



Western Technical College

32412413 Diesel Heavy Equipment Powertrains

Course Outcome Summary

Course Information

Description	This course is a practical study in the procedures associated with diagnosis and repair of heavy equipment transmissions, differentials, final drives, drivelines, and braking systems.
Career Cluster	Transportation, Distribution and Logistics
Instructional Level	Technical Diploma Courses
Total Credits	3
Total Hours	108

Pre/Corequisites

Prerequisite	32412400 Diesel Truck Preventive Maintenance
Prerequisite	32412401 Diesel Truck Powertrains
Prerequisite	32412351 Diesel Truck Brake Systems
Prerequisite	32412402 Diesel Truck Chassis Systems
Prerequisite	32412403 Diesel Online Service Utilization
Prerequisite	32412404 Diesel Safety and Industry Practices
Prerequisite	32412405 Diesel Heavy Truck and Forklift Familiarization
Prerequisite	32412406 Diesel Electricity Fundamentals
Prerequisite	32412407 Diesel Electricity Troubleshooting
Prerequisite	32412303 Diesel Basic Engines

Textbooks

Hydraulic Systems for Mobile Equipment. 2nd Edition. Copyright 2023. Dell, Timothy W. Publisher: Goodheart-Wilcox Co. **ISBN-13:** 978-1-63776-126-7. Required.

Heavy Equipment Power Trains and Systems. 2nd Edition. Copyright 2024. Dell, Timothy W. Publisher: Goodheart-Wilcox Co. **ISBN-13:** 978-1-68584-445-5. Required.

Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** To be discussed in class. Required.

Six inch ankle high, quality leather work shoes - \$75.00-100.00. **Vendor:** To be discussed in class. Required.

Uniform: Four black/grey shirts with embroidered name. **Vendor:** Campus Shop. Required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Expand a Growth-Mindset
3. Cultivate Passion: Increase Self-Awareness
4. Live Responsibly: Develop Resilience
5. Live Responsibly: Embrace Sustainability
6. Live Responsibly: Foster Accountability
7. Refine Professionalism: Act Ethically
8. Refine Professionalism: Improve Critical Thinking
9. Refine Professionalism: Participate Collaboratively
10. Refine Professionalism: Practice Effective Communication

High Impact Practices

1. Learning Community: these courses are designed to enhance your learning experience in which a cohort of peers complete two or more courses that are linked through projects, themes, or program emphasis.

Program Outcomes

1. Diagnose, repair and service drive train systems

Course Competencies

1. **Summarize theory and operation of power train as it pertains to heavy equipment.**

Assessment Strategies

- 1.1. Written Product
- 1.2. Skill Demonstration
- 1.3. Written Objective Test

Criteria

You will know you are successful when:

- 1.1. you identify basic power train components.
- 1.2. you describe how power train components relate to one another by following flow chart from flywheel to ground.
- 1.3. you identify safety concerns related to hybrid systems.
- 1.4. you identify types of gears in matching test.
- 1.5. you explain the benefit of one type of gear versus other types of gears using factors such as cost, strength, quietness, bulkiness, and capability of ratios.
- 1.6. you identify types of bearings in matching test.
- 1.7. you describe proper adjustment procedures for various types of bearings.
- 1.8. you identify components of a torque converter and describe the relationship of those components to one another.
- 1.9. you describe the operation of a given torque converter and various stages of operation.
- 1.10. you use OEM manuals/service information to test a torque converter unit to determine if operation is within specifications.
- 1.11. you explain which clutches and/or brakes are engaged and which planetary gear sets are being used during a specific gear selection.
- 1.12. you explain the differences, advantages, and disadvantages of planetary and countershaft transmissions.
- 1.13. you use service manual/information to test and/or troubleshoot a powershift transmission (on-highway truck transmissions do not qualify) to verify if it is within OEM specifications.
- 1.14. you demonstrate ability to set and measure preload, endplay, and backlash for a specific component using OEM manuals/service information.
- 1.15. you identify all components in a single and multiple disc and plate-type clutch including flywheel, pilot and release bearings, disc and pressure plate parts, and power train input shaft.
- 1.16. you explain differences and benefits of solid and button-type clutches.
- 1.17. you explain operation of a selected clutch.
- 1.18. you explain the relationship of the clutch components to each other and their roles in the transfer of power.
- 1.19. you describe the relationship of the number of discs, types of discs (wet or dry), and type of clutch material to the transfer of torque and horsepower to the ground.
- 1.20. you demonstrate understanding of overrunning clutches by identifying the different types of clutches, their operation and various applications.
- 1.21. you explain the operation of magnetic clutches and name various applications.
- 1.22. you explain operation and applications of modulating clutch.
- 1.23. you identify electronic control system components used on a specific unit.
- 1.24. you explain the functions of all electronic control system components and their relationships to one another.
- 1.25. you demonstrate ability to follow flow and troubleshooting charts to correctly identify the operation of a specific unit's system and troubleshooting methods used by the OEM for the electronic control system.
- 1.26. you explain in writing, how a basic hydrostatic system functions.
- 1.27. you explain the flow of fluids through the charge circuit, pump, motor, control and loop circuits.
- 1.28. you explain the differences between fixed and variable pumps and motors, and the effects of their various combinations.

Learning Objectives

- 1.a. Explain basic powertrain components including safety concerns related to hybrid systems.
- 1.b. Examine types of gears and benefit of one type versus other types for heavy equipment.
- 1.c. Investigate types of bearings and adjustment procedures.
- 1.d. Investigate torque converter components, operation and testing/troubleshooting.
- 1.e. Examine manual transmissions, including sliding gear, collar shift, synchromesh, controls and adjustments.
- 1.f. Examine powershift transmissions related to heavy equipment operation.
- 1.g. Investigate types of clutches, their operation and various applications.
- 1.h. Examine electronic-controlled transmissions related to heavy equipment operation.
- 1.i. Summarize principles of hydrostatic transmissions related to heavy equipment.

2. Evaluate driveshaft function and construction of heavy equipment.

Assessment Strategies

- 2.1. Written Product

- 2.2. Skill Demonstration
- 2.3. Written Objective Test

Criteria

You will know you are successful when:

- 2.1. you identify driveshaft components, realizing the effects of driveline angle and studying why driveline failures occur.
- 2.2. you identify the components of basic differential operation including how pinion, ring, and bevel gears operate in relationship to each other.
- 2.3. you identify each type of differential locking device and explain in detail how each one operates.
- 2.4. you perform all adjustments on a differential with a new ring and pinion, and also perform all adjustments with original ring and pinion but with new bearings.
- 2.5. you identify the most common root causes of failure with differentials.
- 2.6. you exhibit knowledge of final drives by identifying the different types and the components that make up final drives.
- 2.7. you perform adjustments according to OEM standards.

Learning Objectives

- 2.a. Investigate driveshaft components, driveline angle and driveline failures in heavy equipment.
- 2.b. Investigate differential components, differential locking methods and adjustments used for heavy equipment.
- 2.c. Investigate types, components, and adjustments for final drives in heavy equipment.

3. Evaluate hydraulic and pneumatic braking systems used in heavy equipment.

Assessment Strategies

- 3.1. Written Product
- 3.2. Skill Demonstration
- 3.3. Written Objective Test

Criteria

You will know you are successful when:

- 3.1. you explain the fundamental theory, adjustments, and repair of hydraulic and pneumatic braking systems used primarily in mobile construction equipment.
- 3.2. you identify basic brake components, both wet internal and dry external.
- 3.3. you sketch hydraulic and pneumatic brake systems, internal and external.

Learning Objectives

- 3.a. Determine function, construction and operation of the components of hydraulic and pneumatic braking systems used in heavy equipment.
- 3.b. Investigate hydraulic wheel cylinders, master cylinders, air system maintenance, internal wet disc brakes, and brake retarders.

4. Explain maintenance practices in power trains.

Assessment Strategies

- 4.1. Written Product
- 4.2. Skill Demonstration
- 4.3. Written Objective Test

Criteria

You will know you are successful when:

- 4.1. you describe procedures to follow in keeping a work area and the parts worked with clean.
- 4.2. you describe proper flushing procedures, including when components are replaced.
- 4.3. you describe scheduled oil sampling and cite several reasons why it is necessary.

Learning Objectives

- 4.a. Summarize procedures for cleaning work area and parts.
- 4.b. Summarize proper flushing procedures for heavy equipment.
- 4.c. Summarize oil sampling, including reasons why it is necessary for heavy equipment.

5. Interpret power train schematics and flow diagrams for heavy equipment.

Assessment Strategies

- 5.1. Written Product
- 5.2. Skill Demonstration
- 5.3. Written Objective Test

Criteria

You will know you are successful when:

- 5.1. you identify all electrical/hydraulic, pneumatic, and mechanical symbols used in power train units.
- 5.2. you use schematics and flow diagrams to follow both control circuits and power flow of a given piece of equipment using the corresponding OEM manual/service information.

Learning Objectives

- 5.a. Identify all symbols.
- 5.b. Utilize schematics and flow diagrams for problem solving, decision making, and problem analysis for heavy equipment.

6. Demonstrate troubleshooting and failure analysis of power train system for heavy equipment.

Assessment Strategies

- 6.1. Written Product
- 6.2. Skill Demonstration
- 6.3. Written Objective Test

Criteria

You will know you are successful when:

- 6.1. you describe steps in solving a problem related to a power train system, decisions required to perform work and analysis as to why problem occurred, and how it could have been prevented.
- 6.2. you describe common reasons for parts failure and are able to discuss symptoms of wear and corrosion of actual part
- 6.3. you follow reference information, test, and determine if unit is within specifications for a hydraulic/hydrostatic trainer or equipment with a hydrostatic drive using service manuals/information/software; demonstrate ability to follow a diagnostic troubleshooting chart for a specific system.
- 6.4. you demonstrate technical write-up competency: identifying, evaluating, and diagnosing customer complaint; identify the root cause of failure; correction procedure; machine inspection.

Learning Objectives

- 6.a. Summarize common reasons for parts failure.
- 6.b. Demonstrate testing and diagnostic troubleshooting for a specific system.
- 6.c. Demonstrate correct documentation of root cause of failure, correction procedure and machine inspection.
- 6.d. Repair problems when applicable.