diesel engine components
4. Basic internal engine components and their functions
5. Characteristics of gasoline and diesel engines
6. Four-stroke cycle
7. Two-stroke cycle
8. Characteristics of two-stroke and four-stroke diesel engines

Unit 2–A: Disassembly Procedures and Analysis

1. Terms and definitions
2. Special engine tools and their functions
3. Precision measuring instruments and their functions
4. Safety guidelines to following during engine removal and disassembly
5. Good housekeeping practices and procedures
6. Accessory components and lines that must be pulled (disconnected) before the engine is removed
7. Methods for cleaning engine components
8. Engine components that require measurement and analysis
9. Types of materials used on engine components and their applications
10. Types of analyses
11. Eight steps of failure analysis
12. Normal and abnormal wear
13. Common types of mechanical wear and their characteristics
14. Root causes of system failures
15. Determine required tools for various tasks
16. Evaluate worn engine components
17. Determine possible causes of engine component failures
18. Steam clean an engine
19. Remove engine accessories and external lines
20. Remove engine and mount on an engine stand
21. Engine disassembly: Remove cylinder head
22. Engine disassembly: Remove gear train and camshaft
23. Engine disassembly: Remove pistons and connecting rods
24. Engine disassembly: Remove cylinder liners
25. Engine disassembly: Remove crankshaft
Instructional/Task Analysis

Section B: Engine Systems And Components

Unit 1–B: Lubrication Systems

1. Terms and definitions
2. Lubrication system components
3. Functions of lubrication system components
4. Basic types of oil filters and their operations
5. Basic oil pump designs and their operation
6. Basic oil cooler designs
7. Basic oil cooler operation
8. Sources of oil contamination
9. Lubrication system monitor operation
10. API use codes

11. Factors to consider when choosing an engine oil
12. Service and install oil pump and oil pump drive components
13. Service and inspect lubrication system screens and pipes
14. Service and inspect oil pressure regulator valve and bypass valve
15. Service and inspect oil cooler and lines

Unit 2–B: Cooling Systems

1. Terms and definitions
2. Common types of cooling systems
3. Typical cooling system components for air-cooled engines
4. Typical cooling system components for liquid-cooled engines
5. Cooling system operation
6. Effects of incorrect temperature regulation
7. Common types of radiators
8. Types of drives for water pumps
9. Parts of a water pump
10. Types of drive belts
11. Functions of coolant filters, conditioners, and additives
12. Types of antifreeze
13. Characteristics of a suitable antifreeze
14. Purposes of a radiator cap
15. Typical radiator cap operation

16. Flush, refill, and bleed coolant system
17. Inspect water pump, belts, and hoses
18. Check operation of fan assembly and controls
19. Test operation of thermostat installed in engine
20. Test operation of thermostat on the bench
21. Check operation and accuracy of temperature indicating system
### Instructional/Task Analysis

#### Related Information: What the Student Should Know

#### Application: What the Student Should Be Able to Do

#### Unit 3–B: Cylinder Blocks and Liners

1. Terms and definitions
2. Types of cylinder block cooling methods
3. Types of cylinder block liners (sleeves)
4. Characteristics of cylinder liners (sleeves)
5. Cause of abnormal sleeve wear
6. Pressure test a cylinder block
7. Disassemble and clean a cylinder block
8. Inspect a cylinder block
9. Install new camshaft bushings
10. Clean and inspect cylinder bores
11. Install cylinder liners and set liner protrusion

#### Unit 4–B: Crankshafts and Bearings

1. Terms and definitions
2. Parts of a crankshaft
3. Crankshaft throw arrangements
4. Crankshaft throw characteristics
5. Crankshaft balancing methods
6. Crankshaft lubrication
7. Characteristics of a good bearing
8. Bearing materials and their characteristics
9. Parts of main and connecting rod bearings
10. Special design features of main bearings
11. Types of thrust bearings
12. Symptoms of bearing failure
13. Types of vibration dampers
14. Functions of a flywheel
15. Remove, clean, and inspect a crankshaft
16. Install main bearings and crankshaft
17. Perform an in-frame bearing roll-in
18. Inspect viscous vibration damper/harmonic balancer
19. Inspect bonded vibration damper/harmonic balancer
20. Inspect flywheel

#### Unit 5–B: Pistons and Connecting Rods

1. Terms and definitions
2. Primary components of a piston and connecting rod assembly
3. Functions of piston and connecting rod components
4. Parts of a piston
5. Functions of piston parts
6. Common piston designs
7. Types of piston crown designs

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Instructional/Task Analysis

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<td>16. Remove, disassemble, and inspect a piston and connecting rod assembly</td>
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<td>18. Assemble and install piston and connecting rod assembly</td>
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| **Unit 6–B: Camshafts, Trains, and Timing** |
| 1. Terms and definitions |
| 2. Primary parts of a camshaft |
| 3. Types of camshafts |
| 4. Operation of a camshaft |
| 5. Parts of a cam lobe |
| 6. Parts of a valve train |
| 7. Valve actuation |
| 8. Valve timing |
| 9. Types of camshaft bushings |
| 10. Types of cam followers and lifters |
| 11. Methods of driving the camshaft |
| 12. Components in a typical gear train |
| 13. Gear timing |
| 14. Remove, clean, and inspect a camshaft |
| 15. Remove, inspect, and install cam bushings |
| 16. Install a camshaft and set cam timing |
## Unit 7–B: Cylinder Head Assemblies

1. Terms and definitions
2. Functions of a cylinder head
3. Basic differences between basic cylinder head designs
4. Parts of a typical valve
5. Functions of valve parts
6. Basic valve assembly components
7. Functions of valve assembly components
8. Operation of a valve rotator
9. Common cylinder head problems
10. Common valve/seat problems
11. Locate and label intake and exhaust valves
12. Clean and inspect a cylinder head
13. Recondition a cylinder head
14. Install a cylinder head assembly and adjust valves

## Unit 8–B: Air Induction and Exhaust Systems

1. Terms and definitions
2. Basic air induction components
3. Functions of air induction components
4. Types of air induction systems
5. Main parts of a turbocharger
6. Starting aid devices
7. Basic exhaust system components
8. Functions of exhaust system components
9. Operation of an induction and exhaust system
10. Diesel engine scavenging
11. Exhaust systems
12. Parts of a typical catalytic converter
13. Operation of a catalytic converter
14. Inspect and test air induction system
15. Inspect and service turbo/supercharger and related components
16. Clean and test jacket water intercooler
17. Clean and test air-to-air intercooler
18. Inspect and test exhaust system
19. Inspect starting preheater controls
20. Test starting fluid system and controls
Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 9–B: Engine Brakes and Retarders

1. Terms and definitions
2. Common types of engine brakes and retarders
3. Advantages of engine brake and retarer systems
4. Engine compression brake components
5. Functions of engine compression brake components
6. Engine operation with the engine compression brake energized
7. Exhaust brake components
8. Functions of exhaust brake components
9. Engine operation with the exhaust brake energized (throttle-off operation)
10. Hydraulic engine retarder components (BrakeSaver®)
11. Functions of hydraulic engine retarder components
12. Engine operation with the hydraulic engine retarder energized
13. Electric driveline retarder components
14. Functions of electric driveline retarder components
15. Engine operation with an electric driveline retarder energized
16. Remove, inspect, install, and adjust a Jacobs Engine Brake
17. Check operation of a BrakeSaver®
18. Check operation of an exhaust brake
19. Remove, clean, and install an exhaust brake
20. Check operation of a driveline retarder

Section C: Fuel Systems

Unit 1–C: Basic Fuel Systems and Components

1. Terms and definitions
2. Major functions of fuel systems
3. Major parts of a fuel system
4. Functions of fuel system parts
5. Parts of fuel tanks
6. Types of fuel transfer pumps
7. Types of primer pumps
8. Types of fuel injection systems
Unit 1–C: Basic Fuel Systems and Components (continued)

9. Methods of injecting fuel
10. Types of controls on fuel systems
11. Types of fuel lines and their functions
12. Types of fuel filters
13. Types of governors
14. Classes of governors
15. Operation of the mechanical governor
16. Common maintenance problems on fuel systems
17. Factors that affect fuel consumption

Unit 2–C: Mechanical Fuel Injection Diagnosis and Repair

1. Terms and definitions
2. Parts of injection nozzles
3. Types of nozzle valves
4. Operation of an injection nozzle
5. Parts of mechanical unit injectors
6. Fuel flow through the unit injector
7. Optional features on fuel injection pumps
8. Main parts of a distributor-type injection pump
9. Functions of main parts of a distributor-type injection pump
10. Operation of distributor-type injection pumps
11. Fuel flow through distributor-type injection pumps
12. Main parts of an in-line injection pump
13. Functions of main parts of an in-line injection pump
14. Operation of an in-line injection pump
15. Parts and design features of a pumping element
16. Operation of control rack and sleeve
17. Plunger and rack positions
18. Types of PT injection pumps
19. Main parts of a PT injection pump
20. Inspect and service basic fuel supply components

18. Trace fuel flow through basic fuel systems
19. Check fuel level, quality, and consumption
### Instructional/Task Analysis

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<td>20. Functions of the main parts of a PT injection pump</td>
<td>24. Isolate, remove, test, rebuild or replace, and reinstall injection nozzles</td>
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<td>21. Operation of a PT injection pump</td>
<td>25. Isolate, remove, test, and reinstall or replace mechanical unit injectors</td>
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<td>22. Types of PT injectors</td>
<td>26. Inspect, test, adjust, and time a distributor-type (rotary) injection pump; determine needed repairs</td>
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<td>23. Operation of PT injectors</td>
<td>27. Inspect, test, adjust, and time an in-line injection pump; determine needed repairs</td>
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<td>28. Inspect, test, and adjust a PT injection pump and time the injectors; determine needed repairs</td>
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### Unit 3–C: Electronic Fuel Injection Diagnosis and Repair

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<td>Inspect and test power and ground circuits and connections; determine needed repairs</td>
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<td>Check diagnostic trouble codes using electronic diagnostic equipment and technical information; determine needed repairs</td>
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<td>Inspect and replace electrical connectors, terminals, seals, and locks</td>
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<td>Access engine parameters; monitor or change as requested by customer</td>
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<td>Remove, inspect, and rebuild or replace a fuel transfer pump</td>
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<td>Remove, inspect, reinstall, and adjust electronic unit injectors; determine needed repairs</td>
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**Section D: Engine Diagnosis and Maintenance**

**Unit 1-D: General Engine Diagnosis**

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<td>9. Engine computer fault code retrieval</td>
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Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 2-D: Preventive Maintenance and Tune-Up

1. Terms and definitions
2. Purposes of preventive maintenance and tune-up
3. Locating preventive maintenance charts and information
4. Ways of designating preventive maintenance intervals
5. Conditions that require severe service maintenance schedules
6. Engine areas requiring preventive maintenance
7. Preventive maintenance tasks for diesel fuel systems
8. Diesel engine tune-up sequence
9. Determine maintenance needed for given situations
10. Interpret maintenance troubleshooting charts
11. Inspect engine coolant level and condition
12. Pressure test coolant system and radiator cap
13. Take oil sample, and change oil and filter(s)
14. Inspect and test indicator system components
15. Perform a daily preventive maintenance check
16. Perform a mileage preventive maintenance check
17. Perform an engine tune-up