Correlation of

***Heavy Equipment Power Trains and Systems,* Timothy W. Dell**

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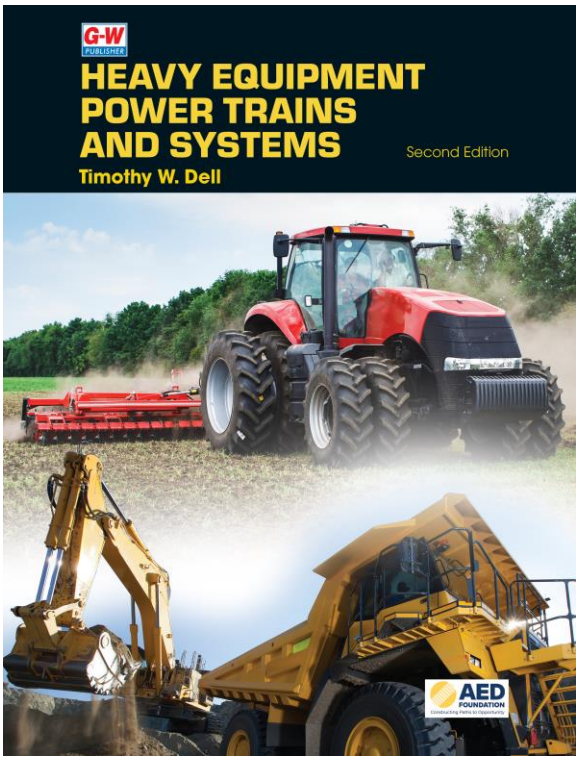
to

AED Power Trains Standards

Goodheart-Willcox is pleased to partner with the AED Foundation by correlating *Heavy Equipment Power Trains and Systems* to their Power Trains standards.

The correlation chart below lists the Standards, Indicators, and Indicators for the AED Power Trains standards in the left column. Corresponding content from *Heavy Equipment Power Trains and Systems* that can be used by a student to help achieve the standard, Indicator, or indicator is listed in the right column.



Standards / Indicators / Indicators	G-W Content
Standard 1: Theory and operation	
Objective 1. Basic principles of power train	
Indicator 1. Demonstrate knowledge of basic power train components and how those components, as a whole, relate to one another. Demonstrate by following a power flow chart from flywheel to ground.	Textbook pgs. 215–248, 253–278, 289, 327–357, 371–404, 411–429, 435–474, 479–504, 563–583, 587–610, 659, 664–669, 683, 832–839
Indicator 2. Recognize hybrid and electric drive systems and/or machines as they relate to safety concerns.	Textbook pgs. 883–910 Lab Workbook pgs. 249–350 (Job 26-1)
Indicator 3. Demonstrate knowledge by identifying the various types of gears using a matching test.	Textbook pgs. 215–219
Indicator 4. 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.	Textbook pgs. 215–221

Standards / Indicators / Indicators	G-W Content
Indicator 5. Identify types of bearings through matching tests.	Textbook pgs. 243–248
Indicator 6. Demonstrate understanding of various types of bearings and proper adjustment procedures.	Textbook pgs. 242–221 Lab Workbook pgs. 216–217 (Job 16-1)
Indicator 7. Identify components of a torque converter and describe the relationship of those components to one another.	Textbook pgs. 412–426 Lab Workbook pgs. 145–147 (Job 12-1)
Indicator 8. Describe the operation of a given torque converter and various stages of operation.	Textbook pgs.414–426
Indicator 9. Use OEM manuals/service information to test a torque converter unit and determine if operation is within specifications.	Textbook pgs. 390–391, 414–429 Lab Workbook pgs. 145–147 (Job 12-1)
Objective 2: Theory and principles of manual transmissions	
Indicator 1. Exhibit your understanding of "sliding gear" transmissions by identifying components, explaining operation, and demonstrating power flow through all gear sets.	Textbook pgs.221–224 Lab Workbook pgs. 79–82 (Job 7-1)
Indicator 2. Exhibit your understanding of "collar shift" transmissions by identifying components, explaining operation, and demonstrating power flow through all gear sets.	Textbook pgs. 224–227 Lab Workbook pgs. 79–82 (Job 7-1)
Indicator 3. Exhibit your understanding of "syncromesh" transmissions by identifying components, explaining operation, and demonstrating power flow through all gear sets.	Textbook pgs. 228–240 Lab Workbook pgs. 79–82 (Job 7-1)
Indicator 4. Identify shifting control components and explain their operation.	Textbook pgs. 241–242, 377–390 Lab Workbook pgs. 79–82 (Job 7-1)
Indicator 5. Demonstrate ability to perform adjustments to transmissions as instructed in the OEM service manual/information.	Textbook pgs. 246–248, 390–391
Objective 3: Theory and principles of powershift transmissions	
Indicator 1. Demonstrate your understanding of the operation of powershift transmissions by explaining which clutches and/or brakes are engaged, and which planetary gear sets are being used during a specific gear selection.	Textbook pgs. 327–357 Lab Workbook pgs. 101–102 (Job 9-1), 103–105 (Job 9-2)
Indicator 2. Explain the differences, advantages, and disadvantages of planetary and countershaft transmissions.	Textbook pgs. 327–357 Lab Workbook pgs. 103–105 (Job 9-2), 119–121 (Job 10-1)
Objective 4: Theory and principles of clutches	

Standards / Indicators / Indicators	G-W Content
Indicator 1. Use service information to test and/or troubleshoot a powershift transmission and verify it is or is not within OEM specifications.	Textbook pgs. 371–404 Lab Workbook pgs. 89–90 (Job 8-1)
Indicator 2. Demonstrate ability to set and measure preload, endplay, and backlash for a specific component using OEM manuals/service information.	Textbook pgs. 248, 390–391, 400–401 Lab Workbook pgs. 107–109 (Job 9-3)
Indicator 3. 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. Also, explain differences and benefits of solid and button-type clutches.	Textbook pgs. 253–278 Lab Workbook pgs. 89–90 (Job 8-1)
Indicator 4. Explain operation of a selected clutch.	Textbook pgs. 253–278 Lab Workbook pgs. 89–90 (Job 8-1)
Indicator 5. Demonstrate knowledge and operation of single and multiple disc clutches by explaining the relationship of the clutch components to each other and their role in the transfer of power.	Textbook pgs.254–256, 263–270 Lab Workbook pgs. 89–90 (Job 8-1), 103–105 (Job 9-2)
Indicator 6. 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.	Textbook pgs. 253–278
Indicator 7. Demonstrate understanding of overrunning clutches by identifying the different types of clutches, their operation, and various applications.	Textbook pgs. 270–274 Lab Workbook pg. 91 (Job 8-1)
Indicator 8. Explain the operation of magnetic clutches and name various applications.	Textbook pgs. 274–276 Lab Workbook pgs. 91–92 (Job 8-1)
Indicator 9. Explain operation and applications.	Textbook pgs. 265–267, 384–389 Lab Workbook pg. 120 (Job 10-1)
Objective 5: Theory and principles of electronic controlled transmissions	
Indicator 1. Exhibit knowledge of electronic control systems by identifying components used in a specific unit.	Textbook pgs. 380–381 Lab Workbook pgs. 135–136 (Job 11-3), 137–138 (Job 11-4), 205–206 (Job 15-1)
Indicator 2. Demonstrate understanding of specific unit's operation by explaining the functions of all components and their relationships to one another.	Textbook pgs. 380–389 Lab Workbook pgs. 135–136 (Job 11-3), 137–138 (Job 11-4)
Indicator 3. 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.	Textbook pg. 393 Lab Workbook pgs. 131–132 (Job 11-1), 133–134 (Job 11-2)
Standard 2: Driveshaft function and construction	
Objective 1: Theory and principles of differentials	

Standards / Indicators / Indicators	G-W Content
Indicator 1. Demonstrate knowledge of driveshafts by recognizing components, realizing the effects of driveline angle, and studying why driveline failures occur.	Textbook pgs. 622–629 Lab Workbook pgs. 237–239 (Job 18-1),
Indicator 2. Exhibit understanding of basic differential operation by identifying the components and explaining how pinion, ring, and bevel gears operate in relation to each other.	Textbook pgs. 563–576 Lab Workbook pgs. 215–217 (Job 16-1)
Indicator 3. Identify each type of differential locking device and explain in detail how each one operates.	Textbook pgs. 568–571
Indicator 4. Given a specific component and proper manuals/information, 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.	Textbook pgs. 577–584 Lab Workbook pgs. 215–217 (Job 16-1)
Indicator 5. Identify the most common root causes of failure with differentials.	Textbook pgs. 567–568, 569–571 Lab Workbook pgs. 215–217 (Job 16-1)
Objective 2: Theory and principles of final drives	
Indicator 1. Exhibit knowledge of final drives by identifying the different types, and the components that make up final drives.	Textbook pgs. 570–594 Lab Workbook pgs. 227–228 (17-1)
Indicator 2. Perform adjustments according to OEM standards.	Textbook pgs. 603–606
Standard 3: Fundamental theory of hydraulic and pneumatic braking systems	
Objective 1. Fundamental theory of hydraulic and pneumatic braking systems	
Indicator 1. Describe fundamental theory, adjustments, and repair of hydraulic and pneumatic braking systems used primarily in mobile construction equipment.	Textbook pgs. 643–683, 689–726 Lab Workbook pgs. 249–253 (Job 19-1), 263–268 (Job 20-1)
Indicator 2. Demonstrate knowledge of basic brake components, both wet internal and dry external.	Textbook pgs. 655-669 Lab Workbook pgs. 249–253 (Job 19-1), 263–268 (Job 20-1)
Indicator 3. Explain and sketch hydraulic and pneumatic brake systems, internal and external.	Textbook pgs. 643–653, 655–670, 689–726 Lab Workbook pgs. 249–253 (Job 19-1), 263–268 (Job 20-1)
Standard 4: Understanding maintenance practices in power trains	
Objective 1. Understanding maintenance practices in power trains	
Indicator 1. Demonstrate procedures to follow in keeping a work area, and the parts worked with, clean.	Textbook pgs. 6, 9–13, 31, 45–48, 429–431
Indicator 2. Describe proper flushing procedures, including when components are replaced.	Textbook pgs. 455–457, 492–494

Standards / Indicators / Indicators	G-W Content
Indicator 3. Describe scheduled oil sampling and cite several reasons why it is necessary.	Textbook pgs. 496, 498, 602, 605–607 Lab Workbook pgs. 169–171 (Job 13-5)
Standard 5: Power train schematics and flow diagrams	
Objective 1. Power train schematics and flow diagrams	
Indicator 1. Be able to identify all electrical/hydraulic, pneumatic, and mechanical symbols used in power train units.	Textbook pgs. 278, 287–288
Indicator 2. Demonstrate the ability to 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.	Textbook pgs. 223–224, 234–240, 278, 287–322, 334–357, 390–391, 455-456 Lab Workbook pgs. 137–138 (Job 11-4), 185–187 (Job 14-3), 189–190 (Job 14-4), 191–193 (Job 14-5), 195–198 (Job 14-6)
Standard 6: Troubleshooting and failure analysis	
Objective 1. Failure analysis	
Indicator 1. Describe steps in solving a problem related to a power train system, decisions required to perform work, and analysis as to why the problem occurred and how it could have been prevented.	Textbook pgs. 206–210, 390–393, 398–402, 427–429, 491–504, 575–576, 605–610, 629–633, 866–867 Lab Workbook pgs. 167–171 (Job 13-5), 185–187 (Job 14-3), 189–190 (Job 14-4),191–193 (Job 14-5), 195–198 (Job 14-6)
Indicator 2. Describe common reasons for parts failure and be able to discuss symptoms of wear, corrosion, etc., of actual parts.	Textbook pgs. 199, 206–210, 426–428, 491–502, 575–576, 606–610, 629–631, 781–782, 866–868 Lab Workbook pgs. 137–138 (Job 11-4), 181–182 (Job 14-2)
Indicator 3. Demonstrate ability to 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.	Textbook pgs. 278, 390–396, 427–429 Lab Workbook pgs. 167–171 (Job 13-5), 185–187 (Job 14-3), 195–198 (Job 14-6)
Objective 2. Troubleshooting	
Indicator 1. Use proper oils and fluids as per manufacturer specifications.	Textbook pgs. 453–456, 602–604 Lab Workbook pg. 187 (Job 14-3)
Indicator 2. Demonstrate technical write-up competency: • Demonstrate logic and critical thinking in identifying, evaluating, and diagnosing customer complaint • Identify the root cause of failure • Correction procedure Machine inspection	Textbook pgs. 14–15, 199, 206–210, 426–428, 491–502, 575–576, 606–610, 629–631, 781–782, 866–868 Lab Workbook pgs. 137–138 (Job 11-4), 189–190 (Job 14-4),