

# Theory and Principles of Engine Operation

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## Instructional/Task Analysis

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

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

### Unit 1: Basic Workplace Safety and First-Aid Skills

1. Definitions of terms associated with workplace safety and first aid
2. Facts about OSHA's role in workplace health and safety
3. Purposes of a material safety data sheet
4. Ways hazardous materials can enter the body
5. Applications for the colors used in the federal safety color code
6. Statements about general workplace safety rules
7. Guidelines for maintaining a safe work area
8. Guidelines for dressing safely on the job
9. Guidelines for lifting and moving items safely
10. Guidelines for preventing slips, trips, and falls
11. Guidelines for preventing electrical shock
12. Guidelines for preventing fire and fire spread
13. Guidelines for using flammable materials and toxic substances
14. Guidelines for using shop tools and machines
15. General safety guidelines for operating and repairing power product equipment
16. Guidelines for working with batteries
17. General steps for handling any emergency situation
18. Basic first-aid procedures for various emergency situations
19. Interpret material safety data sheets
20. Interpret portable fire-extinguisher symbols
21. Determine correct workplace safety practices
22. Determine basic first-aid measures for emergency situations
23. Lift and move a heavy object
24. Operate a fire extinguisher
25. Handle and store flammable materials and toxic substances

# Instructional/Task Analysis

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### Unit 2: Common Hand Tools

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|-----------------------------|---|
| 1. Basic hand tools         | 4. Use tool catalogs to determine the cost of a quality hand-tool set |
| 2. Types of standard gauges |   |
| 3. Standard service tools   |   |

### Unit 3: Common Hand Tools

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| 1. Definitions of terms associated with common fasteners | 5. Identify threaded fasteners by their characteristics           |
| 2. Methods used for holding threaded fasteners in place  | 6. Select correct threaded fasteners for specific applications    |
| 3. Methods used to remove seized or broken fasteners     | 7. Select correct nonthreaded fasteners for specific applications |
| 4. Methods used to repair damaged threads                | 8. Remove seized fasteners  |
|  | 9. Rethread damaged fasteners                                     |
|  | 10. Rethread tapped holes   |

### Unit 4: Related Math and Measuring

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|--|---|
| 1. Definitions of terms associated with math and measuring | 6. Add whole numbers  |
| 2. Place values of a whole number                          | 7. Subtract whole numbers   |
| 3. Types of fractions                                      | 8. Multiply whole numbers   |
| 4. Place values of a decimal number                        | 9. Divide whole numbers   |
| 5. Values of prefixes associated with metric measurement   | 10. Reduce fractions to lowest terms  |
|  | 11. Convert mixed numbers to improper fractions and improper fractions to mixed numbers |
|  | 12. Add fractions   |
|  | 13. Subtract fractions  |
|  | 14. Add decimal numbers   |
|  | 15. Subtract decimal numbers  |
|  | 16. Multiply decimal numbers  |
|  | 17. Divide decimal numbers  |
|  | 18. Calculate correct amount of change due  |
|  | 19. Convert fractions to decimals   |
|  | 20. Read U.S. customary and metric rules  |

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### **Unit 4: Related Math and Measuring (continued)**

21. Use telescoping gauges
22. Use a dial caliper
23. Use a dial indicator

### **Unit 5: Reference Materials**

1. Definitions of terms associated with power product equipment
2. Types of reference materials and their descriptions
3. Interpret illustrations used in power product equipment reference materials
4. Interpret graphs used in power product equipment reference materials
5. Interpret diagrams used in power product equipment reference materials
6. Interpret tables used in power product equipment reference materials
7. Use reference materials to answer specific questions

### **Unit 6: Basic Engine Principles**

1. Definitions of terms associated with basic engine principles
2. The purpose of an internal combustion engine
3. The basic parts of an internal combustion engine
4. Descriptions of the basic parts of an internal combustion engine
5. Types of energy and their descriptions
6. Classifications of forms of energy (kinetic or potential)
7. Characteristics of energy and motion
8. Definitions of types of motion
9. Descriptions of the stages in the process by which an internal combustion engine converts chemical energy into rotary motion
10. Descriptions of the events in the combustion cycle of an internal combustion engine

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### Unit 6: Basic Engine Principles (continued)

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|--|-----------------------------------|
| 11. Purposes of the equipment components that receive energy from the crankshaft | 12. Calculate work                |
|  | 13. Calculate power               |
|  | 14. Calculate torque              |
|  | 15. Calculate engine displacement |
|  | 16. Calculate compression ratio   |

### Unit 7: Engine Design and Identification

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|---|---|
| 1. Definitions of terms associated with engine design and identification                            | 10. Classify engine designs by their valve and cylinder arrangements          |
| 2. Characteristics used to identify engines   | 11. Interpret model and other code numbers used to identify engines           |
| 3. Purposes of the major systems of an internal combustion engine                                   | 12. Complete an engine information form for various two-stroke-cycle engines  |
| 4. Major components of a two-stroke cycle engine  | 13. Complete an engine information form for various four-stroke-cycle engines |
| 5. Major components of a four-stroke cycle engine   |   |
| 6. Descriptions of the combustion cycle of a two-stroke-cycle engine and a four-stroke-cycle engine |   |
| 7. Design characteristics of two-stroke cycle engines and four-stroke-cycle engines                 |   |
| 8. Parts of a crankshaft  |   |
| 9. Parts of a piston and connecting-rod assembly  |   |

### Unit 8: Engine Operation

1. Definitions of terms associated with the operation of a two-stroke-cycle engine
2. Principles of operation of a two stroke-cycle engine
3. Types of pistons commonly used in two-stroke-cycle engines
4. Descriptions of types of valves commonly used in two-stroke-cycle engines
5. Component-design factors that determine timing on a two-stroke cycle engine

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#### Unit 8: Engine Operation (continued)

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|---|--|
| 6. Descriptions of types of scavenging designs used on two-stroke-cycle engines                                   | 14. Analyze the operation of two-stroke cycle engines  |
| 7. Descriptions of exhaust-system component-design factors used to control scavenging on two-stroke cycle engines | 15. Analyze the operation of four-stroke cycle engines |
| 8. Definitions of terms associated with the operation of a four-stroke-cycle engine                               |  |
| 9. Principles of operation of a four-stroke cycle engine  |  |
| 10. Principles of cam operation   |  |
| 11. Basic parts of the valves used in four-stroke-cycle engines   |  |
| 12. Definitions of types of valve actuators used in four-stroke-cycle engines                                     |  |
| 13. Principles of valve timing and overlap on a four-stroke-cycle engine  |  |

#### Unit 9: Parts Management, Inventory Control, and Service Orders

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| 1. Definitions of terms associated with parts management, inventory control, and service orders | 8. Interpret information from parts catalogs and price lists   |
| 2. Reasons for implementing a parts-management system   | 9. Interpret information from time/rate tables                 |
| 3. Types of information found in parts catalogs   | 10. Complete a service order                                   |
| 4. Publications used for identifying parts numbers  | 11. Use a microfiche system to obtain parts information        |
| 5. Descriptions of types of catalog prices  | 12. Use a computer system to obtain parts information          |
| 6. Guidelines for maintaining good inventory control  | 13. Take a physical inventory of power product equipment parts |
| 7. Reasons for using standard time/rate tables  |  |