

# **Power Trains**

## **Subject Code: 010230**

### **Course & Unit Descriptions**

#### **Course Description:**

In the *Power Trains* course, students will learn the physical principles of power trains, the different components that transfer and control power, and how power trains are designed to function. Students will also learn how to adjust and maintain a power train system as well as how to diagnose and test problem areas.

#### **Unit: Hydraulic Theory**

Students learn the components and functions of hydraulic and pneumatic systems. Topics include standard symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching and control devices.

#### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.01 Perform calculations involving speed, torque and power relationships
- 4.5.09 Describe features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, seals, universals)
- 4.5.10 Describe physical and mechanical principles of power transfer (e.g., mechanical, hydraulic, pneumatic and electrical)
- 4.5.11 Describe features, benefits and application of mechanical transmission technologies (i.e., mechanical, hydraulic, pneumatic and electrical)

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

#### **Unit: Component Identification**

Learners are taught the operating principles and service procedures for power train components. These include clutches, multi-speed transmissions, propeller shafts, and rear axles.

#### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)  
Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Service and Preventative Maintenance**

Students learn the fundamentals of power train, service, theory of operation, repair procedures, preventive maintenance, troubleshooting, and power flow from engine to final drive. Students will learn the methods of power transmission, types of gears and bearings, lubrication, and maintenance.

### **Benchmark: 3.2 Sales and Customer Service**

Level 2: Use sales techniques to close the sale of a product and/or service and to handle complex customer issues.

#### **Indicators**

3.2.08 Build and develop customer relationships

#### **Academic Standards**

English: Use a variety of strategies to enhance listening comprehension. (Communication A, 8-10; Communication A, 11-12)  
Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

### **Benchmark: 3.7 Communication Skills**

Level 2: Conduct a business meeting using decision making techniques

#### **Indicators**

3.7.02 Apply active listening strategies  
3.7.04 Articulate ideas and impact audience through verbal and nonverbal communication  
3.7.05 Communicate directions in an organized manner appropriate to the audience  
3.7.07 Extract relevant, valid information from materials and cite sources of information  
3.7.08 Develop reports and documents that organize information accurately and use formatting techniques for user friendliness  
3.7.10 Practice etiquette when using communication techniques

#### **Academic Standards**

English: Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly. (Writing Applications C, 11-12)  
Math: Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations. (Algebra D, 8-10)  
Social Studies: Evaluate the reliability and credibility of sources. (Social Studies Skills and Methods A, 9-10)

### **Benchmark: 4.2 Stationary and Mobile Equipment Maintenance**

Level 2: Inspect and maintain specialized machinery and equipment according to schedule

#### **Indicators**

4.2.02 Lubricate machinery and equipment  
4.2.05 Perform machine adjustments (e.g., belts, clippers, drive chains)  
4.2.10 Conduct preventative maintenance and identify causes of malfunctions and failures

**Academic Standards**

- English: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

**Benchmark: 4.3 Equipment Operation**

Level 2: Inspect and safely operate specialized equipment with some limitations to adjustments and functions

**Indicators**

- 4.3.01 Follow manufacturer's recommended operating procedures and adjustment specifications
- 4.3.03 Perform pre-operation inspection and adjustments
- 4.3.04 Perform appropriate start-up, operating and shut-down procedures
- 4.3.06 Perform post-operating inspection and adjustments

**Academic Standards**

- English: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

**Unit: Belts, Chains and Gear Drives**

Students learn how to maintain and repair lubrication; bearings; belt, gear, and chain drive systems along with couplings and brakes.

**Benchmark: 4.2 Stationary and Mobile Equipment Maintenance**

Level 2: Inspect and maintain specialized machinery and equipment according to schedule

**Indicators**

- 4.2.05 Perform machine adjustments (e.g., belts, clippers, drive chains)

**Academic Standards**

- English: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

**Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

**Indicators**

- 4.5.10 Describe physical and mechanical principles of power transfer (e.g., mechanical, hydraulic, pneumatic and electrical)

**Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Bearings and Seals**

Students are taught an understanding of crankshaft, design, parts, lubrication, balance, thrust accommodation, seals, and general inspection. Students will correctly demonstrate bearing removal, inspection, replacement, and reassembly.

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.09 Describe features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, seals, universals)
- 4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Clutches**

Students learn the complete power train system with emphasis on the theory, application, and servicing of clutch systems.

### **Benchmark: 4.2 Stationary and Mobile Equipment Maintenance**

Level 2: Inspect and maintain specialized machinery and equipment according to schedule

#### **Indicators**

- 4.2.02 Lubricate machinery and equipment

#### **Academic Standards**

- English: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.04 Analyze, diagnose and test clutches and brakes
- 4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Manual Transmissions**

Students learn the basic components of manual shift transmissions and their functions as they relate to the operation of various power train systems.

### **Benchmark: 4.2 Stationary and Mobile Equipment Maintenance**

Level 2: Inspect and maintain specialized machinery and equipment according to schedule

#### **Indicators**

4.2.07 Identify, select and maintain fluid levels

#### **Academic Standards**

English: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)

Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

4.5.05 Analyze, diagnose and test gear-type transmissions (i.e., power shift, synchronized and sliding gear)

4.5.09 Describe features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, seals, universals)

4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Power Take-Off**

Students are taught to diagnose, troubleshoot and repair power take-off devices.

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

4.5.09 Describe features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, seals, universals)

4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Differentials**

Students learn the theory of operation, maintenance, diagnosis, and repair of differentials and final drives.

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.03 Analyze, diagnose and test differentials and final drives
- 4.5.07 Analyze, diagnose and test air shift controls/pneumatics
- 4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)
- Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)
- Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

## **Unit: Hydrostatics**

Learners will demonstrate their knowledge of hydrostatic drives including purpose, design, operating principles, inspection, maintenance and repair procedures.

### **Benchmark: 4.2 Stationary and Mobile Equipment Maintenance**

Level 2: Inspect and maintain specialized machinery and equipment according to schedule

#### **Indicators**

- 4.2.07 Identify, select and maintain fluid levels

#### **Academic Standards**

- English: Use appropriate self-monitoring strategies for comprehension. (Reading Process C, 8-10; Reading Process C, 11-12)
- Math: Apply mathematical knowledge and skills routinely in other content areas and practical situations. (Mathematical Processes B, 8-10)

### **Benchmark: 4.5 Transmission of Power**

Level 2: Diagnose and repair power train components

#### **Indicators**

- 4.5.02 Analyze, diagnose and test hydrostatic transmissions
- 4.5.10 Describe physical and mechanical principles of power transfer (e.g., mechanical, hydraulic, pneumatic and electrical)
- 4.5.12 Remove, inspect and replace/repair power train components

#### **Academic Standards**

- English: Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary. (Vocabulary D, 11-12)

Math: Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions. (Number G, 8-10)

Science: Explain the movement of objects by applying Newton's three laws of motion. (Physical Sciences D, 9-10)

**Safety Indicators are assumed for each Unit.**

**Benchmark: 4.1 Safety Procedures**

Level 2: Follow safety procedures in specific situations with specialized tools and equipment, evaluate situation and take corrective action

**Indicators**

- 4.1.01 Demonstrate knowledge of safety rules and regulations
- 4.1.02 Interpret safety signs and symbols
- 4.1.03 Model safe attitudes and behaviors (e.g., lifting, climbing)
- 4.1.04 Identify safety hazards and take corrective measures
- 4.1.05 Use safety equipment in accordance with established procedures
- 4.1.06 Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary

**Academic Standards**

English: Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing). (Reading Process B, 8-10; Reading Process B, 11-12)