



## COURSE OUTLINE: HET816 - DRIVE TRAIN SYSTEMS

Prepared: Josh Boucher

Approved: Corey Meunier, Chair, Technology and Skilled Trades

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| <b>Course Code: Title</b>                                             | HET816: DRIVE TRAIN SYSTEMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Program Number: Name</b>                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Department:</b>                                                    | MOTIVE POWER APPRENTICESHIP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Semesters/Terms:</b>                                               | 20W                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Description:</b>                                            | Upon successful completion of this course the apprentice will be able to recommend repairs for torque converters, fluid couplings, hydraulic retarders and hydrostatic drive systems following manufacturers' recommendations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Total Credits:</b>                                                 | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Hours/Week:</b>                                                    | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Total Hours:</b>                                                   | 26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Prerequisites:</b>                                                 | There are no pre-requisites for this course.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Corequisites:</b>                                                  | There are no co-requisites for this course.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Essential Employability Skills (EES) addressed in this course:</b> | <div><div>EES 1</div><div>Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</div></div> <div><div>EES 2</div><div>Respond to written, spoken, or visual messages in a manner that ensures effective communication.</div></div> <div><div>EES 3</div><div>Execute mathematical operations accurately.</div></div> <div><div>EES 4</div><div>Apply a systematic approach to solve problems.</div></div> <div><div>EES 5</div><div>Use a variety of thinking skills to anticipate and solve problems.</div></div> <div><div>EES 6</div><div>Locate, select, organize, and document information using appropriate technology and information systems.</div></div> <div><div>EES 7</div><div>Analyze, evaluate, and apply relevant information from a variety of sources.</div></div> <div><div>EES 8</div><div>Show respect for the diverse opinions, values, belief systems, and contributions of others.</div></div> <div><div>EES 9</div><div>Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</div></div> <div><div>EES 10</div><div>Manage the use of time and other resources to complete projects.</div></div> <div><div>EES 11</div><div>Take responsibility for ones own actions, decisions, and consequences.</div></div> |
| <b>Course Evaluation:</b>                                             | Passing Grade: 50%,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Other Course Evaluation &amp; Assessment Requirements:</b>         | <div>Grade</div> <div>Definition Grade Point Equivalent</div> <div>A+ 90 - 100% 4.00</div> <div>A 80 - 89%</div> <div>B 70 - 79% 3.00</div> <div>C 60 - 69% 2.00</div> <div>D 50 - 59% 1.00</div> <div>F (Fail) 49% and below 0.00</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



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|                                                 |
| <b>Books and Required Resources:</b>            |
| <b>Course Outcomes and Learning Objectives:</b> |

CR (Credit) Credit for diploma requirements has been awarded.  
 S Satisfactory achievement in field /clinical placement or non-graded subject area.  
 U Unsatisfactory achievement in field/clinical placement or non-graded subject area.  
 X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.  
 NR Grade not reported to Registrar’s office.  
 W Student has withdrawn from the course without academic penalty.

Modern Diesel Technology: Heavy Equipment Systems by Robert Huzij, Angelo Spano, Sean Bennett  
 Publisher: Cengage Learning Edition: 3rd Edition  
 ISBN: ISBN-10: 1-337-56758-2

| Course Outcome 1                                                                                                                                                              | Learning Objectives for Course Outcome 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| 6.1 Torque Converters, Fluid Couplings, and Hydraulic Retarders<br>6.1.1 Explain the purpose and fundamentals of torque converters, fluid couplings, and hydraulic retarders. | 6.1.1 Explain the purpose and fundamentals of torque converters, fluid couplings, and hydraulic retarders. <ul style="list-style-type: none"> <li>- torque converters             <ul style="list-style-type: none"> <li>• static and dynamic friction</li> <li>• torque multiplication</li> <li>• centrifugal force</li> <li>• centripetal force</li> <li>• vortex and rotary flow</li> <li>• kinetic energy</li> </ul> </li> <li>- hydrodynamic drive</li> <li>- multiplication phase</li> <li>- coupling phase</li> <li>- hydraulic retarders</li> </ul> 6.1.2 Identify the construction features of torque converters, fluid couplings, and hydraulic retarders. <ul style="list-style-type: none"> <li>- torque converters             <ul style="list-style-type: none"> <li>• pumps</li> <li>• impeller</li> <li>• stator</li> </ul> </li> <li>o fixed</li> <li>o rotating             <ul style="list-style-type: none"> <li>• overrunning clutch</li> <li>• flywheel</li> <li>• lock-up device</li> </ul> </li> <li>- fluid couplings             <ul style="list-style-type: none"> <li>• impeller</li> <li>• turbine</li> <li>• flywheel</li> </ul> </li> <li>- hydraulic retarders             <ul style="list-style-type: none"> <li>• rotor and housing</li> <li>• control valve</li> </ul> </li> </ul> 6.1.3 Describe the principles of operation of torque converters, fluid couplings, and hydraulic retarders. <ul style="list-style-type: none"> <li>- torque converters</li> </ul> |

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|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>• pump</li> <li>• impeller</li> <li>• stator</li> </ul> <ul style="list-style-type: none"> <li>o fixed</li> <li>o rotating</li> </ul> <ul style="list-style-type: none"> <li>- overrunning clutch</li> <li>- flywheel</li> <li>- lock-up</li> <li>- fluid couplings <ul style="list-style-type: none"> <li>• impeller</li> <li>• turbine</li> <li>• flywheel</li> </ul> </li> <li>- oil flow action</li> <li>- hydraulic retarders <ul style="list-style-type: none"> <li>• rotor and housing</li> <li>• control valve</li> </ul> </li> </ul> <p>6.1.4 Perform inspection, testing, and diagnostic procedures following manufacturers' recommendations for torque converters, fluid couplings, and hydraulic retarders.</p> <ul style="list-style-type: none"> <li>- oil level condition check</li> <li>- demonstrate oil leak tests</li> <li>- converter end play check</li> <li>- demonstrate converter: <ul style="list-style-type: none"> <li>• stall tests</li> <li>• relief valve tests</li> <li>• performance tests</li> </ul> </li> <li>- component failure analysis</li> </ul> <p>6.1.5 Recommend reconditioning or repair procedures following manufacturers' recommendations for torque converters, fluid couplings, and hydraulic retarders.</p> <ul style="list-style-type: none"> <li>- show examples of component failures for: <ul style="list-style-type: none"> <li>• pumps</li> <li>• impeller</li> <li>• stator</li> <li>• overrunning clutch</li> <li>• lock-up devices</li> <li>• rotors</li> <li>• control valves</li> </ul> </li> <li>- identify contamination protection procedures</li> <li>- outline the recommended oil change procedures</li> </ul> |
|  | <b>Course Outcome 2</b>                                                                                                                                                                    | <b>Learning Objectives for Course Outcome 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|  | <p>6.2 Hydrostatic Drive Systems</p> <p>Upon successful completion the apprentice is able to recommend repairs for hydrostatic drive systems following manufacturers' recommendations.</p> | <p>6.2.1 Explain the purpose and fundamentals of hydrostatic drives.</p> <ul style="list-style-type: none"> <li>- application <ul style="list-style-type: none"> <li>• traction drives</li> <li>• non-traction drives</li> </ul> </li> <li>- types <ul style="list-style-type: none"> <li>• open loop circuits</li> <li>• closed loop circuits</li> </ul> </li> <li>- fundamentals</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

- lubricant types
- hydraulic pressures and output force
- coolers and circuits
- torque multiplication
- hydrodynamic versus hydrostatic drive systems
- charge pump
- charge pump circuits

6.2.2 Identify the types and construction features of hydrostatic drives.

- hydrostatic drives
  - variable displacement pumps
  - fixed displacement pumps
  - variable displacement motors
  - fixed displacement motors
- controls
  - flow limiting
  - flow dividing
  - manual displacement control valves
  - electronic displacement control valves
  - hydraulic displacement control valves
- charge pump
- charge pump circuits
- coolers and circuits

6.2.3 Describe the principles of operation of hydrostatic drives.

- hydrostatic drives
  - variable displacement pumps
  - variable displacement motors
  - fixed displacement pumps
  - fixed displacement motors
- operation of drive systems in neutral, forward, and reverse
- controls
  - flow limiting
  - flow dividing
  - manual displacement control valves
  - electronic displacement control valves
  - hydraulic displacement control valves
- charge pumps
- charge pump circuits
- coolers and circuits

6.2.4 Perform the inspection, testing, and diagnostic procedures following manufacturers' recommendations on hydrostatic drives.

- test pressures of various hydrostatic drive systems
- examine and measure hydrostatic drive motor and pump components
- verify recommended operating functions of hydrostatic drive controls
- outline methods and procedures to diagnose and determine causes of abnormal noises, directional control problems, and malfunctions in hydrostatic drive systems



|                                               | <ul style="list-style-type: none"> <li>- verify recommended operating temperatures of hydrostatic drives               <ul style="list-style-type: none"> <li>• cooler restrictions</li> <li>• filter restrictions</li> </ul> </li> </ul> <p>6.2.5 Recommend reconditioning or repairs following manufacturers` recommendations for hydrostatic drives.</p> <ul style="list-style-type: none"> <li>- demonstrate field adjustments for hydrostatic drive systems</li> <li>- explain the recommended oil levels and grade</li> <li>- outline recommended removal and replacement procedures for hydrostatic motors, pumps, and coolers</li> <li>- Demonstrate the disassembly and reassembly procedures for hydrostatic drive systems</li> </ul> |                 |                   |                    |     |                               |     |                |     |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|--------------------|-----|-------------------------------|-----|----------------|-----|
| <b>Evaluation Process and Grading System:</b> | <table> <tr> <th>Evaluation Type</th><th>Evaluation Weight</th></tr> <tr> <td>Assignments/Theory</td><td>10%</td></tr> <tr> <td>Practical Application Testing</td><td>40%</td></tr> <tr> <td>Theory Testing</td><td>50%</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Evaluation Type | Evaluation Weight | Assignments/Theory | 10% | Practical Application Testing | 40% | Theory Testing | 50% |
| Evaluation Type                               | Evaluation Weight                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                   |                    |     |                               |     |                |     |
| Assignments/Theory                            | 10%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                   |                    |     |                               |     |                |     |
| Practical Application Testing                 | 40%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                   |                    |     |                               |     |                |     |
| Theory Testing                                | 50%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                   |                    |     |                               |     |                |     |
| <b>Date:</b>                                  | February 10, 2020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                   |                    |     |                               |     |                |     |
| <b>Addendum:</b>                              | Please refer to the course outline addendum on the Learning Management System for further information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                   |                    |     |                               |     |                |     |

