

# Diesel Technology: Drive Trains

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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: Introduction to Diesel Drive Trains

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|---|---|
| 1. Terms and definitions  | 18. Calculate gear ratio  |
| 2. Purposes of a drive train                                    | 19. Calculate gear rotation   |
| 3. Basic components of a drive train and their functions        | 20. Diagnose and determine causes of drive train failures               |
| 4. Operation of a drive train (manual and automatic)            | 21. Interpret a transmission data plate                                 |
| 5. Working application of drive trains                          | 22. Perform drive train lubrication and replace grease fittings         |
| 6. Types of drives in drive trains                              | 23. Complete a visual drive train inspection and document discrepancies |
| 7. Types of gears   |   |
| 8. Formula for calculating gear ratio                           |   |
| 9. How to determine gear rotation, and direction of rotation    |   |
| 10. Formula for calculating gear speed                          |   |
| 11. Specialty tools   |   |
| 12. Check fluid levels (driver and technician responsibilities) |   |
| 13. Purposes of troubleshooting and failure analysis            |   |
| 14. Steps in troubleshooting and failure analysis               |   |
| 15. Characteristics of drive train failures                     |   |
| 16. Causes of drive train failures                              |   |
| 17. Shop and vehicle safety procedures                          |   |

### Unit 2: Drive Shafts

1. Terms and definitions
2. Types of driveshafts
3. Parts of a driveshaft with slip yoke
4. Parts of a center support bearing

## Instructional/Task Analysis

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### Related Information: What the Student Should Know

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#### Unit 2: Drive Shafts (continued)

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| 5. Types of U-joints   | 10. Diagnose driveshaft and U-joint problems  |
| 6. Parts of a cross and roller U-joint   | 11. Inspect and service driveshaft, slip joints, yokes, drive flanges, and U-joints; check phasing of all yokes |
| 7. Points on a drive train to check component angles                               | 12. Remove and reinstall the driveshaft and center support bearing and mounts                                   |
| 8. Acceleration-deceleration (cyclical phasing) of driveshaft with cardan U-joints | 13. Disassemble, inspect, and reassemble a U-joint with bolted end  |
| 9. Problems causing driving line noise or vibration                                | 14. Remove and replace a cross and roller (cardan) U-joint  |
|  | 15. Measure and adjust driveline angles   |

#### Unit 3: Power Take-Offs

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|--|---|
| 1. Terms and definitions   | 16. Diagnose and determine PTO problems |
| 2. Safe operation of PTO's   | 17. Inspect the PTO                     |
| 3. Types of PTO guards and shields   | 18. Remove, Install, and Adjust a PTO   |
| 4. Types of PTO systems  |   |
| 5. Parts of a two-gear, reversible PTO   |   |
| 6. Components of hydraulic and electrical circuits in a power shift PTO                |   |
| 7. Parts of a PTO air shift system   |   |
| 8. Parts of a PTO electrical and air shift system                                      |   |
| 9. Shift covers for transmission-mounted PTO's   |   |
| 10. Complaints and causes for noise, heat, and vibration in transmission-mounted PTO's |   |
| 11. Troubleshooting PTO's for poor work rate   |   |
| 12. Complaints and causes for external oil leaks in PTO's                              |   |
| 13. Troubleshooting PTO's for hard shifting  |   |
| 14. Troubleshooting PTO's for jumping out-of-gear                                      |   |
| 15. Troubleshooting power shift PTO's  |   |

## Instructional/Task Analysis

### Related Information: What the Student Should Know

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#### Unit 4: Standard Transmissions

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|---|---|
| 1. Terms and definitions                                      | 14. Diagnose causes of transmission noise, shifting, lockup, jumping out-of-gear, overheating, and vibration                        |
| 2. Types of standard transmissions                            |   |
| 3. Parts of a single countershaft transmission                | 15. Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents       |
| 4. Parts of a twin and triple countershaft transmission       |   |
| 5. Parts of a front section countershaft                      | 16. Inspect and test function of backup lamp, neutral start, and warning device circuits  |
| 6. Parts of a front section case with clutch housing          |   |
| 7. Parts of an auxiliary section of a nine-speed transmission | 17. Inspect, test, adjust, repair, or replace air shift controls, lines, valves, regulators, filters, and cylinder assemblies.      |
| 8. Types of shift (top) covers                                |   |
| 9. Parts of a manual shift bar housing                        | 18. Remove the transmission; check condition of transmission mounts, insulators, and mounting bolts                                 |
| 10. Parts of an electronic shift bar housing.                 |   |
| 11. Parts of a shift lever assembly                           | 19. Inspect, adjust, service, repair, or replace remote shift linkages and control assembly, brackets, bushings, pivots, and levers |
| 12. Parts of a remote shift control assembly                  |   |
| 13. Air flow for range shifting                               | 20. Inspect, adjust, and replace transmission shift lever assembly top cover, and shift bar housing                                 |
|   | 21. Remove, disassemble, inspect, assemble, and reinstall the auxiliary case and its components                                     |
|   | 22. Remove, disassemble, inspect, assemble, and reinstall the main shaft and auxiliary drive assembly                               |
|   | 23. Remove, inspect, and reinstall input shaft gear, spacers, bearing, retainers, and slingers                                      |
|   | 24. Remove, inspect and/or replace main countershafts, reverse idler assembly, and oil pump; time multiple countershafts            |
|   | 25. Inspect transmission cases  |
|   | 26. Reinstall transmission  |
|   | 27. Remove, inspect, and reinstall a transfer case  |

# Instructional/Task Analysis

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## **Unit 4: Standard Transmissions (continued)**

28. Inspect transmission oil filter and cooler
29. Inspect and test transmission temperature gauge
30. Use a diagnostic tool and procedure to diagnose automated transmission problems
31. Inspect, adjust, repair or replace electronic shift controls, sensors, solenoids, shift motors, indicators, control units, and wiring harnesses
32. Inspect, adjust, repair or replace electronic switch selectors, air and electrical switches, displays and indicators, and wiring harness

## **Unit 5: Automatic Transmissions and Torque Converters**

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|---|---|
| 1. Terms and definitions  | 14. Diagnose transmission noise, shifting, lockup, slipping, overheating, and vibration problems  |
| 2. Major mechanical parts (modules) of an automatic transmission (4 speed)                            | 15. Remove transmission; check condition of transmission mounts, insulators, and mounting bolts   |
| 3. Parts of a planetary gear system   | 16. Remove, disassemble, inspect, replace, reassemble, and reinstall automatic transmission modules   |
| 4. Planetary gear system operation  | 17. Reinstall transmission  |
| 5. Speed torque, and directional function of an automatic transmission and ways they are accomplished | 18. Inspect, adjust, repair, or replace electronic shift controls, electronic control unit, wiring harnesses, sensors, control module, vehicle interface module, and related components |
| 6. Fluid pump and pressure regulating valve operation   | 19. Perform a stall test  |
| 7. Clutch application in an automatic transmission for various gears                                  | 20. Perform a shift point adjustment on a 4-speed transmission  |
| 8. Parts of a torque converter  |   |
| 9. Torque converter parts and their functions   |   |
| 10. Types of fluid flow in torque converters and their characteristics                                |   |
| 11. Phases in torque converter operation  |   |
| 12. Characteristics of automatic transmission fluid   |   |
| 13. In-vehicle transmission tests and their functions   |   |

## Instructional/Task Analysis

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#### Unit 6: Clutches

1. Terms and definitions
2. Parts of a basic clutch assembly
3. Types of flywheels
4. Parts of a pot type flywheel
5. Parts of a flat type flywheel
6. Functions of a flywheel
7. Parts of a dry-type disc clutch
8. Types of clutches and their descriptions
9. Operating principles of a push type clutch
10. Operating principles of a pull type clutch
11. Types of clutch linkage mechanisms and their functions
12. Diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, and chatter problems; determine needed repairs
13. Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies), and check pedal height and travel
14. Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines and hoses; bleed system
15. Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanism
16. Remove dual disc clutch
17. Inspect a single-disc and two-plate clutch pressure plate, clutch disc(s), intermediate plate, and drive pins/lugs
18. Inspect, adjust, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals
19. Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer
20. Inspect and replace pilot bearing
21. Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout
22. Inspect flywheel, starter ring gear and measure flywheel face and pilot bore runout
23. Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play
24. Reinstall dual-disc clutch

## Instructional/Task Analysis

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### Related Information: What the Student Should Know

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#### Unit 7: Drive Axles

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|--|---|
| 1. Terms and definitions   | 18. Diagnose drive axle(s) drive unit noise and overheating problems  |
| 2. Parts of a differential carrier assembly  |   |
| 3. Types of differentials and final drives and their definitions                     | 19. Diagnose drive axle for wheel bearing noise and damage  |
| 4. Parts of a gear tooth   | 20. Check axle fluid level and condition; Add proper type of lubricant  |
| 5. Methods used to evaluate conventional gear tooth contact patterns (tooth profile) | 21. Check for and repair fluid leaks; inspect and replace drive axle drive unit cover plates, gaskets, sealants, vents, magnetic plugs, and seals |
| 6. Basic parts of a planetary gear differential and final drive                      |   |
| 7. Planetary gaset components and their characteristics                              | 22. Remove, clean, inspect, lubricate, replace, and adjust wheel bearings and seals   |
| 8. Types of differential locks (traction control)                                    | 23. Inspect and replace drive axle shafts   |
| 9. Purposes of a power divider   | 24. Inspect and test rear axle temperature gauge and sensor   |
| 10. Parts of a power divider   |   |
| 11. Parts of wheel and hub assemblies  | 25. Remove and replace differential carrier, inspect case and caps, side bearing bores, and pilot bearing bore                                    |
| 12. Purposes of wheel bearings   |   |
| 13. Parts of a wheel bearing (tapered roller down)                                   | 26. Inspect and replace differential case assembly including spider gears, cross shaft, side gears, thrust washers, case halves, and bearing      |
| 14. Purposes of wheel seals  |   |
| 15. Types of wheel seals   | 27. Inspect and replace ring and drive pinion gears, spacers, sleeves, bearing cage, and bearings   |
| 16. Types of shifting mechanisms (2-speed axles)                                     |   |
| 17. Types of air line fittings   | 28. Measure and adjust drive pinion depth   |
|  | 29. Measure and adjust drive pinion bearing preload   |
|  | 30. Measure and adjust side bearing preload and ring gear backlash  |
|  | 31. Measure ring gear runout  |
|  | 32. Check and interpret ring gear and pinion tooth contact pattern  |
|  | 33. Inspect, adjust, or repair ring gear thrust block/screw   |
|  | 34. Inspect, adjust, repair, or replace planetary gear-type 2-speed axle assembly   |

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### Unit 7: Drive Axles (continued)

35. Inspect, repair, or replace 2-speed axle shift control system, speedometer adapters, motors, axle shift units, wires, air lines, and connectors
36. Inspect and replace components of locking differential case assembly
37. Inspect, adjust, repair, or replace air-operated power divider (inter-axle differential) lockout assembly
38. Inspect, repair, or replace rear axle lubrication system

### Unit 8: Special Drives

1. Terms and definitions
2. Types of chain drives
3. Detachable-link chains (plain chain)
4. Roller chains
5. Silent chains
6. Characteristics of detachable link chains
7. Characteristics of standard pitch roller chains
8. Characteristics of double pitch roller chains
9. Characteristics of silent chains
10. Principles of chain drives
11. Alignment of sprocket shafts and sprockets
12. Adjustment of chain tension
13. Methods of adjusting chain tension
14. Parts of a chain sprocket
15. Work chains and sprockets
16. Reasons for lubrication of chains
17. Methods of lubricating chains
18. Repair of chain drives
19. Cleaning chains
20. Types of belts

## Instructional/Task Analysis

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#### Unit 8: Special Drives (continued)

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|---|---|
| 21. Factors governing the ability of belts to transmit power  | 40. Diagnose and determine causes of chain drive problems       |
| 22. Belt drive arrangements                                   | 41. Diagnose and determine causes of belt drive problems        |
| 23. Belt sections used on combines                            | 42. Diagnose and determine causes of gear drive problems        |
| 24. Variable speed drives                                     | 43. Diagnose and determine causes of hydrostatic drive problems |
| 25. Belt tension  |   |
| 26. Belt care and maintenance                                 |   |
| 27. Maintenance of pulleys or sheaves                         |   |
| 28. Types of drive gears                                      |   |
| 29. Methods of lubricating gears                              |   |
| 30. Gear back lash  |   |
| 31. Types of reciprocating drives and their characteristics   |   |
| 32. Maintenance of reciprocating drives                       |   |
| 33. Hydrostatic drives  |   |
| 34. Reversing hydrostatic drives                              |   |
| 35. Maintenance of hydrostatic drives                         |   |
| 36. Testing hydrostatic drives                                |   |
| 37. Functions of a safety release mechanism                   |   |
| 38. Types of safety release mechanisms and their descriptions |   |
| 39. Maintenance of safety mechanisms                          |   |