














# Manual Drive Train and Axles 1<sup>st</sup> Edition

## Chapter 6 Manual Transmissions Parts and Operation

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This course or class covers operation and service of <b>Manual Drive Trains and Axles</b> . It correlates material to task lists specified by ASE and NATEF.
<b>Motivate Learners</b>	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
<b>State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.</b>	Explain the chapter learning objectives to the students. <ol style="list-style-type: none"><li>1. Prepare for ASE Manual Drive Train and Axles (A3) certification test content area "B" (Transmission Diagnosis and Repair).</li><li>2. Explain the construction of a manual transmission.</li><li>3. Discuss synchronizer operation.</li><li>4. Explain five-speed transmission torque flow.</li><li>5. Discuss shifter operation.</li><li>6. Explain the construction of manual transmission gears.</li><li>7. Discuss the purpose of transmission case and bearings.</li></ol>
<b>Establish the Mood or Climate</b>	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

ICONS	Ch06 Man Transmissions Parts & Operation
	<p><b>1. SLIDE 1 MANUAL TRANSMISSIONS PARTS &amp; OPERATION</b></p>
 	<p><b>2. SLIDES 2-3 EXPLAIN OBJECTIVES</b></p> <p>Check for <b>ADDITIONAL VIDEOS &amp; ANIMATIONS</b>  @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a>  <b>WEB SITE IS CONSTANTLY UPDATED</b></p>
	<p><b>USE ANIMATION EPA HAZARDOUS MATERIAL IDENTIFICATION <a href="http://www.myautomotivelab.com">WWW.MYAUTOMOTIVELAB.COM</a></b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a1_animation/chapter_02_fig_02_11/index.htm">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A1_ANIMATION/CHAPTER_02_FIG_02_11/INDEX.HTM</a></p>
	<p><b>4. SLIDE 4 EXPLAIN Construction</b> of a Manual Transmission</p> <p><b>5. SLIDE 5 EXPLAIN FIGURE 6–1</b> five-speed transmission gear train</p>
	<p><b>DEMONSTRATION: SHOW SPUR GEAR &amp; WHERE THEY WOULD FIND SPUR GEARS IN NON-AUTOMOTIVE APPLICATIONS. (EG: BOAT WINCHES, GEAR REDUCTION UNITS ON MACHINERY, &amp; ANALOG CLOCKS AND WATCHES)</b></p>
  <p>QUESTION</p>	<p><b>DISCUSSION: DISCUSS THE DIFFERENCE BETWEEN SPUR AND HELICAL GEARS AND OTHER PLACES IN VEHICLE WHERE YOU MAY FIND EACH.</b></p>
	<p><b>DEMONSTRATION: SHOW THE STUDENTS HOW USING DIFFERENT SIZE COMBINATIONS OF GEARS CHANGES ROTATION SPEED.</b></p>
  <p>QUESTION</p>	<p><b>DISCUSSION: DISCUSS HOW GEAR RATIOS HELP WHEN PEDALING A MULTI-SPEED BIKE</b></p>
	<p><b>INPUT SHAFT OPERATION</b>  <b><a href="http://www.myautomotivelab.com">WWW.MYAUTOMOTIVELAB.COM</a></b>  <a href="http://media.pearsoncmg.com/ph/chet/chet_myautotivelab_akamai_template/video640x480.php?title=input%20shaft%20operation&amp;clip=pandc/chet/2012/automotive/auto_parts_specialist/exp19.mov&amp;caption=chet/chet_myautotivelab_akamai/2012/automotive/auto_parts_specialist/xml/exp19.xml">HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=INPUT%20SHAFT%20OPERATION&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/EXP19.MOV&amp;CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/XML/EXP19.XML</a></p>
	<p><b>DEMONSTRATION: SHOW MANUAL TRANSMISSIONS. SHOW DIFFERENCE IN CONSTRUCTION OF EACH. SHOW INTERNAL WORKINGS OF MANUAL TRANSMISSIONS. SHOW LOCATIONS OF MAJOR PARTS.</b></p>

## ICONS

## Ch06 Man Transmissions Parts & Operation



QUESTION



QUESTION



**DISCUSSION: DISCUSS WHY DESIGN OF MANUAL TRANSMISSIONS VARIES. ASK THEM TO EXPLAIN ADVANTAGE & DISADVANTAGE OF EACH DESIGN.**

6. SLIDE 6 EXPLAIN **Synchronizer** Operation
7. SLIDE 7 EXPLAIN FIGURE 6–7 Typical synchronizer assembly.
8. SLIDE 8 EXPLAIN FIGURE 6–10 The shape of the splines helps prevent the transmission transaxle from jumping out of gear during acceleration and deceleration.
9. SLIDE 9 EXPLAIN FIGURE 6–11 Exploded view of a triple cone synchronizer.

**WORN DETENTS CAN CAUSE TRANS LOCK-UP WHEN 2 GEARS SYNCHRONIZE AT SAME TIME**

**DEMONSTRATION: SHOW SYNCHRONIZER ASSEMBLY. SHOW MAJOR COMPONENTS OF SYNCHRONIZER & HOW THEY FIT TOGETHER. SHOW THE PLACEMENT OF SYNCHRONIZER IN A MANUAL TRANSMISSION. SHOW HOW SYNCHRONIZER MOVES BETWEEN CENTERED POSITIONS TO SPEED GEAR.**










**SYNCHRONIZER OPERATION**




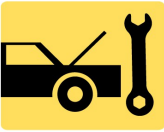

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[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET\\_MYAUTOMOTIVELAB\\_2/ANIMATIONS/A8\\_ANIMATION/CHAPTER95\\_FIG\\_95\\_20/INDEX.HTM](http://media.pearsoncmg.com/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER95_FIG_95_20/INDEX.HTM)

**DISCUSSION: DISCUSS THE EFFECT OF WORN SYNCHRONIZER RINGS IN THE ASSEMBLY.**

10. SLIDES 10-14 EXPLAIN Five-speed Transmission **Torque Flow**
15. SLIDE 15 EXPLAIN FIGURE 6–12 In neutral, the input shaft and the countershaft are rotating if the clutch is engaged (clutch pedal up), but no torque is being transmitted through the transmission.
16. SLIDE 16 EXPLAIN FIGURE 6–13 In first gear, the 1–2 synchronizer sleeve is moved rear-ward, locking the first speed gear to the output shaft.
17. SLIDE 17 EXPLAIN FIGURE 6–18 Torque flows through the transmission in reverse gear.

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	<p><b><u>6 SPEED TRANSMISSION POWER FLOW</u></b></p>
	<p><b><u>DEMONSTRATION:</u> SHOW HOW POWER FLOWS THROUGH A TRANSMISSION. SHOW HOW NEUTRAL IS ACHIEVED WITH CENTERING OF ALL SYNCHRONIZERS.</b></p>
	<p><b><u>DEMONSTRATION:</u> SHOW HOW REVERSE IS ACHIEVED WITH THE CENTERING OF ALL SYNCHRONIZERS.</b></p>
 <p>QUESTION</p>	<p><b><u>DISCUSSION:</u> DISCUSS WHAT THE EFFECT WOULD BE ON SHIFT QUALITY AS THE GEARS AND SYNCHRONIZERS BEGIN TO WEAR.</b></p>
	<p>18. SLIDE 18 EXPLAIN <b>Shifter Operation</b></p> <p>19. SLIDE 19 EXPLAIN FIGURE 6–20 When gearshift lever is moved, internal linkage (shift rails) moves the shift fork and synchronizer sleeve to shift gear speeds</p>
	<p><b><u>DEMONSTRATION:</u> SHOW FLOOR SHIFT ROD-AND-FORK SHIFTING MECHANISM. SHOW THEM HOW MOVING THE SHIFT LEVER MOVES THE FORKS AND HOW DETENTS PREVENT TWO GEARS FROM BEING SHIFTED AT ONE TIME.</b></p>
	<p><b><u>HANDS-ON TASK:</u> HAVE STUDENTS MOVE THE SHIFT LEVER AND WATCH ACTION OF THE FORKS. HAVE THEM OBSERVE USE OF DETENTS TO PREVENT 2 FORKS FROM MOVING AT ONE TIME.</b></p>
	<p>20. SLIDES 20-21 EXPLAIN Construction of Manual Transmission Gears</p>
	<p><b><u>DEMONSTRATION:</u> SHOW COUNTERSHAFT. SHOW HOW GEARS ON SHAFT ARE FIXED AND DECREASE IN SIZE FROM ONE END TO OTHER. DEMONSTRATE THAT GEARS ON COUNTERSHAFT ARE FIXED TO SHAFT AND ALL TURN TOGETHER WHENEVER POWER COMES INTO THE INPUT SHAFT. SHOW THE MAIN SHAFT. SHOW THEM THAT ONLY THE INPUT GEAR IS FIXED TO SHAFT. SHOW THE STUDENTS HOW THE GEARS ON THE MAIN SHAFT DECREASE IN SIZE IN THE OPPOSITE</b></p>

ICONS	Ch06 Man Transmissions Parts & Operation
    	<p><b>DIRECTION FROM THE COUNTERSHAFT.</b></p> <p><b>DISCUSSION: DISCUSS TERMS "GEAR REDUCTION" &amp; "OVERDRIVE." IN EACH COMBINATION, SOMETHING IS GAINED AND SOMETHING IS LOST (EG, GEAR REDUCTION, # OF ROTATIONS IS LOST BUT TORQUE IS INCREASED)</b></p> <ul style="list-style-type: none"> <li>22. SLIDE 22 EXPLAIN FIGURE 6-25 Two gears, (3) and (4), are press fit onto the cluster gear in a TR-3550 transmission.</li> <li>23. SLIDES 23-24 EXPLAIN Transmission Case and Bearings</li> <li>25. SLIDE 25 EXPLAIN FIGURE 6-26 Borg-Warner T5 5-speed transmission shown with shifter cover removed.</li> </ul> <p><b>NATEF TASK DESCRIBE OPERATIONAL CHARACTERISTICS OF ELECTRONICALLY CONTROLLED MANUAL TRANSMISSION/TRANSAXLE</b></p> <ul style="list-style-type: none"> <li>26. SLIDES 26-27 EXPLAIN Summary</li> </ul>