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ABSTRACT
 One of twelve individualized courses included in an automotive repair curriculum, this course covers the theory, diagnoses, and overhaul of manual and automatic transmissions, drivelines, and differentials. The course is comprised of five units: (1) Clutches, (2) Standard Transmissions, (3) Automatic Transmissions, (4) Drive Shafts, and (5) Differentials. Each unit begins with a Unit Learning Experience Guide that gives directions for unit completion. The remainder of the unit consists of Learning Activity Packages (LAP) that provide specific information for completion of a learning activity. Each LAP is comprised of the following parts: objective, evaluation procedure, resources, procedure, supplemental sheets, study guide, and a LAP test with answers. The course is preceded by a pretest which is designed to direct the student to units and performance activities. (LRA)

ED197150

MOUNTAIN PLAINS LEARNING EXPERIENCE GUIDE:

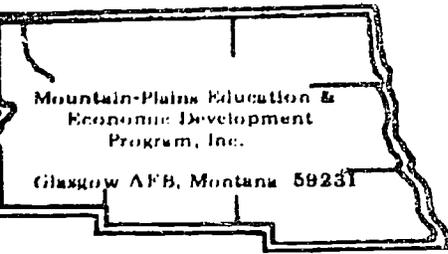
Automotive Repair.

Course: Power Train.

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Learning Experience Guide

COURSE: POWER TRAIN

DESCRIPTION:

"Transmission" covers the theory, diagnoses and overhaul of manual and automatic transmissions, drivelines and differentials.

RATIONALE:

The theory and techniques covered in this course will enable a person to diagnose and repair manual and automatic transmissions, drivelines and differentials.

PREREQUISITES:

Math Skills - level as determined by the specific requirement of the particular job title.
Communication - level as determined by the specific requirement of the particular job title.

OBJECTIVE:

Adjust and replace clutches, troubleshoot and overhaul a standard transmission; inspect and replace universal joints and driveshafts; and diagnose and repair differentials for automobiles.

RESOURCES:

A resource list is attached.

GENERAL INSTRUCTIONS:

This course has five units. Each unit has a Unit Learning Experience Guide (LEG) that gives directions for unit completion. Each unit consists of Learning Activity Packages (LAPs) that provide specific information for completion of a learning activity. Pretesting results direct the student to units and performance activities.

The general procedure for this course is as follows:

- (1) Read the assigned unit LEG for this course.

Principal Author(s): C. Schramm/W. Osland

- (2) Begin and complete the first assigned LAP.
 - a. Take and score the LAP test.
 - b. Turn in the LAP test answer sheets.
 - c. Determine the reason for any missed items on the LAP test.
 - d. Proceed to the next assigned LAP in the unit.
 - e. Complete all required LAPs for the unit by following steps (a) through (d).
- (3) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
- (4) Proceed to the next assigned unit in this course.
- (5) Proceed to the next assigned course.

You will work independently unless directed to do otherwise. When questions or problems arise, you are expected to discuss them with the instructor. At all times remember to follow correct safety procedures during the performance activity.

UNIT TITLES:

- .01 Clutches
- .02 Standard Transmission
- .03 Automatic Transmissions
- .04 Drive Shafts
- .05 Differentials

EVALUATION PROCEDURE:

Course evaluation is by pre and post testing using a multiple-choice type of test.

In this course, the course test is used as a pretest to determine which units, if any, the student may be able to validate. The student is considered validated for a particular unit if 4 out of 5 items are correctly answered for each LAP part on the course pretest and that particular unit does not have a performance test requirement.

For those units with performance test requirements, the student must also satisfactorily complete the performance test to validate that unit. Unit performance test validation procedures are given in the "Evaluation Procedure" section of the unit Learning Experience Guide (LEG).

The course test will also be taken by the student as a post test to determine any changes resulting from taking all or part of the course. Score at least 80% correct on the post test.

FOLLOW-THROUGH:

Go to the first assigned Unit Learning Experience Guide (LEG) listed on your Student Progress Record (SPR).

3. Replacement parts (cont.)

- gaskets
 - overhead set
 - shift cover
- gasket cement
- jack, transmission
- planetary unit
- piston servo bands
- pump
- pump, front
- seal and bushing, rear three-speed
- servo band:
 - two-speed
 - three-speed
- servo pistons
- shims
- synchronizers
- transmission:
 - oil
 - lubricant
- universal joint
- valve body:
 - two-speed
 - three-speed

4. Tools, basic hand:

- chisel and punch set
- 5/32" pin punch
- 3/16" solid
- gauge, feeler (.002" - .025")
- hammer, ball peen
- hammer, plastic tip
- handle, speed
- hex key set
- pliers, diagonal cutting
- pliers, needle nose
- scraper, gasket
- screwdriver, standard (set)
 - screwdriver, Phillips (set)
 - screw starter'
- socket set (3/8" drive)
 - extension (3")
- ratchet
- socket set (1/4" drive)
 - extension (3")
 - handle (6" flex)
 - ratchet
- socket, spark plug
 - extension (6")
- wrench, combination (set)
- wrench, combination ignition (set)

5. Tools, general: C-clamp
cleaning fluid
cleaning solvent
compressed air
creeper
drain pan
drill indicator
fender covers
file
finishing stone
gauges, feeler
grease
holding fixture
jacks or lift
magnifying glass
press
press, hydraulic
puller
seal remover
sealant
slide hammer puller with adapter
snap ring pliers
thickness gauge
trouble lights
wrench, torque
vise
6. Tools, transmissions systems: **bushing driver**
pressure gauge
7. Video-Tape player.

RESOURCE LIST

Printed Materials

1. Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc., 1974.
2. Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc., 1975.
3. Operator's Manuals.
4. Motor's Auto Repair Manual. Motor. The Hearst Corporation, 1972 (or equivalent).
5. National Service Data. Mitchell Manuals. National Service Corporation.

Audio/Visuals

1. Video Tape: Torque Converter. Mountain-Plains Education & Economic Development Company, Inc.

Equipment

1. Automobile needing:
 - throw out bearing replacement
 - pilot bushing
 - drive shaft repair
 - differential repair
 - universal joint
 - axle bearing and seal replacement
2. Automobile with:
 - automatic transmission
 - two-speed
 - three-speed
 - standard transmission
 - clutch
 - high
 - reverse
 - forward
 - one-way
 - differential unit
 - governor
 - two-speed
 - three-speed
 - propeller shaft, two piece with center support
 - rear axle assembly
3. Replacement parts:
 - transmissions
 - carrier and pinion bearing
 - bypass/pressure regulator valve
 - clutch unit
 - converter and stator
 - two-speed
 - three-speed
 - drive line components

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:

File Code:

Name:

Family Pay Number:

37.11.00.00.B1-2

Power Train

Sex M F (Circle 1)

ANSWERS

37.11.01.01	1. C _____	37.11.01.05	21. C _____	37.11.02.01	41. C _____
	2. C _____		22. D _____		42. B _____
	3. B _____		23. C _____		43. A _____
	4. A _____		24. A _____		44. A _____
	5. B _____		25. C _____		45. A _____
37.11.01.02	6. B _____	37.11.01.06	26. D _____	37.11.02.02	46. A _____
	7. C _____		27. A _____		47. C _____
	8. A _____		28. D _____		48. B _____
	9. A _____		29. A _____		49. B _____
	10. A _____		30. B _____		50. A _____
37.11.01.03	11. A _____	37.11.01.07	31. C _____	37.11.02.03	51. B _____
	12. A _____		32. D _____		52. D _____
	13. D _____		33. A _____		53. B _____
	14. A _____		34. B _____		54. C _____
	15. A _____		35. A _____		55. A _____
37.11.01.04	16. D _____	37.11.01.08	36. B _____	37.11.02.04	56. A _____
	17. D _____		37. A _____		57. A _____
	18. D _____		38. C _____		58. C _____
	19. C _____		39. C _____		59. B _____
	20. C _____		40. B _____		60. B _____

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:

File Code:

Name:

37.11.00.00.B1-2Power TrainANSWERS

37.11.02.05	61. A _____	37.11.02.09	81. C _____	37.11.03.02	101. A _____
	62. B _____		82. D _____		102. A _____
	63. C _____		83. C _____		103. C _____
	64. D _____		84. C _____		104. B _____
	65. A _____		85. A _____		105. D _____
37.11.02.06	66. D _____	37.11.02.10	86. D _____	37.11.03.03	106. D _____
	67. D _____		87. D _____		107. A _____
	68. A _____		88. C _____		108. C _____
	69. B _____		89. B _____		109. B _____
	70. D _____		90. D _____		110. A _____
37.11.02.07	71. C _____	37.11.02.11	91. A _____	37.11.03.04	111. B _____
	72. D _____		92. D _____		112. C _____
	73. D _____		93. D _____		113. B _____
	74. B _____		94. A _____		114. B _____
	75. A _____		95. D _____		115. D _____
37.11.02.08	76. D _____	37.11.03.01	96. D _____	37.11.03.05	116. C _____
	77. D _____		97. D _____		117. D _____
	78. A _____		98. D _____		118. A _____
	79. D _____		99. B _____		119. A _____
	80. A _____		100. C _____		120. A _____

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:

File Code:

Name:

37.11.00.00.B1-2Power TrainANSWERS

7.11.03.06	121. B _____	37.11.04.03	141. C _____	37.11.05.04	161. D _____
	122. A _____		142. B _____		162. C _____
	123. A _____		143. D _____		163. A _____
	124. A _____		144. A _____		164. D _____
	125. A _____	37.11.04.04	145. A _____		165. A _____
7.11.03.07	126. A _____	37.11.05.01	146. C _____	37.11.05.05	166. B _____
	127. B _____		147. D _____		167. B _____
	128. D _____		148. B _____		168. D _____
	129. B _____		149. C _____		169. C _____
	130. D _____		150. C _____		170. A _____
7.11.04.01	131. D _____	37.11.05.02	151. D _____	37.11.05.06	171. B _____
	132. B _____		152. A _____		172. C _____
	133. C _____		153. A _____		173. B _____
	134. D _____		154. B _____		174. B _____
	135. A _____		155. C _____		175. A _____
7.11.04.02	136. B _____	37.11.05.03	156. D _____	37.11.05.07	176. B _____
	137. A _____		157. D _____		177. D _____
	138. B _____		158. D _____		178. C _____
	139. C _____		159. A _____		179. C _____
	140. B _____		160. B _____		180. A _____

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:
 File Code:
 Name:

37.11.00.00.B1-2
 Power Train

ANSWERS

.11.05.08	181. B _____	201. _____	221. _____
	182. B _____	202. _____	222. _____
	183. A _____	203. _____	223. _____
	184. C _____	204. _____	224. _____
	185. D _____	205. _____	225. _____
	186. _____	206. _____	226. _____
	187. _____	207. _____	227. _____
	188. _____	208. _____	228. _____
	189. _____	209. _____	229. _____
	190. _____	210. _____	230. _____
	191. _____	211. _____	231. _____
	192. _____	212. _____	232. _____
	193. _____	213. _____	233. _____
	194. _____	214. _____	234. _____
	195. _____	215. _____	235. _____
	196. _____	216. _____	236. _____
	197. _____	217. _____	237. _____
	198. _____	218. _____	238. _____
	199. _____	219. _____	239. _____
	200. _____	220. _____	240. _____

37.11.01.02 (continued)

7. You need to remove what first before you can remove the throw-out bearing?
- transmission.
 - pressure plate.
 - clutch plate.
 - throw-out fork.
8. It is a good safety practice to do what before you start working on a throw-out bearing?
- disconnect battery.
 - drain transmission.
 - have the correct tools available.
 - be sure car is in gear.
9. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:
- inspection pan.
 - transmission.
 - clutch cover.
 - pressure plate.
10. When you have insufficient pedal-free travel, you can fix it by:
- grinding the disc.
 - aligning pilot bearing.
 - adjusting linkage.
 - replacing disc.

37.11.01.03

11. What kind of lubricant do you use on the throw-out bearing shaft?
- high temperature grease.
 - graphite.
 - none.
 - light oil.
12. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:
- inspection pan.
 - transmission.
 - clutch cover.
 - pressure plate.
13. Name one type of throw-out bearing.
- graphite.
 - hydraulic.
 - aluminum.
 - bronze.

37.11.01.03 (continued)

14.

- a.
- b.
- c.
- d.

15. A new throw-out bearing is generally installed every:

- a. time you overhaul your clutch.
- b. 25,000 miles.
- c. year, or after 30,000 miles.
- d. six months.

37.11.01.04

16. How many different types of pilot shaft bearings are there?

- a. 2
- b. 1
- c. 3
- c. 4

17. A defective pilot shaft bearing will make noise:

- a. whtn the clutch is disengaged fully.
- b. all the time.
- c. when the clutch is disengaged half way.
- d. when the clutch is fully engaged.

18. The pilot bushing is located:

- a. in the clutch disc.
- b. in the pressure plate.
- c. in the crankshaft.
- d. in the cluster gear.

19. What is used to take off a pilot bushing?

- a. your giners.
- b. a small hammer.
- c.a a pry bar.
- d. a threaded puller.

20. What part fits into the pilot bushing?

- a. clutch disc.
- .b. throw-out sleeve.
- c. input shaft.
- d. throw-out bearing.

37.11.01.05

21. Excessive pedal-free travel can cause:
- throw-out fork wear.
 - clutch slipping.
 - hard shifting.
 - fast throw-out bearing wear.
22. Average free-pedal travel is about:
- 1
 - 3
 - 4
 - 1/8
23. Pedal-free travel is adjusted by:
- aligning the clutch housing.
 - bending the pedal stop.
 - adjusting the clutch linkage.
 - placing shims under the clutch cover.
24. Insufficient pedal-free travel can cause:*
- excessive throw-out bearing wear.
 - hard shifting.
 - clutch slipping.
 - rapid clutch disc wear.
25. Before removing the clutch cover fasteners, always:*
- block the flywheel.
 - check for disc warpage.
 - wipe them off.
 - prick punch the cover and flywheel.

37.11.01.06

26. When removing the clutch, you should first disconnect the:
- transmission.
 - flywheel.
 - distributor.
 - battery.
27. Before removing the transmission when replacing a clutch, it is advisable to:**
- drain transmission.
 - block flywheel.
 - jack up the engine.
 - loosen clutch housing bolts.

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1969, page 24-16, #s 3, 15, 22).

ERIC*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, page 231, Figure 12-27).

37.11.01.06 (continued)

28. In replacing a clutch, which one of the following is taken off first?
- universal joints.
 - drive shaft.
 - transmission.
 - flywheel.
29. You disconnect the drive shaft by:
- taking the flywheel off.
 - taking off the transmission.
 - disconnecting linkage.
 - taking off a universal joint.
30. In replacing a clutch, which of the following is removed secondly?
- universal joints.
 - drive shaft.
 - transmission.
 - flywheel.

37.11.01.07

31. On a hydraulic linkage you should first check what, if your free travel is not correct?
- lever-struts.
 - throw-out lever.
 - cylinder fluid level.
 - pressure plate.
32. When adjusting linkage, you check for:
- free play.
 - clutch vibration.
 - clutch temperature.
 - pressure plate freeness.
33. Name one type of procedure used to activate the throw-out fork:
- torque.
 - pedal.
 - push rod.
 - hydraulic.
34. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:
- 1/4 inch.
 - 1/2 inch.
 - 1 inch.
 - 2 inches.

37.11.01.07 (continued)

35. Free travel on a pedal is set by adjusting the:

- a. clutch linkage.
- b. pressure plate.
- c. rod pedal.
- d. clutch pedal.

37.11.01.08

36. In a self-adjusting clutch, there is something different than other linkage clutches. What is it?

- a. It has no pressure palte.
- b. It has twice the pedal-free travel.
- c. It has no pedal-free travel.
- d. It has no throw-out lever.

37. At all times during driving, the throw-out bearing in a self-adjusting clutch is in contact with the:

- a. pressure plate cover.
- b. pressure plate levers.
- c. clutch housing.
- d. flywheel.

38. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

- a. coil springs.
- b. mainspring.
- c. throwout leverl.
- d. diaphragm springs.

39. Clutch break-in is:

- a. wearing the fuzz off a clutch plate.
- b. adjusting the free play.
- c. adjusting linkage.
- d. aligning and realigning the pilot bearing.

40. Depressing the lutch pedal will do what to the throw-out bearing in a self-adjusting clutch?

- a. Pulls the throw-out bearing away from the clutch levers.
- b. Pushes the throw-out bearing toward's the clutch levers.
- c. Applies pressure to the pressure plate.
- d. Engages the driver plate with the pressure plate.

37.11.02.01

41. Low gear in a three speed transmission has an approximate gear ratio of:
- 3 to 1
 - 1 to 1
 - 2 to 1
 - 4 to 1
42. What is the gear ratio of a setup where the driving gear has 20 teeth and the driven gear has 50?
- 2.5 to 1
 - 5 to 20
 - 1 to 2.5
 - 4 to 10
43. A torque multiplier is another name for a:
- transmission.
 - crankshaft.
 - supercharger.
 - camshaft.
44. What is the function of an overrunning clutch in a overdrive transmission?
- eliminates the clutch.
 - disengages the overdrive unit.
 - rollers are wedged on the cam to eliminate power.
 - restricts drive to one direction.
45. The type of gear which is the most superior of all the gears is the:
- face gear.
 - spur gear.
 - helical gear.
 - crank gear.

37.11.02.02

46. One type of a transmission housing is made of:
- magnesium.
 - pewter.
 - cast iron.
 - special steel.
47. Transmission gears are:
- formed while cold.
 - formed while red hot.
 - put into casting molds when warm.
 - cut from a piece of cast iron.

37.11.02.02 (continued)

48. Generally in four speed transmission the gears are of what type?
- Spur.
 - Helical.
 - Backlash.
 - Flank.
49. A typical transmission has how many shafts?
- at least 4
 - 3
 - 2
 - 1
50. A transmission is shifted by means of:
- shifter forks.
 - spring loaded steel balls.
 - drive pins.
 - shifter gates.

37.11.02.03

51. What shaft in the transmission drives the overdrive?
- input shaft.
 - reverse adler shaft.
 - output shaft.
 - counter shaft.
52. The internal gear on an overdrive meshes with the:
- cluster gear.
 - low gear.
 - back gear.
 - planetary pinions.
53. An overdrive is attached to:
- the rear of the transmission.
 - the clutch plates.
 - the sun gear.
 - the front of the transmission.
54. An overdrive will give speed reduction for the engine of about what percent?
- 75%
 - 30%
 - 50%
 - 60%

37.11.02.03 (continued)

55. In an overdrive there is something that will cause free wheeling. That is the:
- internal gear.
 - low gear.
 - roller clutch.
 - cluster gear.

37.11.02.04

56. Before working on a transmission, it is advisable to do what?
- Clean transmission thoroughly.
 - Use a black light.
 - Test drive.
 - Read manual on assembly procedure.
57. To adjust excessive clutch pedal-free travel, you would:
- adjust pedal linkage.
 - adjust shift linkage.
 - use a stronger return spring.
 - adjust clutch.
58. When transmission shifts hard in all gears, it could be:
- wrong transmission lubricant.
 - defective input shaft bearing.
 - counter gear antilash plate worn or damaged.
 - worn or damaged input shaft bearing.
59. When a transmission is noisy in high gear, it could be because of:
- shift linkage defective.
 - sticking shift rails.
 - defective output shaft bearing.
 - counter gear rear bearings worn or damaged.
60. When you have a problem such as overdrive that won't engage, it would be because:
- the relay fust is blown.
 - the roller clutch cam is worn.
 - the kick-down switch is grounded.
 - there is insufficient back ring tension.

37.11.02.05

61. Before you can remove the transmission, you first must remove the:
- pressure plate.
 - throw-out bearing.
 - drive shaft.
 - input shaft.

37.11.02.05 (continued)

62. What part(s) must be marked before removal?
- pressure plate.
 - transmission bolts.
 - throw-out bearing.
 - u-joints.
63. Before removal of a transmission, what should you do for a safety measure?
- Disconnect battery.
 - Remove clutch assembly.
 - Remove drive shaft.
 - Drain gas tank.
64. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:
- pressure plate.
 - u-joint yoke.
 - input shaft.
 - throw-out bearing.
65. On some removals of transmissions it may be necessary to do what to the engine?
- set timing on the engine.
 - loosen motor mounts.
 - start engine.
 - take engine out of car.

37.11.02.06

66. To remove the output or input shaft you must first remove the:
- pressure plate.
 - counter gear.
 - housing.
 - low gear.
67. If a hammer needs to be used, what type should you use?
- a soft face hammer.
 - none at all.
 - not more than 3 lb. hammer.
 - a small ballpeen hammer.
68. Where do you place a transmission when overhauling it?
- on a clean floor.
 - in a clean parts tub.
 - on a bench.
 - on a swivel stand.

37.11.02.06 (continued)

69. When removing the synchronizer, it is important to keep what on each side of it to insure proper assembly?
- counter shaft.
 - shifting forks.
 - reverse idler gear.
 - blocking rings.
70. What should you have on hand when dismantling a transmission?
- a steam cleaner.
 - a person who is an expert on transmissions.
 - an assortment of parts.
 - a service manual.

37.11.02.07

71. It is possible to secure any degree of torque multiplication by:
- a heavier clutch.
 - a larger engine.
 - a larger torque amplifier.
 - a set of various gears.
72. A rear seal can be removed:
- by heat, by expanding it.
 - with a slide hammer.
 - by shrinking it by using dry ice.
 - by pressing it off.
73. When putting a front seal on a transmission, you have it facing:
- with lip facing the right of the housing.
 - with lip out.
 - with lip in.
 - with lip facing the left of the housing.
74. To remove a rear oil seal, you can do so by:
- removing the throw-out bearing.
 - taking the transmission out.
 - removing the pressure plate.
 - removing the drive shaft.
75. When overhauling a direct clutch and piston assembly, what do you do with the old seal?
- discard them.
 - clean in gasoline.
 - clean in carburetor cleaner.
 - clean with clean rag.

37.11.02.08

76. If a gear has a blocking ring surface, it must be:
- smooth.
 - rounded.
 - uneven.
 - rippled.
77. All snap ring grooves must have what kind of shoulders?
- square shoulders.
 - stepped shoulders.
 - bevelled shoulders.
 - rounded shoulders.
78. The output shaft bearing surfaces should be smooth with:
- no evidence of galling.
 - galling formations evident.
 - excessive racking when gear is on.
 - excessive play where gears are on.
79. The cluster gear is removed by removing the:
- anti-lash plate.
 - reverse idler shaft.
 - output shaft assembly.
 - counter shaft.
80. One method used to secure a counter shaft is to:
- use a roll pin.
 - use a bolt and nut.
 - use a set screw.
 - use an allen screw.

37.11.02.09

81. What fits over the inserts on a synchronizer hub?
- third-speed gear.
 - blocking ring.
 - insert springs.
 - sleeve.
82. When assembling a synchronizer, you should lubricate with:
- light 10 weight oil.
 - graphite.
 - transmission lube.
 - light weight grease.

87.11.02.09 (continued)

83. The hub has slats in it where what goes?
- blocking ring.
 - sleeve.
 - inserts.
 - snap ring.
84. On the hub you should check for wear on the inner:
- course grooves.
 - fine grooves.
 - splines.
 - cone surface.
85. How many inserts does a synchronizer hub have?
- 1
 - 2
 - 3
 - 4

37.11.02.10

86. When pins pass through outer wall of the case, what should you do to prevent them from slipping out?
- lead hole in.
 - glue pin to hole.
 - lubricate them.
 - stake them.
87. When the countershaft is in place, you should check end play with a:
- depth gauge.
 - oscilloscope.
 - micrometer.
 - feeler gauge.
88. When the countershaft is in place, you should check end play with a:
- -
 -
 -
89. New thrust washers, when assembling a transmission, will provide:
- tight fit with no end play.
 - proper end play.
 - and act as an oil seal.
 - a backing mechanism for the shaft.

37.11.02.10 (continued)

90. When installing a new part in a transmission, it is important to try it in the transmission to be sure it:
- has excessive clearance for heat expansion.
 - has excessive play.
 - fits properly.
 - wobbles on the shaft.

37.11.02.11

91. To hold a typical four-speed linkage in neutral while adjusting the linkage, you would use a(n):
- pinion carrier.
 - retaining pin.
 - dust boot.
 - alignment pin.
92. If the linkage on a shift column has slotted adjustment holes, you:
- just loosen adjustment nuts and leave shift rods connected.
 - take linkage completely off.
 - tighten adjusting nuts fully.
 - put shift levers in reverse.
93. To install the shift cover, you must place the transmission in:
- low.
 - high.
 - reverse.
 - neutral.
94. When installing a shift fork cover, the shift forks must align with the:
- countershaft.
 - pressure plate.
 - pilot bearing.
 - gear fork grooves.
95. When adjusting the linkage on a car, the transmission is:
- in neutral.
 - out of the car.
 - just overhauled.
 - in high gear.

37.11.03.01

96. What unit in an automatic transmission eliminates the conventional clutch and pedal as used in the standard transmission?
- torque converter.
 - stator.
 - fluid coupling.
 - governor valve.

37.11.03.01 (continued)

97. The converter vanes are shaped in what way?

- a. corrugated.
- b. straight.
- c. square.
- d. curved.

98. What is the principal difference between a fluid coupling and a torque converter?*

- a. the torque converter can't transmit engine torque but can multiply it.
- b. the fluid coupling can't transmit engine torque but can multiply it.
- c. the torque converter transmits engine torque but can't multiply it.
- d. the fluid coupling transmits all engine torque but can't multiply it.

99. A torus is:

- a. another name for a stator.
- b. half of a fluid coupling.
- c. another name for a torque converter.
- d. a complete fluid coupling.

100. The vanes in a fluid coupling are shaped how?

- a. boxed.
- b. straight.
- c. curved.
- d. corrugated.

37.11.03.02

101. For large torque increase what do the planetary pinions rotate around?

- a. the torque converter.
- b. the sun gear.
- c. the stator.
- d. the internal gear.

102. The planetary pinions rotate around the:

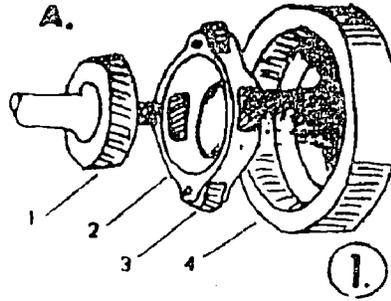
- a. stator.
- b. torque converter.
- c. sun gear.
- d. internal gear.

* (From Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1993, page 230-231).

37.11.03.02 (continued)

103. In diagram A, what is #2:

- a. stator.
- b. sun gear.
- c. planetary pinions.
- d. internal gear.

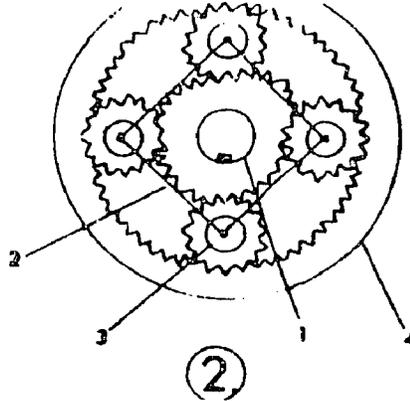


104. In diagram A, what is #4:

- a. planetary pinions.
- b. sun gears.
- c. planetary carrier.
- d. internal gear.

105. In diagram A*, what is #1:

- a. internal gear.
- b. planetary pinions.
- c. sun gear.
- d. stator.

37.11.03.03

106. What valve has to open just before the shifter valve does?

- a. governor valve.
- b. torus feed valve.
- c. manual valve.
- d. relief valve.

107. A servo operates a:

- a. torque converter.
- b. universal joint.
- c. brake bank.
- d. fluid coupling.

108. One type of oil pump used in an automatic transmission is the:

- a. cooler type.
- b. disc pump type.
- c. stator type.
- d. variable output type.

109. An apply piston is a servo is used to:

- a. apply heavy pressure.
- b. apply light pressure.
- c. disengage the actuating lever.
- d. release pressure.

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, page 231, Figure 12-27).

37.11.03.03 (continued)

110. In some servos you may have an accumulator piston used to:

- a. apply heavy pressure.
- b. apply light pressure.
- c. release pressure.
- d. disengage the actuating lever.

37.11.03.04

111. What type of modulator has a collapsing bellows in it?

- a. engine vacuum.
- b. altitude pressure type.
- c. boost valve type.
- d. check valve type.

112. A modulator consists of a container separated into two areas by a:

- a. seal.
- b. plate.
- c. valve.
- d. diaphragm.

113. A modulator uses what to operate?

- a. engine oil pressure.
- b. engine heat.
- c. engine vacuum.
- d. check valve.

114. One type of modulator works on the:

- a. camshaft.
- b. altitude air pressure.
- c. check valve.
- d. engine heat.

115. The modulator provides accurate control over the :

- a. release valve.
- b. throttle valve.
- c. compensator valve.
- d. pressure booster valve.

37.11.03.05

116. For normal duty transmissions, how many miles can you go before it is recommended to change oil?

- a. 24,000 miles.
- b. 10,000 miles.
- c. 50,000 miles.
- d. 12,000 miles.

37.11.03.05 (continued)

117. Transmission fluid installed at the factory is generally:*

- a. a green color.
- b. a blue color.
- c. clear color.
- d. a red color.

118. Automatic transmissions require special fluid. It is identified by:

- a. BD-A
- b. AQ-TAF
- c. AQ-ATF
- d. AQ-A

119. You check transmission fluid level when the fluid is at:

- a. normal operating temperature.
- b. it doesn't matter what temperature.
- c. hot operating temperature.
- d. cold operating temperature.

120. To determine what type of leak you have under your car you can use a:

- a. flour spray.
- b. flourescent light.
- c. light coat of dust on pan.
- d. black light.

37.11.03.06

121. To check the adjustment of the downshift switch you use a:

- a. socket.
- b. gauge rod and test light.
- c. double square socket.
- d. torque wrench.

122. What do you use to adjust the tightening hand adjusting screw on an automatic transmission?

- a. a preset torque wrench.
- b. a hex bit.
- c. .250 in gauge block.
- d. throttle lever gauge.

*(From Auto Service and Repair, Stockel, Goodheart-Wilcox, 1969, pages 26-24, #12).

37.11.03.06 (continued)

123. A vacuum controlled primary throttle valve can be checked by:

- a. applying a controlled vacuum unit to system.
- b. applying a vacuum gauge to the system.
- c. using a front servo gauge.
- d. using a rear servo gauge.

124. To adjust a TV lever you must use what tool?

- a. throttle lever bending tool.
- b. rear servo gauge.
- c. sliding t-bar.
- d. sockets.

125. The engine mounts can effect what on the transmission?

- a. shift linkage.
- b. fluid coupling.
- c. oil pump.
- d. stator.

37.11.03.07

126. If the propeller shaft and transmission are not in sound condition, you would tow by:

- a. disconnecting the drive shaft.
- b. raising rear wheels.
- c. putting transmission in neutral.
- d. towing at a speed less than 25 mph.

127. The best way to start a car with an automatic transmission is by:

- a. continually shifting transmission from reverse to low.
- b. towing it forwards.
- c. pushing it backward.
- d. pushing it forward.

128. You should not tow a car with an automatic transmission when:

- a. you can't raise the rear wheels.
- b. you can't remove the drive shaft.
- c. you can't put the transmission in drive.
- d. there is no transmission fluid.

129. For some cars with automatic transmissions, the maximum distance that they can be towed is:

- a. 25 miles.
- b. 0 miles.
- c. 10 miles.
- d. 50 miles.

37.11.03.07 (continued)

130. Cars with torsion-level suspension system cannot be towed until:

- the car is in neutral.
- the linkage is disconnected.
- the drive shaft is disconnected.
- the levelizer control switch is off.

37.11.04.01

131. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary flexing of the drive line?

- ball bearings.
- yoke.
- propeller shaft.
- transmission.

132. Wing type rollers are secured with:

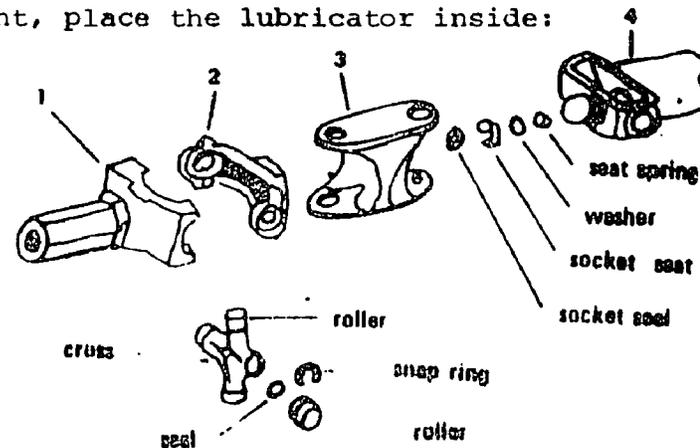
- snap ring.
- cap screws.
- center punching.
- u-bolts or clamps.

133. When lubricating a ball and trunnion joint, place the lubricator inside:

- no lubrication is needed.
- the dust boot.
- locating tang.
- the body raceway.

134. In the diagram*, what is #4?

- centering socket yoke.
- center yoke.
- socket support yoke.
- slip yoke.



135. To seat the roller against the snap rings, you strike the:

- seal.
- bearing.
- retainer.
- yoke.

* (Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, pages 258 and 259, #s 2 and 4).

37.11.04.02

136. To check clearances on the propeller shaft, you use a(n):
- feeler gauge.
 - dial indicator.
 - micrometer.
 - oscilloscope.
137. Angularity of the drive shaft can be checked by the use of a(n):
- feeler gauge.
 - micrometer.
 - protractor.
 - oscilloscope.
138. To correct wrong angularity of a shaft, you would:
- tighten transmission down tighter.
 - use shims.
 - tighten universal and yoke.
 - realign the differential drive pinion.
139. To prevent vibration, when drive shafts are made they should be:
- lubricated.
 - balanced.
 - undercoated.
 - painting.
140. To maintain correct alignment of the gears, the bearings in a differential are made of:
- aluminum-coated bearings.
 - hardened antifriction bearings.
 - spring steel.
 - bronze-covered bearings.

37.11.04.03

141. The recommended lubrication of rollers is:
- sae 90 weight grease.
 - petroleum jelly.
 - light grease.
 - sae 140 weight grease.
142. If the center yoke is higher than the front and rear shafts, you can correct by using:
- different rollers.
 - shims.
 - different differentials.
 - a different bearing support bracket assembly.

37.11.04.03 (continued)

143. When the propeller shaft is removed, you should do what with the rollers?
- tape them on shaft.
 - lubricate them.
 - replace whenever the propeller shaft is removed.
 - wash them and place on clean rag.
144. The front shaft slip yoke engages the:
- differential pinion gear.
 - rear end.
 - output shaft.
 - input shaft.
145. You can remove a roller with a vise and a:
- ratchet.
 - socket.
 - punch.
 - pair of pliers.

37.11.05.01

146. The ring gear is in direct contact with:
- a pinion gear.
 - the transmission.
 - special head gear.
 - the propeller shaft.
147. How many units can a rear axle assembly be broken into?
- four
 - two
 - three
 - five
148. The outer ends of the axles run in:
- rubber seals.
 - bronze bushings.
 - roller or ball bearings.
 - brass bushings.
149. How many different types of axles are there?
- five.
 - two.
 - three.
 - four.

37.11.05.01 (continued)

150. One type of housing that is used to house a differential is:

- a. the strut.
- b. the split.
- c. the forked.
- d. the spline.

37.11.05.02

151. The thrust member is spliced to the:

- a. pinion shaft.
- b. axle.
- c. side gears.
- d. differential case.

152. How many pinion shafts does a Chrysler sure-grip differential have?

- a. three
- b. one
- c. four
- d. two

153. How many clutch discs are spliced to the differential case?

- a. tow
- b. four
- c. six.
- d. three

154. How many clutch discs are spliced to the thrust member?

- a. two
- b. four
- c. six
- d. three

155. On a sure-grip differential what is forced to rotate with the differential case?

- a. transmission.
- b. rear end.
- c. drive sprocket.
- d. pinion shafts.

37.11.05.03

156. You would check for backlash with a:

- a. dial indicator.
- b. feeler gauge.
- c. micrometer.
- d. hydrometer.

37.11.05.03 (continued)

157. Excessive backlash should be corrected by:
- adjusting the pinion shafts adjusting nut.
 - installing shim.
 - adjusting the side-gear yoke.
 - replacing defective parts.
158. When casing is completely stripped down and just before reassembly, you should:
- put linshaft back on the precise way you removed it.
 - fill housing with lubrication.
 - replace all oil seals.
 - flush housing thoroughly.
159. To prevent damage to the oil seal when reinstalling, you:
- place a plug in axle hole.
 - coat axle shaft with lubricant for 6".
 - apply light heat to soften seal for installation.
 - install a new seal.
160. Before removing the axle, you should measure:
- the rear ratio.
 - the outside diameter of the axle.
 - the power train assembly angle.
 - end play.

37.11.05.04

161. To remove the bearing retainer, you use:
- a pliers.
 - a punch.
 - a puller.
 - a chisel.
162. When you remove a bearing, you do so by:
- pressing it out.
 - rapping it out.
 - applying heat to case so you can slip bearing out.
 - prying it out.
163. What else besides the bearing retainer has to be removed from the bearing before its removed?
- oil seal.
 - pinion gear.
 - inner bearings outer cup.
 - pinion retainer.

37.11.05.04

164. The narrow ring of a bearing goes in, in what direction?

- a. toward the end of the axle shaft.
- b. it doesn't matter what way it goes in.
- c. toward the housing.
- d. toward the pinion gear.

165. To remove the axles, you should use a:

- a. press jack.
- b. spreader.
- c. pry bar.
- d. slide hammer type puller.

37.11.05.05

166. Before removing the differential case side bearing caps, make certain each cap and adjusting nut is:

- a. measured.
- b. marked.
- c. loosened.
- d. tightened.

167. When attaching the ring gear to the case flange, use:

- a. double-headed nuts.
- b. special fasteners for the purpose.
- c. fasteners with split back washers.
- d. any fasteners of the right size.

168. After you have the car jacked up and secured, you remove the:

- a. drive shaft.
- b. differential case.
- c. pinion drive gear.
- d. pinion shaft.

169. If the differential case is of the shim adjusted preload type, you remove it with:

- a. two pry bars.
- b. an easyout.
- c. a spreader.
- d. pliers.

170. After draining the housing, you remove:

- a. one axle shaft.
- b. the pinion bearing.
- c. both axle shafts.
- d. the axle housing.

37.11.05.06

171. Ring and pinion tooth contact pattern is checked by:

- a. a dial indicator.
- b. coating ring gear with red lead and oil mixture.
- c. a feeler gauge.
- d. applying grease to the pinion gear and rotating gear in a full circle.

172. The toe part of a ring gear is that part which:

- a. is centralized between the top and bottom of gear heel, is closer to the top
- b. faces the inside of the gear.
- c. faces the outside of the gear.
- d. centralized between the top and the bottom of the gear.

173. What advantage does the spiral bevel gear have over the spur bevel?

- a. less tooth contact.
- b. the teeth are straight.
- c. it's quieter.
- d. center the tongue load on one tooth.

174. Why is a hypoid used?

- a. to facilitate in a non-slip rear end.
- b. to facilitate lowering the body of the car.
- c. to save on wear of the clutch plates.
- d. to facilitate raising the body of the car.

175. What is a hypoid gear setup as used in the differential?

- a. pinion gear engages ring gear above axle center line.
- b. pinion gear engages ring gear below the center line.
- c. a no-slip rear end.
- d. can clutch is synchronism with the side gear.

37.11.05.07

176. To dry bearings, you:

- a. apply heat.
- b. let evaporate.
- c. use compressed air.
- d. use a clean rag.

177. What contains the carrier and pinion bearings?

- a. the bell housing.
- b. the clutch plates.
- c. the transmission.
- d. the differential carrier.

37.11.05.07 (continued)

178. To clean bearings, you wash them in:

- a. diesel fuel.
- b. gasoline.
- c. hot soapy water.
- d. cleaning solvent.

179. You install a side bearing by:

- a. driving it into position.
- b. lubricating and slipping into position.
- c. heating and slipping it into position.
- d. cooling and slipping it into position.

180. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

- a. a hollow punch.
- b. a long punch.
- c. a puller.
- d. a needle vise pliers.

37.11.05.08

181. You check backlash in how many different spots around the gear?

- a. four
- b. three
- c. two
- d. one

182. Backlash must not vary more than:

- a. .101
- b. .005
- c. .002
- d. .020

183. You measure backlash with a:

- a. micrometer.
- b. dial indicator.
- c. feeler gauge.
- d. hydrometer.

37.11.05.08 (continued)

184. For each .001 change in backlash desired you transfer how many shims?

- a. .003
- b. .001
- c. .005
- d. .002

185. Why do you rotate a differential case a few times?

- a. to seal pinion gears.
- b. to seal bearings.
- c. to seal side gear.
- d. to adjust prelead.

UNIT TEST ANSWER SHEET

Occupational Area:
File Code:
Name:
Family Pay Number:

Automotive
37.11

Sex: M F (Circle 1)

ANSWERS

- 0101 1. B
2. A
3. B
4. C
5. C
0102 6. C
7. A
8. A
9. A
10. C
0103 11. A
12. A
13. A
14.
15. A
0104 16. D
17. D
18. C
19. D
20. C

- 0105 21. C
22. A
23. C
24. C
25. D
0106 26. D
27. A
28. A
29. D
30. B
0107 31. C
32. A
33. D
34. C
35. A
0108 36. C
37. B
38. C
39. A
40. B

- 0201 41. A
42. A
43. A
44. B
45. C
0202 46. C
47. B
48. B
49. A
50. A
0203 51. C
52. D
53. A
54. B
55. C
0204 56. C
57. A
58. A
59. C
60. A

UNIT TEST ANSWER SHEET

Occupational Area:
File Code:
Name:

Automotive

37.11

ANSWERS

0205	61.	<u>C</u>	0209	81.	<u>D</u>	0302	101.	<u>D</u>
	62.	<u>D</u>		82.	<u>C</u>		102.	<u>C</u>
	63.	<u>A</u>		83.	<u>C</u>		103.	<u>C</u>
	64.	<u>B</u>		84.	<u>C</u>		104.	<u>D</u>
	65.	<u>B</u>		85.	<u>C</u>		105.	<u>C</u>
0206	66.	<u>B</u>	0210	86.	<u>D</u>	0303	106.	<u>A</u>
	67.	<u>A</u>		87.	<u>D</u>		107.	<u>C</u>
	68.	<u>D</u>		88.	<u>D</u>		108.	<u>D</u>
	69.	<u>D</u>		89.	<u>B</u>		109.	<u>A</u>
	70.	<u>D</u>		90.	<u>C</u>		110.	<u>B</u>
0207	71.	<u>D</u>	0211	91.	<u>D</u>	0304	111.	<u>B</u>
	72.	<u>B</u>		92.	<u>A</u>		112.	<u>D</u>
	73.	<u>C</u>		93.	<u>D</u>		113.	<u>C</u>
	74.	<u>D</u>		94.	<u>D</u>		114.	<u>B</u>
	75.	<u>A</u>		95.	<u>A</u>		115.	<u>B</u>
0208	76.	<u>A</u>	0301	96.	<u>C</u>	0305	116.	<u>A</u>
	77.	<u>A</u>		97.	<u>D</u>		117.	<u>D</u>
	78.	<u>A</u>		98.	<u>D</u>		118.	<u>C</u>
	79.	<u>D</u>		99.	<u>B</u>		119.	<u>A</u>
	80.	<u>A</u>		100.	<u>B</u>		120.	<u>D</u>

COURSE TEST ANSWER SHEET

Occupational Area:
File Code:
Name:
Family Pay Number:

Automotive
37.11

Sex: M F (Circle 1)

ANSWERS

0306	121.	<u>B</u>	0403	141.	<u>D</u>	0504	161.	<u>D</u>
	122.	<u>A</u>		142.	<u>B</u>		162.	<u>A</u>
	123.	<u>A</u>		143.	<u>A</u>		163.	<u>A</u>
	124.	<u>A</u>		144.	<u>C</u>		164.	<u>A</u>
	125.	<u>A</u>	0404	145.	<u>B</u>		165.	<u>D</u>
0307	126.	<u>B</u>	0501	146.	<u>A</u>	0505	166.	<u>B</u>
	127.	<u>D</u>		147.	<u>C</u>		167.	<u>B</u>
	128.	<u>D</u>		148.	<u>C</u>		168.	<u>A</u>
	129.	<u>B</u>		149.	<u>C</u>		169.	<u>A</u>
	130.	<u>D</u>		150.	<u>B</u>		170.	<u>C</u>
0401	131.	<u>B</u>	0502	151.	<u>B</u>	0506	171.	<u>B</u>
	132.	<u>D</u>		152.	<u>D</u>		172.	<u>B</u>
	133.	<u>D</u>		153.	<u>A</u>		173.	<u>C</u>
	134.	<u>C</u>		154.	<u>A</u>		174.	<u>B</u>
	135.	<u>D</u>		155.	<u>D</u>		175.	<u>B</u>
0402	136.	<u>A</u>	0503	156.	<u>D</u>	0507	176.	<u>C</u>
	137.	<u>C</u>		157.	<u>D</u>		177.	<u>D</u>
	138.	<u>B</u>		158.	<u>D</u>		178.	<u>D</u>
	139.	<u>B</u>		159.	<u>B</u>		179.	<u>A</u>
	140.	<u>B</u>		160.	<u>D</u>	0508	180.	<u>C</u>
							181.	<u>A</u>
							182.	<u>C</u>
							183.	<u>B</u>
							184.	<u>D</u>
							185.	<u>B</u>

Basic hand tools cont.

Screw starter
 Socket Set (3/8" drive)
 extension (3")
 ratchet
 Socket Set (1/4" drive)
 extension (3")
 handle (6" flex)
 ratchet
 Socket, spark plug
 extension (6")
 Wrench, combination (set)
 Wrench, combination ignition (set)

Bushing puller -
 Clutch aligning tool
 Fender covers
 Jack
 Jack stands
 Press
 Replacement parts as needed
 Slide hammer puller with adapter.

GENERAL INSTRUCTIONS:

This unit consists of eight Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

- (1) Read the first assigned Learning Activity Package (LAP).
- (2) Begin and complete the first assigned LAP.
- (3) Take and score the LAP test.
- (4) Turn in the LAP test answer sheet.
- (5) Determine the reason for any missed items on the LAP test.
- (6) Proceed to and complete the next assigned LAP in the unit.
- (7) Complete all required LAPs for the unit by following steps 3 through 6.
- (8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
- (9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
- (10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

- .01 Fundamentals of Clutch
- .02 Troubleshooting Clutches
- .03 Replace Throw-Out Bearing
- .04 Replace Clutch Pilot Bushing
- .05 Pressure Plates
- .06 Clutch Removal and Replace
- .07 Adjusting Clutch Linkage
- .08 Self-Adjusting Clutch

EVALUATION PROCEDURE:

When pretesting:

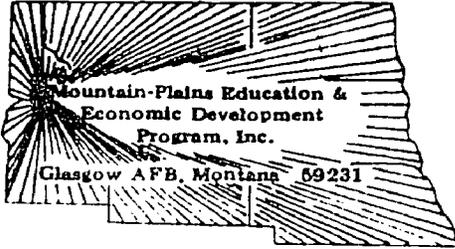
1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).



UNIT PRETEST: CLUTCHES

37.11.01.01.

1. The clutch disc is constructed of:
 - a. a high quality steel.
 - b. pewter.
 - c. bronze.
 - d. cast iron.
2. The hub splines on a clutch are located.
 - a. on the flywheel.
 - b. on the clutch disc.
 - c. on the pilot bushing.
 - d. on the crankshaft.
3. What is used to provide pressure against the pressure plate?
 - a. springs.
 - b. torque from the engine.
 - c. pressure plate.
 - d. splined hub.
4. The pilot bearing of a clutch can either be made of ball bearings or:
 - a. alloyed steel.
 - b. bronze.
 - c. aluminum.
 - d. pewter.
5. The throw-out bearing sleeve is moved in and out by a:
 - a. pressure plate spring.
 - b. flywheel.
 - c. clutch release lever.
 - d. throw-out fork.

37.11.01.02.

6. When you have a warped clutch disc you can fix it by:
 - a. adjusting linkage.
 - b. grinding disc.
 - c. install fork properly.
 - d. replacing disc.

37.11.01.02. cont.

7. When your pilot bearing is worn, you can remedy it by:
 - a. replacing it.
 - b. installing new pressure plate.
 - c. adjusting fingers.
 - d. adjusting linkage.
8. When you have insufficient pedal free travel, you can fix it by:
 - a. replacing disc.
 - b. adjusting linkage.
 - c. grind disc.
 - d. align pilot bearing.
9. When you have broken a weak pressure plate spring, you can fix it by:
 - a. replacing pressure plate.
 - b. adjusting linkage.
 - c. grinding clutch disc.
 - d. clean clutch disc.
- 10.

37.11.01.03.

11. When installing a throw-out bearing just before you put the bearing on the shaft, you should:
 - a. install pressure plate assembly.
 - b. put the drive shaft on the transmission.
 - c. lubricate it.
 - d. align pilot bearing and pressure plate.
12. What kind of lubricant do you use on the throw-out bearing shaft?
 - a. graphite.
 - b. light oil.
 - c. high temperature grease.
 - d. none.
13. A new throw-out bearing is generally installed every:
 - a. time you overhaul your clutch.
 - b. year, or after 30,000 miles.
 - c. six months.
 - d. 25,000 miles.

37.11.01.03. cont.

14. To check a throw-out bearing for wear you:
- there is no inspection for a sealed throw-out bearing.
 - test it with a dial indicator.
 - test it with a feeler gauge.
 - press against flat surface with pressure and revolve bearing.
15. One type of throw-out bearing is:
- hydraulic.
 - bronze.
 - aluminum.
 - graphite.

37.11.01.04.

16. The pilot bushing is located:
- in the crankshaft.
 - in the cluster gear.
 - in the clutch disc.
 - in the pressure plate.
- 17.
18. What part fits into the pilot bushing?
- throw-out bearing.
 - input shaft.
 - clutch disc.
 - throw-out sleeve.
19. A defective pilot shaft bearing will make noise:
- all the time.
 - when the clutch is disengaged half-way.
 - when the clutch is fully engaged.
 - when the clutch is disengaged fully.
20. You would lubricate a pilot bushing with:
- high temperature grease.
 - graphite.
 - heavy oil.
 - light grease.

37.11.01.05.

21.

22. If you have scarring upon a pressure plate, you remove it by:

- a. polishing it.
- b. washing it in solvent.
- c. sanding lightly.
- d. scraping.

*23. Before removing the clutch cover fasteners, always:

- a. block the flywheel.
- b. check for disc warpage.
- c. prick punch the cover and flywheel.
- d. wipe them off.

*24. When installing the pressure plate assembly to the flywheel, always:

- a. tighten each fastener fully before starting on the next one.
- b. install the top bottom first.
- c. use a c-clamp to secure the unit.
- d. align the prick punch marks.

25. Pedal free travel is adjusted by:

- a. aligning the clutch housing.
- b. placing shims under the clutch cover.
- c. bending the pedal stop.
- d. adjusting the clutch linkage.

37.11.01.06.

26.

27. When removing the clutch, you should first disconnect the:

- a. flywheel.
- b. transmission.
- c. distributor.
- d. battery.

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3, 15, 22.)

37.11.01.06. cont.

28.

29. You disconnect the drive shaft by:

- a. taking off the transmission.
- b. taking off a universal joint.
- c. disconnecting linkage.
- d. taking the flywheel off.

30. In replacing a clutch, which one of the following is taken off first?

- a. pressure plate.
- b. universal joints.
- c. transmission.
- d. flywheel.

37.11.01.07.

31. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:

- a. 1 inch.
- b. 2 inches.
- c. 1/4 inch.
- d. 1/2 inch.

32. Free travel on a pedal is set by adjusting the:

- a. clutch pedal.
- b. pressure plate.
- c. pedal.
- d. clutch linkage.

33. On a hydraulic linkage if your free travel is not correct, you should first check the:

- a. throw-out lever.
- b. pressure plate.
- c. cylinder fluid level.
- d. lever-struts.

34.

37.11.01.07. cont.

35. How many different methods, in general, are used to actuate the throw-out fork?
- 2.
 - 3.
 - 4.
 - 5.

37.11.01.08.

36. At all times during driving, the throw-out bearing in a self-adjusting clutch is in contact with the:
- clutch housing.
 - pressure plate cover.
 - flywheel.
 - pressure plate levers.
37. In a self-adjusting clutch, pressure is applied to the throw-out fork by the:
- coil springs.
 - lever struts.
 - heavy mainspring.
 - diaphragm spring.
38. Depressing the clutch pedal in a self-adjusting clutch will cause the throw-out bearing to:
- engage the driven plate with the pressure plate.
 - pull away from the clutch levers.
 - apply pressure to the pressure plate.
 - push towards the clutch levers.
39. Clutch break-in is:
- aligning and realigning the pilot bearing.
 - adjusting linkage.
 - wearing off the fuzz off a clutch plate.
 - adjusting the free play.
40. What applies pressure to an actuator in a self-adjusting clutch?
- pressure plate.
 - coil springs.
 - throw-out lever fork.
 - a heavy mainspring.

UNIT TEST ANSWER SHEET

Occupational Area:

File Code:

37.11.01.00.B1-2

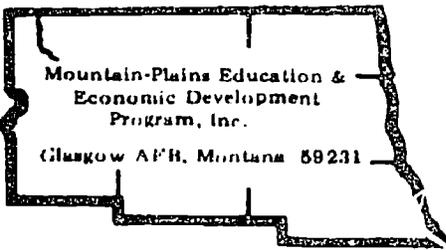
Name:

Family Pay Number:

Sex M F (Circle 1)

ANSWERS

37.11.01.01	1. A	37.11.01.05	21. D	41. _____
	2. B		22. C	42. _____
	3. A		23. C	43. _____
	4. B		24. D	44. _____
	5. D		25. D	45. _____
37.11.01.02	6. D	37.11.01.06	26. D	46. _____
	7. A		27. D	47. _____
	8. B		28. C	48. _____
	9. A		29. B	49. _____
	10. A		30. B	50. _____
37.11.01.03	11. C	37.11.01.07	31. A	51. _____
	12. C		32. D	52. _____
	13. A		33. C	53. _____
	14. D		34. C	54. _____
	15. D		35. A	55. _____
37.11.01.04	16. A	37.11.01.08	36. D	56. _____
	17. B		37. C	57. _____
	18. B		38. B	58. _____
	19. D		39. C	59. _____
	20. A		40. D	60. _____



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Fundamentals of Clutch**OBJECTIVE:**

Recognize the components and proper operation of the automotive clutch.

EVALUATION PROCEDURE:

80% correct on LAP study questions. 80% accuracy on LAP test.

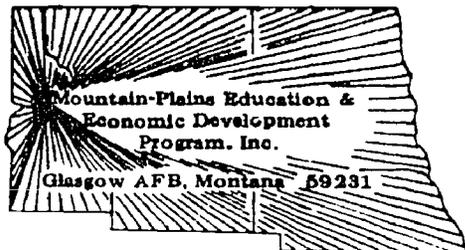
RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Secure a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Read Chapter 9, "Engine Clutches," page 201 to page 209
3. On a separate sheet of paper, answer the questions on page 209.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text to its proper place.
6. Take the LAP post test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland



LAP TEST: FUNDAMENTALS OF CLUTCH

1. The pilot bearing of a clutch can be made either of ball bearings or:
 - a. bronze.
 - b. alloyed steel.
 - c. pewter.
 - d. aluminum.

2. The clutch pressure plate is generally made of:
 - a. cast iron.
 - b. pewter.
 - c. stainless steel.
 - d. aluminum.

3. The throw-out bearing sleeve is moved in and out by a:
 - a. flywheel.
 - b. throw-out fork.
 - c. clutch release fingers.
 - d. pressure plate spring.

4. What is used to provide pressure against the pressure plate?
 - a. torque from the engine.
 - b. splined hub.
 - c. springs.
 - d. pressure plate.

5. Of the following, which is not part of a conventional clutch?
 - a. pressure plate.
 - b. clutch sleeve.
 - c. clutch cover.
 - d. diaphragm spring.

6. The hub spline on a clutch is located:
 - a. on the crankshaft.
 - b. on the clutch disc.
 - c. on the pilot bushing.
 - d. on the flywheel.

7. The clutch housing bolts to the:
 - a. engine.
 - b. pressure plate.
 - c. flywheel.
 - d. crankshaft.

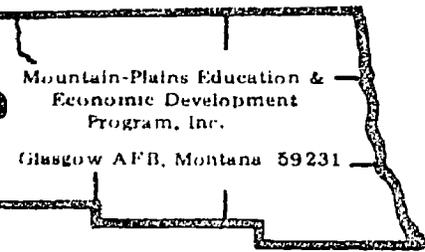
8. When mounting the transmission to the clutch housing, the transmission should be drawn up against the housing with the transmission mounting bolts.
 - a. true
 - b. false

9. The clutch side of a flywheel is:
 - a. constructed of a starting gear ring.
 - b. machined smooth.
 - c. corrugated.
 - d. mounted to the crankshaft.

10. The throw-out bearing is lubricated and should be serviced:
 - a. when you have a lube job done on your car.
 - b. twice a year.
 - c. once a year.
 - d. ordinarily would never be serviced.

LAP TEST ANSWER KEY: FUNDAMENTALS OF CLUTCH

1. A
2. A
3. B
4. C
5. B
- B
7. A
8. B
9. B
10. D



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Troubleshooting Clutches

OBJECTIVE:

Troubleshoot automotive clutches.

EVALUATION PROCEDURE:

The performance of the troubleshooting to be evaluated by the instructor in accordance with "Clutch Problem Diagnoses", pages 24-14, 24-15, 24-16 in Auto Service and Repair, Martin W. Stockel, Goodheart-Willcox Company, Inc., and the manufacturer's specifications.

80% accuracy on the LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

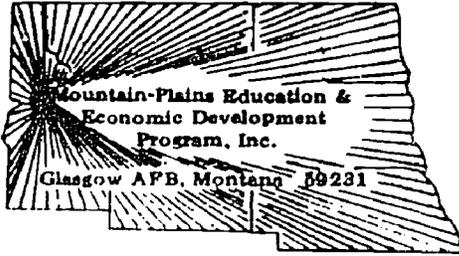
Automobile with clutch problem

PROCEDURE:

1. Record the problem as explained by the customer.
NOTE: Sometimes disassembly of the clutch component and careful examination of the parts is required to determine the exact cause of the problem. Refer to the repair manual for further aids on diagnosis.
2. Record what you believe the problem is.
3. Using the chart on pages 24-14 to 24-16 in Auto Service and Repair, record the cause of the problem and what work and parts are needed to correct the problem.
4. Give your paper to the instructor for evaluation.
5. Return the text and manual to proper places.
6. Take the LAP test.

Principal Author(s):

C. Schramm/W. Osland



LAP TEST: TROUBLESHOOTING CLUTCHES

1. When the driver rides the clutch, you can best remedy it by:
 - a. setting back clutch.
 - b. instructing driver.
 - c. putting heavy duty pressure plate springs in.
 - d. setting up clutch.

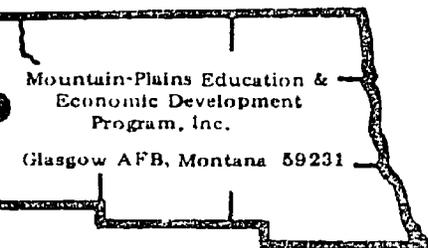
2. When your pilot bearing is worn, you can remedy it by:
 - a. installing new pressure plate.
 - b. adjusting linkage.
 - c. adjusting fingers.
 - d. replacing it.

3. When your clutch disc is worn, you can fix it by:
 - a. replacing pressure plate.
 - b. replacing disc.
 - c. grinding disc.
 - d. adjusting throw-out bearing.

LAP TEST ANSWER KEY: TROUBLESHOOTING CLUTCHES

LAP .02

1. b
2. d
3. b



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacing Throw-Out Bearing

OBJECTIVE:

Recognize and follow the proper procedure to replace the automotive clutch throw-out bearing.

EVALUATION PROCEDURE:

80% accuracy required on the LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

Automobile needing throw-out bearing replacement

Press

Throw-out bearing, new

Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

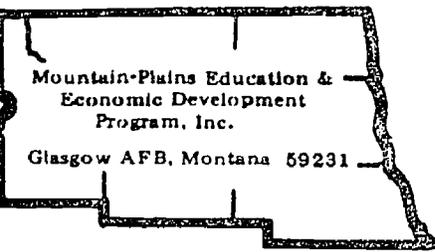
NOTE: Review pages 24-8 and 24-9 in Auto Service and Repair.

1. Obtain the repair manual for the year and model you are working on.
2. Follow the procedure outlined in the manual and remove and replace the throw-out bearing.

NOTE: If the bearing is the type that must be pressed into the sleeve, use a press. The use of a hammer may damage the bearing.

3. Ask the instructor to evaluate your work.
4. Take the LAP test.

Principal Author(s):



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacing Clutch Pilot Bushing

OBJECTIVE:

Recognize and follow the proper procedure to replace the automotive clutch pilot bushing.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering 8 out of 10 items on a multiple-choice test that is combined with "Replacing Throw-Out Bearing" LAP. The test will be taken after completing this LAP.

RESOURCES:

Auto Service and Repair, Stockel.

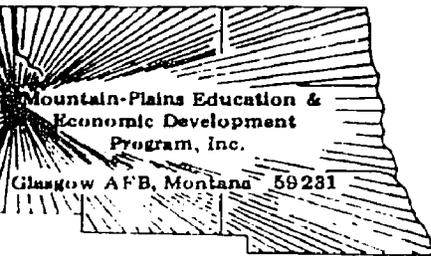
Bushing puller
 Engine equipped with pilot bushing
 Pilot bushing, new
 Slide hammer bearing puller with adapter
 Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review Chapter 24 in Auto Service and Repair.

1. Obtain the repair manual for the model and year engine you are working on.
2. Following the procedure in the manual, remove the pilot bushing.
 NOTE: A slide-hammer bearing puller, with an adapter to fit the size bushing you are working on, usually works very well.
3. Following the procedure in the manual, install the new pilot bushing.
4. Ask the instructor to evaluate your complete work.
5. Clean the work area, and clean and return tools, equipment and the manual.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland



LAP TEST: REPLACE CLUTCH PILOT BUSHING/THROW-OUT
BEARING

37.11.04.04.

1. What part fits into the pilot bushing?
 - a. clutch disc
 - b. input shaft
 - c. throw-out bearing
 - d. throw-out sleeve

2. The pilot bushing is located:
 - a. in the crankshaft.
 - b. in the cluster gear.
 - c. in the pressure plate.
 - d. in the clutch disc.

3. How many different types of pilot shaft bearings are there?
 - a. 2
 - b. 4
 - c. 1
 - d. 3

4. What is used to take out a pilot bushing?
 - a. your fingers
 - b. a small hammer
 - c. a threaded puller
 - d. a pry bar

5. A defective pilot shaft bearing will make noise:
 - a. when the clutch is fully engaged.
 - b. when the clutch is disengaged halfway.
 - c. when the clutch is disengaged fully.
 - d. It will make noise all the time.

37.11.01.03.

6. To check a throw-out bearing for wear, you:
 - a. there is no inspection for a sealed throw-out bearing.
 - b. press against flat surface with pressure and revolve bearing.
 - c. test it with feeler gauge.
 - d. test it with a dial indicator.

7. A new throw-out bearing is generally installed every:
 - a. time you overhaul your clutch.
 - b. six months.
 - c. 2,500 miles.
 - d. year, or after 30,000 miles.

8. To seat a throw-out bearing in a sleeve, you:
 - a. press it in.
 - b. use a puller to seat bearing.
 - c. use a dial for set-up to seat bearing.
 - d. tap it in with a hammer.

9. What kind of lubricant do you use on the throw-out bearing shaft?
 - a. graphite
 - b. high temperature grease
 - c. none
 - d. light oil

- 10.

LAP TEST ANSWER KEY: REPLACE CLUTCH PILOT BUSHING/THROW-OUT BEARING

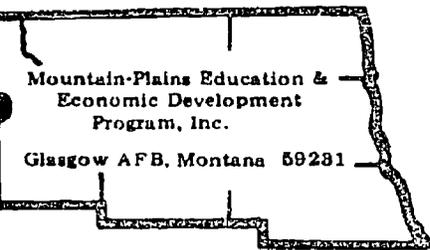
LAP .04

1. b
2. a
3. a
4. c
5. c

LAP .03

6. b
7. a
8. a
9. b

~~10. c~~



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Pressure Plates

OBJECTIVE:

Recognize the types of plates and causes for failure.

EVALUATION PROCEDURE:

80% correct on LAP study questions.

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Clutch Removal and Replacement" LAP test and is taken after completing that LAP.

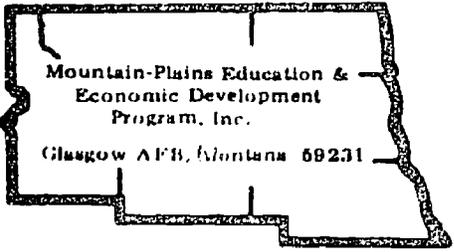
RESOURCES:

Auto Service and Repair, Stockel.

PROCEDURE:

1. Read Chapter 24, "Clutch Service," pages 24-1 to 24-16.
2. On a separate sheet of paper, answer the questions on pages 24-16 and 24-17.
3. Give your answer sheet to the instructor for evaluation.
4. Return the text to its proper place.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland



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Economic Development
Program, Inc.

Glasgow AFB, Montana 59231

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Clutch Removal and Replacement

OBJECTIVE:

Recognize and follow the correct procedure to remove and replace the automotive clutch assembly.

EVALUATION PROCEDURE:

80% accuracy required on LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

Clutch aligning tool
Clutch plate, new
Jack stands
Jacks or lift
Pressure plate, new
Tools, Basic Hand: (See Unit LEG)

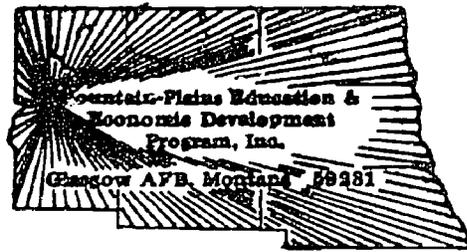
PROCEDURE:

NOTE: Review Chapter 24 in Auto Service and Repair.

1. Raise car and secure on jack stands.
2. Find proper procedures for removing clutch in repair manual.
3. Follow procedures in the manual for removing and replacing the clutch.
4. Ask the instructor to evaluate your work.
5. Return tools to their proper places.
6. Clean your work area.
7. Take the LAP test.

NOTE: Use the clutch aligning tool during installation.

Principal Author(s): J. Anderson/C. Schramm/W. Osland



LAP TEST: PRESSURE PLATE/CLUTCH REMOVAL AND REPLACEMENT

37.1 01.05

1. Before removing the clutch cover fasteners, always:
 - a. wipe them off.
 - b. prick punch the cover and flywheel.
 - c. check for disc warpage.
 - d. block the flywheel.
2. Excessive pedal free travel can cause:
 - a. hard shifting.
 - b. throw-out fork wear.
 - c. fast throw-out bearing wear.
 - d. clutch slipping.
3. The clutch friction disc is splined to the:
 - a. crankshaft.
 - b. transmission output shaft.
 - c. clutch shaft.
 - d. countershaft.
4. When the clutch is engaged, the friction disc is held against the flywheel by:
 - a. the release levers.
 - b. spring pressure.
 - c. the throwout bearing.
 - d. diaphragm-spring fingers.
5. Pedal free travel is adjusted by:
 - a. aligning the clutch housing.
 - b. bending the pedal stop.
 - c. adjusting the clutch linkage.
 - d. placing shims under the clutch cover.

37.11.01.06

6. The most likely cause of clutch slippage is:
 - a. excessive clutch-spring pressure.
 - b. insufficient clutch-spring pressure.
 - c. excessive pedal lash.
 - d. worn throwout bearing.

37.11.01.06 (continued)

7. You disconnect the drive shaft by:
 - a. disconnecting linkage.
 - b. taking off a universal joint.
 - c. taking off the transmission.
 - d. taking the flywheel off.

8. Free clutch pedal travel, or pedal lash, is adjusted by adjusting the:
 - a. release levers.
 - b. release bearing.
 - c. clutch linkage.
 - d. pressure plate.

9. What is used to align the clutch disc, pressure plate, and pilot bearing?
 - a. clutch cushion
 - b. your eye
 - c. screwdriver
 - d. clutch arbor.

10. In the diaphragm, spring clutch, the diaphragm not only provides the pressure that holds the friction against the flywheel but also:
 - a. prevents engagement of the clutch when the pedal is released.
 - b. actuates the throwout bearing.
 - c. dampens the pulsations in clutch.
 - d. functions as the release levers when the pedal is pushed down.

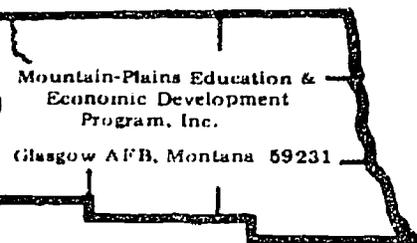
LAP TEST ANSWER KEY: PRESSURE PLATE/CLUTCH REMOVAL AND REPLACEMENT

LAP 05

1. B
2. A
3. C
4. B
5. C

LAP 06

6. B
7. B
8. C
9. D
10. D



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Clutch Linkage

OBJECTIVE:

Recognize and follow the proper procedure to adjust clutch pedal free play.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test.

RESOURCES:

Auto Service and Repair, Stockel.

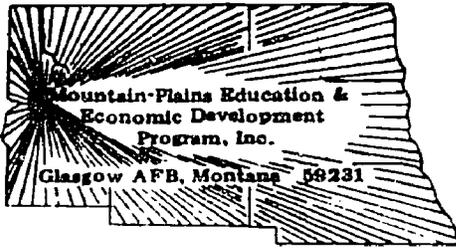
Automobile needing clutch adjustment
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review pages 24-10 to 24-12 in Auto Service and Repair.

1. Obtain the manual for the year and model that you are working on.
2. Find the procedure in the manual for clutch adjustment.
NOTE: Pedal free play allows the throw-out to move away from the pressure plate release fingers.
3. Adjust the pedal free play.
NOTE: If snap rings or cotter keys are removed, replace with new ones.
If hydraulic linkage is used, be sure to check for leaks.
4. Ask the instructor to evaluate your work.
5. Return manual and tools; clean work area.
6. Take LAP test.

Principal Author(s): C. Schramm/W. Osland

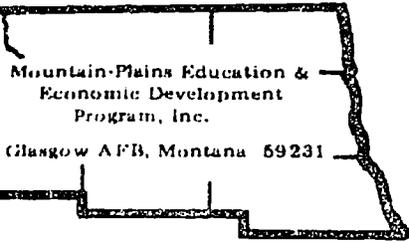


LAP TEST: ADJUSTING CLUTCH LINKAGE

1. How many different methods in general are used to actuate the throw-out fork?
 - a. 3
 - b. 4
 - c. 5
 - d. 2

2. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:
 - a. 1/2 inch.
 - b. 1 inch.
 - c. 1/4 inch.
 - d. 2 inches.

3. When adjusting linkage you check for:
 - a. clutch temperature.
 - b. clutch vibration.
 - c. free play.
 - d. pressure plate freeness.



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Self-Adjusting Clutch

OBJECTIVE:

Recognize the operation of the automotive self-adjusting clutch.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test.

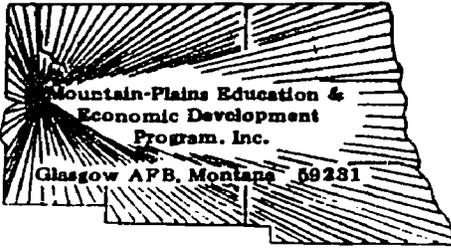
RESOURCES:

Auto Service and Repair, Stockel.

PROCEDURE:

1. Secure a copy of Auto Service and Repair and a quiet place to study.
2. Read "Self-Adjusting Clutch" on page 24-12.
3. On a separate sheet of paper, write what makes the self-adjusting clutch different from other clutches.
4. On the same sheet of paper, write a description of how the self-adjusting clutch works.
5. Give your paper to the instructor for evaluation.
6. Return the text to its proper place.
7. Take the LAP test for this LAP.

Principal Author(s): C. Schramm/W. Osland



LAP TEST: SELF-ADJUSTING CLUTCH

1. Depressing the clutch pedal in a self-adjusting clutch will cause the throw-out bearing in a self-adjusting clutch to:
 - a. pull away from the clutch levers.
 - b. engage the driven plate with the pressure plate.
 - c. apply pressure to the pressure plate.
 - d. push towards the clutch levers.
2. Clutch break-in is:
 - a. aligning and realigning the pilot bearing.
 - b. adjusting linkage.
 - c. adjusting the free play.
 - d. wearing the fuzz off a clutch plate.
3. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?
 - a. it has no pedal free travel.
 - b. it has no pressure plate.
 - c. it has twice the pedal free travel.
 - d. it has no throw-out lever.
4. In a self-adjusting clutch, pressure is applied to the throw-out fork by:
 - a. coil springs.
 - b. a heavy mainspring.
 - c. lever struts.
 - d. a diaphragm spring.

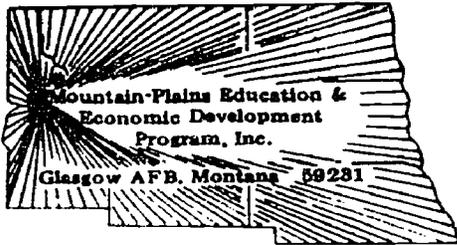
LAP TEST ANSWER KEY: ADJUSTING CLUTCH LINKAGE/
SELF-ADJUSTING CLUTCH

LAP .07

1. d
2. b
3. c

LAP .08

4. a
5. d
6. a
7. b



UNIT POST TEST: CLUTCHES (A)

37.11.01.01.

1. The clutch side of a flywheel is:
 - a. cone shaped.
 - b. corrugated.
 - c. machined smooth.
 - d. knurled.
2. Release levers in a clutch are in what group?
 - a. spindle hub assembly.
 - b. starter ring gear assembly.
 - c. flywheel assembly.
 - d. pressure plate assembly.
3. The inner hub of a clutch disc and the thin outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:
 - a. stop pins.
 - b. pressure plate spring.
 - c. crankshaft splines.
 - d. coil spring.
4. The hub splines engage:
 - a. splines on the camshaft.
 - b. splines on the clutch disc.
 - c. splines on the transmission input shaft.
 - d. splines on the crankshaft.
5. The throw-out bearing is lubricated and should be serviced:
 - a. ordinarily would never be serviced.
 - b. when you have a lube job done on your car.
 - c. twice a year.
 - d. once a year.

37.11.01.02.

6. When the driver rides the clutch, you can remedy it by:
 - a. instructing driver.
 - b. setting up clutch.
 - c. setting back clutch.
 - d. putting heavy duty pressure plate springs in.

37.11.01.02. cont.

- 7.
8. When you have broken a weak pressure plate spring, you can fix it by:
- adjusting linkage.
 - grinding clutch disc.
 - cleaning clutch disc.
 - replacing pressure plate.
9. When you have a warped clutch disc, you can fix it by:
- installing fork properly.
 - grinding disc.
 - replacing disc.
 - adjusting linkage.
10. When the pilot bearing becomes worn, it should be fixed by:
- replacement.
 - adjusting the linkage.
 - adjusting the fingers.
 - installing a new pressure plate.

37.11.01.03.

- 11.
12. It is a good safety practice before you start working on a throw-out bearing to:
- be sure car is in gear.
 - drain transmission.
 - disconnect battery.
 - have the correct tools available.
13. Before you can remove the throw-out bearing, you need to first remove the:
- clutch plate.
 - pressure plate.
 - throw-out fork.
 - transmission.

37.11.01.03. cont.

14. To seat a throw-out bearing in a sleeve, you:
- use a puller to seat bearing.
 - tap it in with a hammer.
 - press it in.
 - use a dial fork set-up to seat bearing.
15. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:
- transmission.
 - pressure plate.
 - inspection pan.
 - clutch; pressure plate.

37.11.01.04.

16. How many different types of pilot shaft bearings are there?
- 2.
 - 1.
 - 3.
 - 4.
17. You would lubricate a pilot bushing with:
- graphite.
 - light grease.
 - heavy oil.
 - high temperature grease.
18. What is used to take out a pilot bushing?
- a threaded puller.
 - your fingers.
 - a pry bar.
 - a small hammer.
19. The pilot bushing is located:
- in the clutch disc.
 - in the crankshaft.
 - in the pressure plate.
 - in the cluster gear.
20. What part fits into the pilot bushing?
- input shaft.
 - throw-out sleeve.
 - throw-out bearing.
 - clutch disc.

37.11.01.05.

- *21. When installing the pressure plate assembly to the flywheel, always:
- install the top bottom first.
 - align the prick punch marks.
 - use a C-clamp to secure the unit.
 - tighten each fastener fully before starting on the next one.
22. Pedal free travel is adjusted by:
- placing shims under the clutch cover.
 - aligning the clutch housing.
 - adjusting the clutch linkage.
 - bending the pedal stop.
- *23.
24. Excessive pedal free travel can cause:
- fast throw-out bearing wear.
 - throw-out fork wear.
 - hard shifting.
 - clutch slipping.
- 25.

37.11.01.06.

26. What is used to align the clutch disc, pressure plate pilot bearing?
- screwdriver.
 - clutch arbor.
 - your eye.
 - clutch cushion.
- 27.

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3, 15, 22.)

37.11.01.06. cont.

28.

29. When replacing a clutch, you remove the throw-out bearing by:

- a. tapping it off lightly with soft-face hammer.
- b. screwing it out by hand.
- c. pressing it off the shaft.
- d. lifting it out by hand.

30.

37.11.01.07.

31.

32. One type of procedure used to activate the throw-out fork is:

- a. electric.
- b. hydraulic.
- c. torque procedure.
- d. chain link.

33. On a hydraulic linkage, if your free travel is not correct, you should first check the:

- a. lever-struts.
- b. cylinder fluid level.
- c. throw-out lever.
- d. pressure plate.

34.

37.11.01.07.

35. When adjusting linkage, you check for:

- a. pressure plate freeness.
- b. clutch vibration.
- c. clutch temperature.
- d. free play.

37.11.01.08.

36. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?

- a. it has no pressure plate.
- b. it has twice the pedal free travel.
- c. it has no pedal free travel.
- d. it has no throw-out lever.

37. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

- a. diaphragm springs.
- b. throw-out lever.
- c. coil springs.
- d. second spring.

38. In a self-adjusting clutch, pressure is applied to the throw-out fork by:

- a. lever-struts.
- b. coil springs.
- c. a diaphragm spring.
- d. a heavy mainspring.

39. Pressure is applied to an actuator in a self-adjusting clutch by:

- a. a heavy mainspring.
- b. coil springs.
- c. a throw-out lever fork.
- d. a pressure plate.

40. Clutch break-in is:

- a. wearing the fuzz off a clutch plate.
- b. adjusting linkage.
- c. aligning and realigning the pilot bearing.
- d. adjusting the free play.

UNIT POST TEST ANSWER KEY (A)

Occupational Area:

File Code:

Name:

Family Pay Number:

37.11.01.00.C1-2

Sex M F (Circle 1)

ANSWERS

37.11.01.01 1. C _____

2. D _____

3. A _____

4. C _____

5. A _____

37.11.01.02 6. A _____

7. C _____

8. D _____

9. C _____

10. A _____

37.11.01.03 ~~11. B~~ _____

12. C _____

13. D _____

14. C _____

15. G _____

37.11.01.04 16. A _____

17. D _____

18. A _____

19. B _____

20. A _____

37.11.01.05 21. B _____

22. C _____

~~23. B~~ _____

24. C _____

~~25. B~~ _____

37.11.01.06 26. B _____

~~27. B~~ _____

~~28. B~~ _____

29. D _____

~~30. C~~ _____

37.11.01.07 31. B _____

32. B _____

33. B _____

~~34. C~~ _____

35. D _____

37.11.01.08 36. C _____

37. B _____

38. D _____

39. A _____

40. A _____

41. _____

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

51. _____

52. _____

53. _____

54. _____

55. _____

56. _____

57. _____

58. _____

59. _____

60. _____



UNIT POST TEST: CLUTCHES (B)

37.11.01.01

1. The throw-out bearing is lubricated and should be serviced:
 - a. ordinarily would never be serviced
 - b. when you have a lube job done on your car
 - c. twice a year
 - d. once a year
2. The hub splines engage:
 - a. splines on the camshaft
 - b. splines on the clutch disc
 - c. splines on the transmission input shaft
 - d. splines on the crankshaft
3. The inner hub of a clutch disc and the thin outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:
 - a. stop pins
 - b. pressure plate spring
 - c. crankshaft splines
 - d. coil spring
4. Release levers in a clutch are in what group?
 - a. spindal hub assembly
 - b. starter ring gear assembly
 - c. flywheel assembly
 - d. pressure plate assembly
5. The clutch side of a flywheel is:
 - a. cone shaped
 - b. corrugated
 - c. machined smooth
 - d. knurled

37.11.01.02

6. When the pilot bearing becomes worn, it should be fixed by:
 - a. replacement
 - b. adjusting the linkage
 - c. adjusting the fingers
 - d. installing a new pressure plate

37.11.01.02 cont.

7. When you have a warped clutch disc, you can fix it by:
 - a. installing fork properly
 - b. grinding disc
 - c. replacing disc
 - d. adjusting linkage
8. When you have broken a weak pressure plate spring, you can fix it by:
 - a. adjusting linkage
 - b. grinding clutch disc
 - c. cleaning clutch disc
 - d. replacing pressure plate
9. When the driver rides the clutch, you can remedy it by:
 - a. instructing driver
 - b. setting up clutch
 - c. setting back clutch
 - d. putting heavy duty pressure plate springs in

37.11.01.03

10. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:
 - a. transmission
 - b. pressure plate
 - c. inspection pan
 - d. clutch pressure plate
11. To seat a throw-out bearing in a sleeve, you:
 - a. use a puller to seat bearing
 - b. tap it in with a hammer
 - c. press it in
 - d. use a dial fork set-up to seat bearing
12. Before you can remove the throw-out bearing, you need to first remove the:
 - a. clutch plate
 - b. pressure plate
 - c. throw-out fork
 - d. transmission
13. It is a good safety practice before you start working on a throw-out bearing to:
 - a. be sure car is in gear
 - b. drain transmission
 - c. disconnect battery
 - d. have the correct tools available

37.11.01.04

14. What part fits into the pilot bushing?
- input shaft
 - throw-out sleeve
 - throw-out bearing
 - clutch disc
15. The pilot bushing is located:
- in the clutch disc
 - in the crankshaft
 - in the pressure plate
 - in the cluster gear
16. What is used to take out a pilot bushing?
- a threaded puller
 - your fingers
 - a pry bar
 - a small hammer
17. You would lubricate a pilot bushing with:
- graphite
 - light grease
 - heavy oil
 - high temperature grease
18. How many different types of pilot shaft bearings are there?
- 2
 - 1
 - 3
 - 4

37.11.01.05

19. Excessive pedal free travel can cause:
- fast throw-out bearing wear
 - throw-out fork wear
 - hard shifting
 - clutch slipping
20. Pedal free travel is adjusted by:
- placing shims under the clutch cover
 - aligning the clutch housing
 - adjusting the clutch linkage
 - bending the pedal stop

37.11.01.05 cont.

21. *When installing the pressure plate assembly to the flywheel, always:
- install the top bottom first
 - align the prick punch marks
 - use a C-clamp to secure the unit
 - tighten each fastener fully before starting on the next one

37.11.01.06

22. When replacing a clutch, you remove the throw-out bearing by:
- tapping it off lightly with soft-face hammer
 - screwing it out by hand
 - pressing it off the shaft
 - lifting it out by hand
23. What is used to align the clutch disc, pressure plate pilot bearing?
- screwdriver
 - clutch arbor
 - your eye
 - clutch cushion

37.11.01.07

24. When adjusting linkage, you check for:
- pressure plate freeness
 - clutch vibration
 - clutch temperature
 - free play
25. On a hydraulic linkage, if your free travel is not correct, you should first check the:
- lever-struts
 - cylinder fluid level
 - throw-out lever
 - pressure plate
26. One type of procedure used to activate the throw-out fork is:
- electric
 - hydraulic
 - torque procedure
 - chain link

37.11.01.08

27. Clutch break-in is:
- wearing the fuzz off a clutch plate
 - adjusting linkage
 - aligning and realigning the pilot bearing
 - adjusting the free play

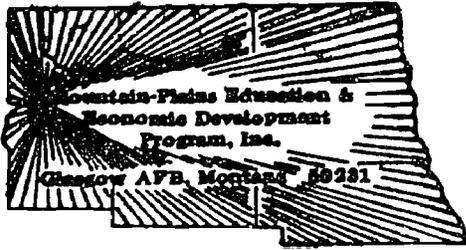
*(Adapted from Auto Service and Repair
Stockel, Goodheart-Wilcox, 1975, p.

37.11.01.08 cont.

28. Pressure is applied to an actuator in a self-adjusting clutch by:
- heavy mainspring
 - coil springs
 - a throw-out lever fork
 - a pressure plate
29. In a self-adjusting clutch, pressure is applied to the throw-out fork by:
- lever-struts
 - coil springs
 - a diaphragm spring
 - a heavy mainspring
30. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?
- diaphragm springs
 - throw-out lever
 - coil springs
 - second spring
31. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?
- it has no pressure plate
 - it has twice the pedal free travel
 - it has no pedal free travel
 - it has no throw-out lever

UNIT POST TEST ANSWER KEY: CLUTCHES (B)

- | | |
|-------|-------|
| 1. A | 26. B |
| 2. C | 27. A |
| 3. A | 28. A |
| 4. D | 29. D |
| 5. C | 30. B |
| 6. A | 31. C |
| 7. C | |
| 8. D | |
| 9. A | |
| 10. C | |
| 11. C | |
| 12. D | |
| 13. C | |
| 14. A | |
| 15. B | |
| 16. A | |
| 17. D | |
| 18. A | |
| 19. C | |
| 20. C | |
| 21. B | |
| 22. D | |
| 23. B | |
| 24. D | |
| 25. B | |



UNIT POST TEST: CLUTCHES (C)

37.11.01.01

1. Release levers in a clutch are in what group?
 - a. spindal hub assembly
 - b. starter ring gear assembly
 - c. flywheel assembly
 - d. pressure plate assembly

2. The inner hub of a clutch disc and the thin outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:
 - a. stop pins
 - b. pressure plate spring
 - c. crankshaft splines
 - d. coil springs

3. The throw-out bearing is lubricated and should be serviced:
 - a. ordinarily would never be serviced
 - b. when you have a lube job done on your car
 - c. twice a year
 - d. once a year

4. The clutch side of a flywheel is:
 - a. cone shaped
 - b. corrugated
 - c. machined smooth
 - d. knurled

5. The hub splines engage:
 - a. splines on the camshaft
 - b. splines on the clutch disc
 - c. splines on the transmission input shaft
 - d. splines on the crankshaft

37.11.01.02

6. When the driver rides the clutch, you can remedy it by:
 - a. instructing driver
 - b. setting up clutch
 - c. setting back clutch
 - d. putting heavy duty pressure plate springs in

37.11.01.02 cont.

7. When the pilot bearing becomes worn, it should be fixed by:
 - a. replacement
 - b. adjusting the linkage
 - c. adjusting the fingers
 - d. installing a new pressure plate
8. When you have broken a weak pressure plate spring, you can fix it by:
 - a. adjusting linkage
 - b. grinding clutch disc
 - c. cleaning clutch disc
 - d. replacing pressure plate
9. When you have a warped clutch disc, you can fix it by:
 - a. installing fork properly
 - b. grinding disc
 - c. replacing disc
 - d. adjusting linkage

37.11.02.03

10. Before you can remove the throw-out bearing, you need to first remove the:
 - a. clutch plate
 - b. pressure plate
 - c. throw-out fork
 - d. transmission
11. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:
 - a. transmission
 - b. pressure plate
 - c. inspection pan
 - d. clutch pressure plate
12. It is a good safety practice before you start working on a throw-out bearing to:
 - a. be sure car is in gear
 - b. drain transmission
 - c. disconnect battery
 - d. have the correct tools available
13. To seat a throw-out bearing in a sleeve, you:
 - a. use a puller to seat bearing
 - b. tap it in with a hammer
 - c. press it in
 - d. use a dial fork set-up to seat bearing

37.11.01.04

14. How many different types of pilot shaft bearings are there?
- a. 2
 - b. 1
 - c. 3
 - d. 4
15. What part fits into the pilot bushing?
- a. input shaft
 - b. throw-out sleeve
 - c. throw-out bearing
 - d. clutch disc
16. The pilot bushing is located:
- a. in the clutch disc
 - b. in the crankshaft
 - c. in the pressure plate
 - d. in the cluster gear
17. You would lubricate a pilot bushing with:
- a. graphite
 - b. light grease
 - c. heavy oil
 - d. high temperature grease
18. What is used to take out a pilot bushing?
- a. a threaded puller
 - b. your fingers
 - c. a pry bar
 - d. a small hammer

37.11.01.05

19. When installing the pressure plate assembly to the flywheel, always:
- a. install the top bottom first
 - b. align the prick punch marks
 - c. use a C-clamp to secure the unit
 - d. tighten each fastener fully before starting on the next one
20. Excessive pedal free travel can cause:
- a. fast throw-out bearing wear
 - b. throw-out fork wear
 - c. hard shifting
 - d. clutch slipping

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3,15,22.)

37.11.01.05 cont.

21. Pedal free travel is adjusted by:
- placing shims under the clutch cover
 - aligning the clutch housing
 - adjusting the clutch linkage
 - bending the pedal stop

37.11.01.06

22. What is used to align the clutch disc, pressure plate pilot bearing?
- screwdriver
 - clutch arbor
 - your eye
 - clutch cushion
23. When replacing a clutch, you remove the throw-out bearing by:
- tapping it off lightly with soft-face hammer
 - screwing it out by hand
 - pressing it off the shaft
 - lifting it out by hand

37.11.01.07

24. On a hydraulic linkage, if your free travel is not correct, you should first check the:
- lever-struts
 - cylinder fluid level
 - throw-out lever
 - pressure plate
25. When adjusting linkage, you check for:
- pressure plate freeness
 - clutch vibration
 - clutch temperature
 - free play
26. One type of procedure used to activate the throw-out fork is:
- electric
 - hydraulic
 - torque procedure
 - chain link

37.11.01.08

27. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?
- it has no pressure plate
 - it has twice the pedal free travel
 - it has no pedal free travel
 - it has no throw-out lever

37.11.01.08 cont.

28. Clutch break-in is:
- a. wearing the fuzz off a clutch plate
 - b. adjusting linkage
 - c. aligning and realigning the pilot bearing
 - d. adjusting the free play
29. Pressure is applied to an actuator in a self-adjusting clutch by:
- a. a heavy mainspring
 - b. coil springs
 - c. a throw-out lever fork
 - d. a pressure plate
30. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?
- a. diaphragm springs
 - b. throw-out lever
 - c. coil springs
 - d. second spring
31. In a self-adjusting clutch, pressure is applied to the throw-out fork by:
- a. lever-struts
 - b. coil springs
 - c. a diaphragm spring
 - d. a heavy mainspring

UNIT POST TEST ANSWER KEY: CLUTCHES (C)

- | | |
|-------|-------|
| 1. D | 26. B |
| 2. A | 27. C |
| 3. A | 28. A |
| 4. C | 29. A |
| 5. C | 30. B |
| 6. A | 31. D |
| 7. A | |
| 8. D | |
| 9. C | |
| 10. D | |
| 11. C | |
| 12. C | |
| 13. C | |
| 14. A | |
| 15. A | |
| 16. B | |
| 17. D | |
| 18. A | |
| 19. B | |
| 20. C | |
| 21. C | |
| 22. B | |
| 23. D | |
| 24. B | |
| 25. D | |

Student: _____

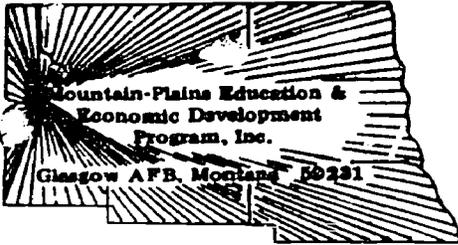
File Code: 37.11.01.00.B1-5

Date: _____

Date Published: 3/10/76

Family Pay Number: _____

Sex: M F (Circle 1)



UNIT PERFORMANCE TEST: CLUTCHES

OBJECTIVE 1:

Trouble shoot clutch.

OBJECTIVE 2:

Remove and repair clutch

OBJECTIVE 3:

Replace and adjust clutch.

TASK:

The student will be assigned a vehicle with a clutch and he must troubleshoot, remove, repair, replace, and adjust the clutch assembly.

ASSIGNMENT:

CONDITIONS:

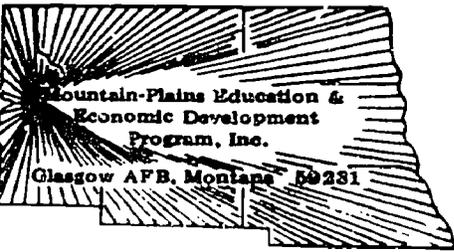
The student may use only those materials provided for the test and must perform the test in the auto shop.

RESOURCES:

Auto with clutch
Repair manual
Time and parts guide
New clutch parts, if needed

RESOURCES: (Continued)

Jack
Jack stands
Fender covers
Pilot shaft
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set



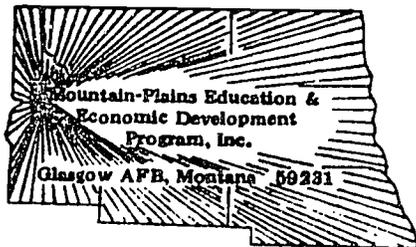
Family Pay Number: _____ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

CRITERION
Met Not Met

	Met	Not Met
Objective 1:		
1. Troubleshoot clutch.		
Criterion: Compare to manufacturer's operation and specifications.		
Objective 2:		
2. Remove and repair clutch.		
Criterion: Safely remove clutch assembly without damage		
to transmission; compare all parts to manufacturer's		
specifications.		
Objective 3:		
3. Replace and adjust clutch assembly.		
Criterion: Must operate as per manufacturer's specifications.		
4. Complete test in allotted time.		
Criterion: Must meet flat rate on assigned vehicle.		
Student must complete 3 of 4 line items to pass test.		

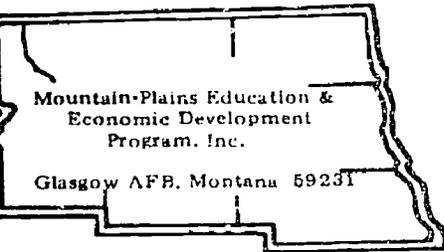


Family Pay Number: _____ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Remove steering gear box.		
Criterion: Does not damage car or gear box.		
2. Disassembles and inspects gear box components.		
Criterion: Follows service manual procedure and compares parts to manufacturer's specifications.		
3. Assembles steering gear box.		
Criterion: Must meet manufacturer's specifications.		
Objective 2:		
4. Adjusts end play.		
Criterion: Must meet manufacturer's specifications.		
5. Adjusts high point or through point.		
Criterion: Must meet manufacturer's specifications.		
6. Completes test in allotted time for assigned vehicle.		



Learning Experience Guide

UNIT: POWER STEERING

RATIONALE:

The fundamentals and techniques in this unit will enable one to diagnose and overhaul power steering components.

PREREQUISITES:

Math Skills at Level F
Communication Skills at Level F

OBJECTIVES:

Recognize the components and proper operation of power steering. Use the proper procedure for overhaul of power steering components.

RESOURCES:

Printed Materials

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Motor's Auto Repair Manual. Motor, The Hearst Corporation. 1972 or equivalent.

Equipment

Automobile with power steering
Drain pan
Fender covers
Power steering fluid
Replacement parts as needed
Tools, Basic Hand:

Chisel and Punch Set
5/32" Pin Punch
3/16" Solid

Gauge, feeler (.002" - .025")

Hammer, ball peen
Hammer, plastic tip
Handle, speed
Hex Key Set

Pliers, diagonal cutting
Pliers, needle nose

Resources: Equipment: Continued

Scraper, gasket
 Screwdriver, standard (Set)
 Screwdriver, phillips (Set)
 Screw starter

Socket Set (3/8" drive)
 extension (3")
 ratchet

Socket Set (1/4" drive)
 extension (3")
 handle (6" flex)
 ratchet

Socket, spark plug
 extension (6")

Wrench, combination (Set)
 Wrench, combination ignition (Set)

GENERAL INSTRUCTIONS:

This unit consists of four Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

- (1) Read the first assigned Learning Activity Package (LAP).
- (2) Begin and complete the first assigned LAP.
- (3) Take and score the LAP test.
- (4) Turn in the LAP test answer sheet.
- (5) Determine the reason for any missed items on the LAP test.
- (6) Proceed to and complete the next assigned LAP in the unit.
- (7) Complete all required LAPs for the unit by following steps 3 through 6.
- (8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
- (9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
- (10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

- .01 Fundamentals of Power Steering
- .02 Overhaul of Power Steering Pumps
- .03 Overhaul of Power Steering Control Units
- .04 Overhaul of Power Steering Cylinders

EVALUATION PROCEDURE:

When pretesting:

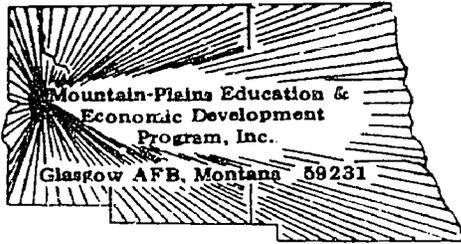
1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).



UNIT PRETEST: POWER STEERING

37.10.03.01.

1. A hydraulic pump power steering unit is generally operated by:
 - a. a belt driven by the engine.
 - b. a power piston.
 - c. an electric motor running off of the battery.
 - d. a universal shaft, generally six (6) feet long.
2. What is meant by a self-contained power steering unit?
 - a. it is the same as the slipper vane unit and roller vane unit.
 - b. the power cylinder and control valve are in separate units.
 - c. the oil reservoir is mounted directly on top of the power steering unit.
 - d. the control valve mechanism, power piston, and gears are in an integral unit.
3. Oil, in a power steering unit under pressure from the pumps, enters the valve body by way of:
 - a. the back pressure valve.
 - b. the inlet passage.
 - c. the lower cylinder head.
 - d. the power chamber.
4. When no pressure is being applied to the steering wheel, the spool valve is:
 - a. in a neutral position.
 - b. straight up and down.
 - c. compressed or engaged by the pivot lever.
 - d. vibrating profusely along with the pivot lever.
5. The center thrust bearing can move up or down with the worm shaft, but not:
 - a. when there is an excess of lubricating oil.
 - b. while under pressure.
 - c. while having pressure on it and the spool valve is in the left position.
 - d. around with it.

37.10.03.02.

6. The pump pulley should be removed with a:
 - a. puller.
 - b. press.
 - c. plastic hammer.
 - d. slide hammer.

7. To replace a leaking drive shaft seal:
 - a. the pulley can be removed, pry the seal out and install a new one without further disassembly.
 - b. the entire unit must be removed and disassembled.
 - c. it is best to overhaul the entire pump.
 - d. the pump should be fully tested for additional leaks.

37.10.03.03.

8. A power steering control valve regulates oil under pressure to:
 - a. the worm.
 - b. the reservoir.
 - c. the right or left of the rack-piston nut.
 - d. the sector shaft.

37.10.03.04.

9. When overhauling a power steering cylinder, it is important to:
 - a. know where the reservoir is located.
 - b. avoid nicking parts and to keep all parts clean.
 - c. keep the oil full at all times.
 - d. have the ball nut connected directly to the power piston.

10. When reinstalling the steering gear, misalignment can:
 - a. correct itself over a period of time.
 - b. cause bindings and premature wear.
 - c. affect the reservoir and pump.
 - d. affect the steering pump cooler.

UNIT PRETEST ANSWER KEY: POWER STEERING

LAP .01

1. a
2. d
3. b
4. a
5. d

LAP .02

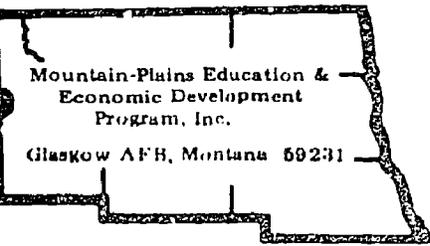
6. a
7. a

LAP .03

8. c

LAP .04

9. b
10. b



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Fundamentals of Power Steering**OBJECTIVE:**

Recognize components and proper operation of the power steering system.

EVALUATION PROCEDURE:

Score 80% correct on LAP study questions.
Eight correct responses to a ten-item multiple choice objective test.

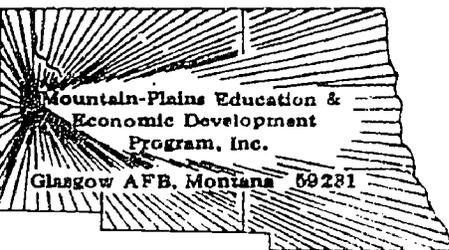
RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:**Steps**

1. Obtain text copy and secure a quiet place to study.
2. From Chapter 17, beginning with "Power Steering" page 326, read through to "Quiz" page 336.
3. Study figures 17-32 through 17-52.
4. On separate paper, neatly answer questions 22 through 32 on page 336.
5. Give answer sheet to instructor for evaluation.
6. Return text to shelf.
7. Take and score the LAP test.
8. Upon successful completion, proceed to the next LAP.

Principal Author(s): J. Anderson/W. Osland



LAP TEST: FUNDAMENTALS OF POWER STEERING

1. A power steering unit is designed:
 - a. to reduce the steering wheel turning effort.
 - b. for women primarily.
 - c. for racing when quick turning is needed.
 - d. to be used in the more sophisticated cars.

2. The feeling imparted to the steering wheel by the wheels of a car in motion is called:
 - a. phantom pressure.
 - b. power steering.
 - c. turning effort.
 - d. road feel.

3. To maintain road feel, power steering systems require:
 - a. them to be mounted somewhat loosely.
 - b. some wheel effort.
 - c. them to be self-contained.
 - d. them to have rack and pinion steering gearbox.

4. A hydraulic pump power steering unit is generally operated by:
 - a. a belt driven by the engine.
 - b. a power piston.
 - c. an electric motor running off of the battery.
 - d. a universal shaft, generally (6) six feet long.

5. What is meant by a self-contained power steering unit?
 - a. it is the same as the slipper vane unit and roller vane unit.
 - b. the power cylinder and control valve are in separate units.
 - c. the oil reservoir is mounted directly on top of the power steering unit.
 - d. the control valve mechanism, power piston, and gears are in an integral unit.

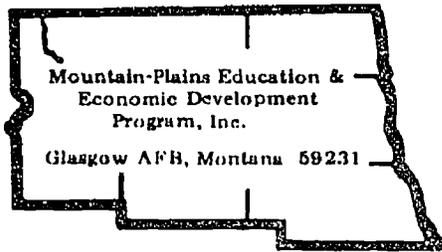
6. Oil, in a power steering unit under pressure from the pump, enters the valve body by way of:
 - a. the back pressure valve.
 - b. the inlet passage.
 - c. the lower cylinder head.
 - d. the power chamber.

7. The center thrust bearing can move up or down with the worm shaft, but not:
 - a. when there is an excess of lubricating oil.
 - b. while under pressure.
 - c. while having pressure on it and the spool valve is in the left position.
 - d. around with it.
8. If the spool valve is in a neutral position, oil is fed:
 - a. to the pitman shaft by the power piston.
 - b. nowhere.
 - c. only to the steering column connection.
 - d. to both sides of the power piston and to the reaction rings.
9. Oil leakage in the power steering pump is prevented by:
 - a. neoprene rubber rings that ride in grooves.
 - b. a brass bushing.
 - c. a collar.
 - d. a back pressure valve.
10. The worm shaft must be connected to the steering shaft to allow for:
 - a. movement on the end of the pitman shaft.
 - b. play in the steering shaft.
 - c. play in the steering column.
 - d. movement on the end of the worm shaft.

LAP TEST ANSWER KEY: FUNDAMENTALS OF POWER STEERING

LAP .01

1. a
2. d
3. b
4. a
5. d
6. l
7. d
8. d
9. a
10. d



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Overhaul of Power Steering Pumps

OBJECTIVE:

Use the proper procedure for overhaul of power steering pumps.

EVALUATION PROCEDURE:

80% correct on performance checklist.
LAP test after completing LAP 37.10.03.04.

RESOURCES:

Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

Automobile with power steering pump
Fender covers
Power steering fluid
Replacement parts as needed
Tools, Basic Hand (see Unit LEG)

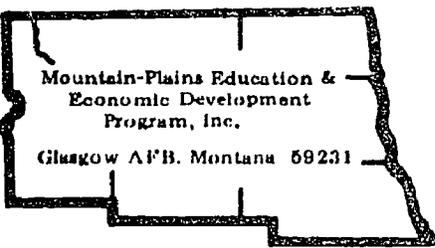
PROCEDURE:

NOTE: Review pages 31-15 through 31-17 in Auto Service and Repair.

1. Place fender covers.
2. Remove power steering pumps. Follow removal procedure of repair manual.
3. Drain remaining fluid out of pumps.
4. Disassemble the pump. Refer to disassembly procedure of manual. Lay all parts out in removal order on a clean area of the work bench.
5. Inspect all parts for wear and damage.
6. Replace all damaged parts. Replace all worn parts with the new replacement parts.
7. Lubricate all new parts and reassemble the pump. Refer to assembly procedure of manual.
8. Re-install pump in vehicle.

Principal Author(s): J. Anderson/W. Osland

9. Fill fluid level with power steering fluid.
10. Test power steering by turning the wheels full right and left for positive assistance.
11. When satisfactorily operational, ask the instructor to inspect the completed work for evaluation.
12. Clean and return all tools and equipment.
13. Clean work areas.
14. Proceed to next LAP.



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Overhaul of Power Steering Control Units

OBJECTIVE:

Use the proper procedure for the overhaul of power steering control unit.

EVALUATION PROCEDURE:

80% correct on performance checklist.
LAP test after completing LAP 37,10,03,04.

RESOURCES:

Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

Automobile with power steering control unit
Drain pan
Fender covers
Power steering fluid
Replacement parts as needed
Tools, Basic Hand (see Unit LEG)

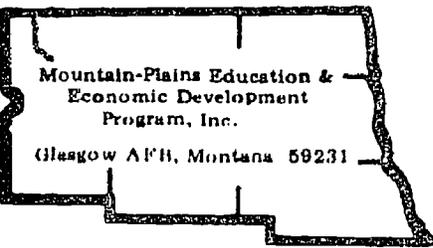
PROCEDURE:

NOTE: Review pages 31-7 through 31-15 in Auto Service and Repair.

1. Place fender covers.
2. Examine power steering fluid level.
3. Diagnose power steering problem.
NOTE: Prediagnosis aids the inspection of the disassembled unit in locating the defective part. Operate the steering full left and right while listening and feeling for noticeable problems. Refer to manual for diagnosis procedure. Record diagnosis results on work order.
4. Place drain pan below control unit to catch leaking fluid during removal from vehicle.
5. Remove control unit from vehicle. Refer to removal procedure of manual.

Principal Author(s): J. Anderson/W. Osland

6. Drain remaining fluid from control unit.
7. Disassemble control unit on a clean bench. Follow closely the disassembly procedure outlined in the manual. CAUTION: Extreme care must be taken to insure correct reassembly of control unit. Place all parts in the removal sequence on the bench.
8. Clean and inspect all parts for wear and damage.
9. Replace the worn parts with the new replacement parts.
10. Lubricate the parts with power steering fluid and reassemble. Follow re-assembly procedure of repair manual closely.
11. Remount control unit in the vehicle. Refer to manual for proper steering centering procedure.
12. Correct fluid level with power steering fluid.
13. Operate steering full left and right turns for positive assistance and assurance of repair of the problem. Check for leaks.
14. Ask the instructor to evaluate the completed work.
15. Clean work areas.
16. Clean and return all tools and equipment.
17. Proceed to next LAP.



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Overhaul of Power Steering Cylinders

OBJECTIVE:

Overhaul a power steering cylinder.

EVALUATION PROCEDURE:

80% correct on performance checklist.

Eight correct responses to a ten-item multiple choice objective test.

RESOURCES:

Repair Manual for make and model of car assigned

Automobile with power steering cylinder

Drain pan

Fender covers

Power steering fluid

Replacement parts as needed

Tools, Basic Hand (see Unit LEG)

PROCEDURE:

Steps

1. Place fender covers.
2. Correct fluid level if needed.
3. Test operate the power steering to diagnose problem of the defective steering. Refer to diagnose procedure of manual. Record results on work order.
4. Remove cylinder from vehicle. Refer to removal procedure of the repair manual. Use drain pan to catch leaking fluid.
5. Clean excessive dirt and grease from the cylinder exterior.
6. Disassemble cylinder on a clean bench. Refer to the manual for disassembly procedure. Keep all parts in order of removal.
7. Clean and inspect all parts for damage and wear.
8. Replace worn parts with the new replacement parts.

Principal Author(s): J. Anderson/W. Osland

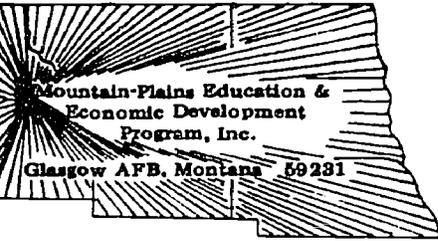
9. Lubricate all the parts with power steering fluid and reassemble. Refer to assembly procedure of manual.
10. Install cylinder on vehicle.
11. Correct fluid level.
12. Test operate power steering for satisfactory operation. Check for any signs of leakage.
13. Ask the instructor to evaluate the completed work.
14. Clean and return all tools and equipment.
15. Clean work areas.
16. Take and score the LAP test.

Student: _____

File Code: _____

Date: _____

Date Published: _____



LAP TEST: OVERHAULING POWER STEERING PUMPS, CONTROL UNITS
AND CYLINDERS

37.10.03.02.

1. To replace a leaking drive shaft seal:
 - a. ~~the pulley~~ can be removed, pry the seal out and install a new one without further disassembly.
 - b. the entire unit must be removed and disassembled.
 - c. it is best to overhaul the entire pump.
 - d. the pump should be fully tested for additional leaks.
2. Over-tightening of the pump belt will usually result in:
 - a. premature failure of the pump.
 - b. premature failure of the shaft bearing.
 - c. premature failure of the belt.
 - d. misalignment of the pump pulley.
3. The majority of power steering pumps are:
 - a. not equipped with any pressure control device.
 - b. partial flow.
 - c. pressure-relieved when the wheels are straight ahead.
 - d. constant pressure flow.

37.10.03.03.

4. You should record diagnosis results on:
 - a. the power steering unit.
 - b. top of the air cleaner so you won't forget.
 - c. nothing, it is not necessary.
 - d. a work order.
5. Prior to reassembly of the power steering unit, you should:
 - a. lubricate the parts with 30 weight oil.
 - b. lubricate the parts with a light grease.
 - c. clean them thoroughly and put them together dry.
 - d. lubricate the parts with power steering fluid.
6. To completely drain a power steering control unit you could:
 - a. turn the housing in every angle and it will drip completely dry.
 - b. put an air hose on the end of the pressure port seat.
 - c. remove the hoses from the pressure port seat and let it drain overnight.
 - d. drain it by turning the stub shaft on the rack piston several times.

37.10.03.04.

7. When overhauling a power steering cylinder, it is important to:
 - a. know where the reservoir is located.
 - b. avoid nicking parts and to keep all parts clean.
 - c. keep the oil full at all times.
 - d. have the ball nut connected directly to the power piston.

8. When reinstalling the steering gear, check for proper alignment with the:
 - a. worm.
 - b. steering shaft.
 - c. shift rods.
 - d. shim.

9. When reinstalling the steering gear, misalignment can:
 - a. correct itself over a period of time.
 - b. cause bindings and premature wear.
 - c. affect the reservoir and pump.
 - d. affect the steering pump cooler.

10. To admit oil pressure to the power cylinder, the pitman arm:
 - a. forces the tie rod to pump the oil into the cylinder.
 - b. turns off the shut-off valve.
 - c. moves the control valve to the open position.
 - d. develops five pounds of back pressure.

LAP TEST ANSWER KEY: OVERHAULING POWER STEERING PUMPS, CONTROL UNITS AND CYLINDERS

LAP .02

1. a
2. b
3. d

LAP .03

4. d
5. d
6. d

LAP .04

7. b
8. b
9. b
10. c

UNIT POST TEST ANSWER KEY: POWER STEERING(A)

LAP .01

1. c
2. c or b
3. a
4. d
5. c

LAP .02

6. b
7. c

LAP .03

8. c
9. c

LAP .04

10. a

37.10.03.02.

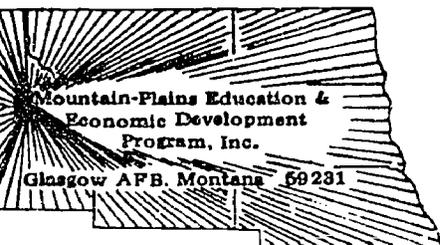
6. The slipper pump uses what to keep the slippers out against the wall?
- oil pressure.
 - springs.
 - centrifugal force.
 - balanced weights.
7. A vibrating flow control valve in the pump usually indicates:
- overfilled with fluid.
 - sticking valve.
 - low on fluid in the reservoir.
 - leaking pressure within the pump.

37.10.03.03.

8. A power steering control valve regulates oil under pressure to:
- the worm.
 - the reservoir.
 - the right or left of the rack-piston nut.
 - the sector shaft.
9. When adjusting the worm to rack-piston preload, you receive a mild preload from:
- the damper seal.
 - the reservoir tank.
 - the worm groove which is ground with a high point in the center.
 - the pressure port seat.

37.10.03.04.

10. When putting a power steering unit together again, you have how many basic adjustments on an in-line power steering gear?
- 3
 - 5
 - 2
 - 4



UNIT POST TEST: POWER STEERING (B)

37.10.03.01

1. In a rotary valve action unit, when the steering wheel is moved to the right, a turning force is applied to the stub shaft and through the pin to the:
 - a. pitman shaft.
 - b. spool valve.
 - c. torsion bar.
 - d. check valve.

2. In a self-contained, offset, power steering gear, the additional force offered by the pressurized oil is applied to:
 - a. the right turn power chamber only.
 - b. the spool valve.
 - c. the left turn power chamber only.
 - d. the pitman shaft.

3. Oil leakage in the power steering pump is prevented by:
 - a. neoprene rubber rings that ride in grooves.
 - b. a brass bushing.
 - c. a collar.
 - d. a back pressure valve.

4. The worm shaft is connected to the steering shaft by a:
 - a. brass bushing.
 - b. universal joining.
 - c. flexible connector.
 - d. spool valve.

5. The two forces on the center thrust bearing "fight" against the driver's turning force on the wheel and produce:
 - a. a vibration in the front-end which can cause you to lose control of your car.
 - b. a hazard when driving.
 - c. road feel.
 - d. no feel at all if you have a good power steering unit.

37.10.03.02

6. A vibrating flow control valve in the pump usually indicates:
 - a. overfilled with fluid.
 - b. sticking valve.
 - c. low on fluid in the reservoir.
 - d. leaking pressure within the pump.

37.10.03.02 (continued)

7. The slipper pump uses what to keep the slippers out against the wall?
- oil pressure.
 - springs.
 - centrifugal force.
 - balanced weights.

37.10.03.03

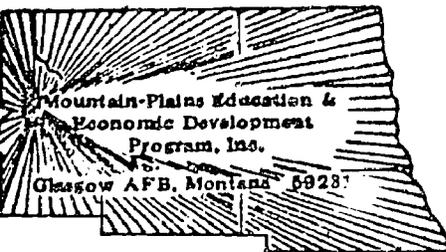
8. When adjusting the worm to rack-piston preload, you receive a milk preload from:
- the damper seal.
 - the reservoir tank.
 - the worm groove which is ground with a high point in the center.
 - the pressure port seat.
9. A power steering control valve regulates oil under pressure to:
- the worm.
 - the reservoir.
 - the right or left of the rack-piston nut.
 - the sector shaft.

37.10.03.04

10. When putting a power steering unit together again, you have how many basic adjustments on an in-line power steering gear?
- 3
 - 5
 - 2
 - 4

UNIT POST TEST ANSWER KEY: POWER STEERING (B)

1. C
2. D
3. A
4. C or B
5. C
6. C
7. B
8. C
9. C
10. A



UNIT POST TEST: POWER STEERING(C)

37.10.03.01

1. In a self-contained, offset, power steering gear, the additional force offered by the pressurized oil is applied to:
 - a. the right turn power chamber only.
 - b. the spool valve.
 - c. the left turn power chamber only.
 - d. the pitman shaft.
2. Oil leakage in the power steering pump is prevented by:
 - a. neoprene rubber rings that ride in grooves.
 - b. a brass bushing.
 - c. a collar.
 - d. a back pressure valve.
3. In a rotary valve action unit, when the steering wheel is moved to the right, a turning force is applied to the stub shaft and through the pin to the:
 - a. pitman shaft.
 - b. spool valve.
 - c. torsion bar.
 - d. check valve.
4. The two forces on the center thrust bearing "fight" against the driver's turning force on the wheel and produce:
 - a. a vibration in the front-end which can cause you to lose control of your car.
 - b. a hazard when driving.
 - c. road feel.
 - d. no feel at all if you have a good power steering unit.
5. The worm shaft is connected to the steering shaft by a:
 - a. brass bushing.
 - b. universal joint.
 - c. flexible connector.
 - d. spool valve.

37.10.03.02

6. The slipper pump uses what to keep the slippers out against the wall?
 - a. oil pressure.
 - b. springs.
 - c. centrifugal force.
 - d. balanced weights.

37.10.03.02 (continued)

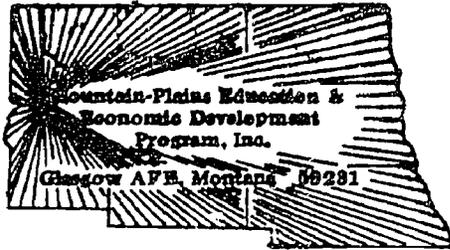
7. A vibrating flow control valve in the pump usually indicates:
- overfilled with fluid.
 - sticking valve.
 - low on fluid in the reservoir.
 - leaking pressure within the pump.

37.10.03.03

8. A power steering control valve regulates oil under pressure to:
- the worm.
 - the reservoir.
 - the right or left of the rack-piston nut.
 - the sector shaft.
9. When adjusting the worm to rack-piston preload, you receive a milk preload from:
- the damper seal.
 - the reservoir tank.
 - the worm groove which is ground with a high point in the center.
 - the pressure port seat.

37.10.03.04

10. When putting a power steering unit together again, you have how many basic adjustments on an in-line power steering gear?
- 3
 - 5
 - 2
 - 4



UNIT POST TEST: POWER STEERING(C)

37.10.03.01

1. In a self-contained, offset, power steering gear, the additional force offered by the pressurized oil is applied to:
 - a. the right turn power chamber only.
 - b. the spool valve.
 - c. the left turn power chamber only.
 - d. the pitman shaft.
2. Oil leakage in the power steering pump is prevented by:
 - a. neoprene rubber rings that ride in grooves.
 - b. a brass bushing.
 - c. a collar.
 - d. a back pressure valve.
3. In a rotary valve action unit, when the steering wheel is moved to the right, a turning force is applied to the stub shaft and through the pin to the:
 - a. pitman shaft.
 - b. spool valve.
 - c. torsion bar.
 - d. check valve.
4. The two forces on the center thrust bearing "fight" against the driver's turning force on the wheel and produce:
 - a. a vibration in the front-end which can cause you to lose control of your car.
 - b. a hazard when driving.
 - c. road feel.
 - d. no feel at all if you have a good power steering unit.
5. The worm shaft is connected to the steering shaft by a:
 - a. brass bushing.
 - b. universal joint.
 - c. flexible connector.
 - d. spool valve.

37.10.03.02

6. The slipper pump uses what to keep the slippers out against the wall?
 - a. oil pressure.
 - b. springs.
 - c. centrifugal force.
 - d. balanced weights.

37.10.03.02 (continued)

7. A vibrating flow control valve in the pump usually indicates:
- overfilled with fluid.
 - sticking valve.
 - low on fluid in the reservoir.
 - leaking pressure within the pump.

37.10.03.03

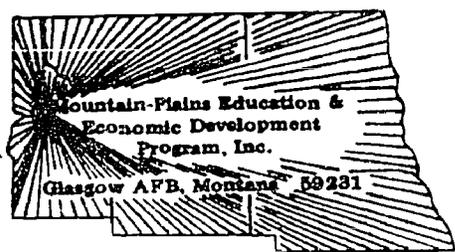
8. A power steering control valve regulates oil under pressure to:
- the worm.
 - the reservoir.
 - the right or left of the rack-piston nut.
 - the sector shaft.
9. When adjusting the worm to rack-piston preload, you receive a milk preload from:
- the damper seal.
 - the reservoir tank.
 - the worm groove which is ground with a high point in the center.
 - the pressure port seat.

37.10.03.04

10. When putting a power steering unit together again, you have how many basic adjustments on an in-line power steering gear?
- 3
 - 5
 - 2
 - 4

UNIT POST TEST ANSWER KEY: POWER STEERING (C)

1. D
2. A
3. C
4. C
5. C or B
6. B
7. C
8. C
9. C
10. A



UNIT PERFORMANCE TEST: POWER STEERING

OBJECTIVE 1:

Overhaul power steering units.

TASK:

The student will be assigned a vehicle on which he must overhaul the power steering pump and control units.

ASSIGNMENT:

CONDITIONS:

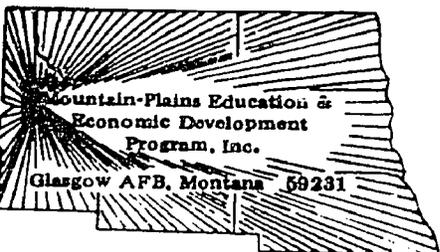
The student must perform the test using only those materials provided for the test and complete the test in the auto shop.

RESOURCES:

- Service Manual
- Parts and Time Manual
- Parts if Needed
- Snap Ring Pliers
- Hoses if needed
- Power Steering Fluid
- Overhaul Gasket Set

RESOURCES: (Cont.)

Jack
Jack Stands
Fender Covers
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

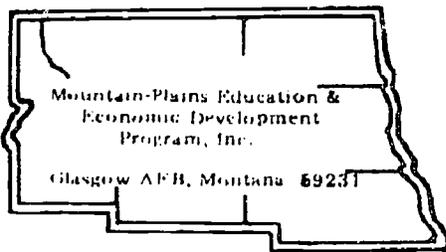


Family Pay Number: _____ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Remove power steering pump.		
Criterion: Does not damage pump or vehicle.		
2. Disassemble and inspect pump components.		
Criterion: Compares parts to manufacturer's specifications.		
3. Assembles pump.		
Criterion: Must follow service manual procedures and meet manufacturer's specifications.		
4. Remove power steering control unit.		
Criterion: Does not damage unit or vehicle.		
5. Disassembles and inspects power steering control unit.		
Criterion: Compares parts to manufacturer's specifications.		
6. Assembles and installs power steering control unit.		



Learning Experience Guide

UNIT: FUNDAMENTALS OF SUSPENSION

RATIONALE:

The fundamentals in this unit will familiarize you with the components of front-end suspension and enable you to properly replace front-end components.

PREREQUISITES:

Math Skills at Level E for LAP 1
 Math Skills at Level F for LAPs 2-4
 Communication Skills at Level E for LAP 1
 Communication Skills at Level F for LAPs 2-4

OBJECTIVE:

Recognize the components and proper operation of front-end suspension and the correct procedure for replacement of front-end components. Replace front-end components.

RESOURCES:

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Motor's Auto Repair Manual. Motor, The Hearst Corporation, 1972 or equivalent.

Automobile needing replacement for: ball joint
 control arm bushing
 idler arm
 tie rod

Cotter key
 Creeper
 Grease
 Jacks (or lift)
 Jack stands
 Projector
 Replacement parts
 Special installation tools for ball joints

Principal Author(s): C. Schramm/W. Osland

RESOURCES: Equipment (cont.)

Tools, Basic Hand:

Chisel and Punch Set
 5/32" Pin Punch
 3/16" Solid

Gauge, feeler (.002" - .025")

Hammer, ball peen
 Hammer, plastic tip
 Handle, speed
 Hex Key Set

Pliers, diagonal cutting
 Pliers, needle nose

Scraper, gasket
 Screwdriver, standard (Set)
 Screwdriver, phillips (Set)
 Screw starter

Socket Set (3/8" drive)
 extension (3")
 ratchet

Socket Set (1/4" drive)
 extension (3")
 handle (6" flex)
 ratchet

Socket, spark plug
 extension (6")

Wrench, combination (Set)
 Wrench, combination ignition (Set)

GENERAL INSTRUCTIONS:

This unit consists of five Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

- (1) Read the first assigned Learning Activity Package (LAP).
- (2) Begin and complete the first assigned LAP.
- (3) Take and score the LAP test.
- (4) Turn in the LAP test answer sheet.
- (5) Determine the reason for any missed items on the LAP test.
- (6) Proceed to and complete the next assigned LAP in the unit.
- (7) Complete all required LAPs for the unit by following steps 3 through 6.
- (8) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
- (9) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

- .01 Fundamentals of Front-End Suspension
- .02 Replacing Ball Joints
- .03 Replacement of Tie-Rod Ends
- .04 Replacement of Idler Arms
- .05 Replacement of Control Arm Bushings

EVALUATION PROCEDURE:

When pretesting:

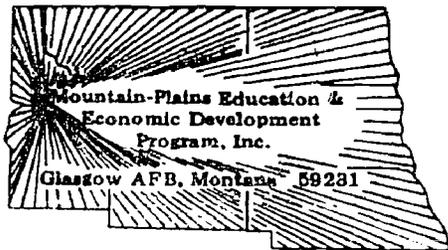
1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).



UNIT PRETEST: FUNDAMENTALS OF SUSPENSION

37.10.04.01.

1. The integral type frame is constructed as a:
 - a. part of the body.
 - b. separate unit from the body.
 - c. part of the main suspension.
 - d. separate steel frame.
2. Spring oscillation is:
 - a. the forward and backward movement of the springs caused by the wheel hitting a bump.
 - b. the up and down movement of the spring caused by the wheel hitting a bump.
 - c. the upward movement of the spring caused by the wheel hitting a bump.
 - d. the downward motion of the spring caused by the wheel hitting a bump.
3. Independent front suspension:
 - a. lets each front wheel turn independently.
 - b. allows the car to turn freely on corners.
 - c. allows either front wheel to move up and down independently.
 - d. allows the front wheels to move up and down at the same time.
4. The use of ball joints on the independent front suspension replaces the use of:
 - a. rubber bushing and gromets.
 - b. spindle and wheel bearings.
 - c. springs and shackles.
 - d. threaded bushings and kingpins.
5. The stabilizer bar is used to:
 - a. stabilize lower control arm.
 - b. overcome spring oscillations.
 - c. overcome unsprung weight.
 - d. overcome the tendency for car's body to lean on corners.
6. When lubricating the suspension system, never grease:
 - a. ball joints.
 - b. kingpins.
 - c. tie rod ends.
 - d. rubber gromets and bushings.

37.10.04.01. cont.

7. Positive camber is tipping the tops of the wheels:
- in.
 - out.
 - back.
 - forward.
8. When removing coil springs that are under pressure:
- lower the complete front-end.
 - stand clear as the last bolt is loosened.
 - keep the weight on the spring.
 - use a coil spring compressor.
9. A long bar of strong steel that is used to support suspension weight is referred to as a:
- strut bar.
 - stabilizer bar.
 - torsion bar.
 - tie rod bar.
10. The term used for the weight of all parts of the car that are supported by the suspension system is:
- drop-weight.
 - unsprung weight.
 - out-of-balance.
 - sprung weight.

37.10.04.02.

11. To check the ball joint wear effectively:
- the wheel bearings must be loose.
 - the wheel must not be off the floor.
 - the pressure must be released.
 - the front shocks must be removed.
12. _____
13. Riveted mounted ball joints are replaced with:
- bolts.
 - new rivets.
 - welding into place.
 - screw in ball joints.

37.10.04.02. cont.

14. When lowering the disconnected ball joint arm with a jack, the jack should be:
- a quick release hydraulic hand jack.
 - parallel with the frame.
 - directly below the spring on the arm.
 - parallel with the length of the suspension arm.
15. After installation of the joint into the spindle:
- a lock washer and nut should be quickly installed.
 - the nut should be hand tightened as much as possible and pinned.
 - the nut should be torqued.
 - the joint nut and a lock nut should be installed.

37.10.04.03.

16. Before tie-rod-end removal:
- the tie rod should be checked for being bent.
 - the length of the tie rod should be measured and recorded.
 - the tie-rod-end should be threaded out of the sleeve.
 - the steering wheel should be locked into position.

37.10.04.04.

17. The function of the idler arm is to:
- support front-end suspension weight.
 - move the steering linkage to turn the wheels.
 - carry the steering linkage movement.
 - move the pitman arm in the direction necessary to turn.
- 18.

37.10.04.05.

19. When one arm bushing is worn:
- both bushings of that arm should be replaced.
 - it should be replaced only to save time and expense.
 - replace the one and measure the other for amount of extended life.
 - the entire control arm should be replaced.
- 20.

UNIT/LAP PRETEST ANSWER KEY: FUNDAMENTALS OF SUSPENSION

LAP .01

1. a
2. b
3. c
4. d
5. d
6. d
7. b
8. d
9. c
10. d

LAP .02

11. c
12. d
13. a
14. d
15. c

LAP .03

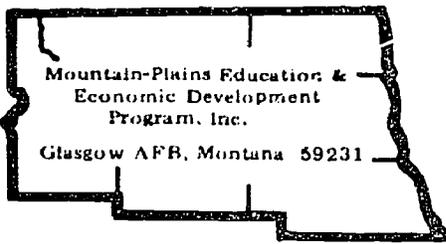
16. b

LAP .04

17. c
18. d

LAP .05

19. a
20. b



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Fundamentals of Front-End Suspension

OBJECTIVE:

Recognize the operation of each component of a suspension system.

EVALUATION PROCEDURE:

80% correct on LAP study questions.

Eight correct responses to a ten-item multiple-choice objective test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

Auto Service and Repair, Stockel.

PROCEDURE:

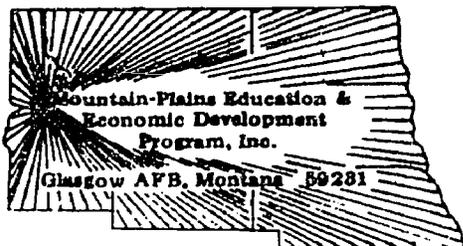
1. Do the following assignments using Auto Mechanics Fundamentals:
 - a. Read Chapter 15, "Frames, Bodies, Springs, Suspension Systems," pages 283-301.
 - b. Study all schematic drawings thoroughly.
 - c. Answer quiz questions 1-35 on pages 300, 301.
 - d. Read Chapter 17, "Front Wheel Alignment, Steering System," pages 313-336.
 - e. Study all the schematic drawings thoroughly.
 - f. Answer quiz questions 1-17 on page 336.
 - g. Return text to shelf and turn quiz answers over to the instructor for evaluation.

2. Do the following assignments using Auto Repair and Service:
 - a. Read Chapter 31, "Steering Suspension Systems Service," pages 31.20 through 31.38.
 - b. Study all the schematic drawings.
 - c. Familiarize yourself with "Problem Diagnosis," pages 31.38 through 31.40.
 - d. Complete answers to quiz questions 23-42 on page 31.41.
 - e. Read Chapter 30, "Wheels, Bearings, Tires," pages 30.1 through 30.20.

Principal Author(s): J. Anderson/W. Osland

Procedure: continued

- f. Study all the schematic drawings on page 30.20.
 - g. Read the "Problem Diagnosis" section, page 30.26 through page 30.29. This information will be helpful in actual work diagnosing.
 - h. Answer quiz questions 1-24 on pages 30.29 and 30.30.
 - i. Return text to shelf and turn your quiz answers over to the instructor for evaluation.
3. Take and score the LAP test.
 4. If the score is less than 80%, review the material.



LAP TEST: FUNDAMENTALS OF FRONT-END SUSPENSION

1. The integral type frame is constructed as a:
 - a. part of the body.
 - b. separate unit from the body.
 - c. part of the main suspension.
 - d. separate steel frame.

2. Spring oscillation is:
 - a. the forward and backward movement of the springs caused by the hitting a bump.
 - b. the up and down movement of the spring caused by the wheel hitting a bump.
 - c. the upward movement of the spring caused by the wheel hitting a bump.
 - d. the downward motion of the spring caused by the wheel hitting a bump.

3. Independent front suspension:
 - a. lets each front wheel turn independently.
 - b. allows the car to turn freely on corners.
 - c. allows either front wheel to move up and down independently.
 - d. allows the front wheels to move up and down at the same time.

4. The use of ball joints on the independent front suspension replaces the use of:
 - a. rubber bushing and gromets.
 - b. spindle and wheel bearings.
 - c. springs and shackles.
 - d. threaded bushings and kingpins.

5. The stabilizer bar is used to:
 - a. stabilize lower control arm.
 - b. overcome spring oscillations.
 - c. overcome unsprung weight.
 - d. overcome the tendency for car's body to lean on corners.

6. When lubricating the suspension system, never grease:
 - a. ball joints.
 - b. kingpins.
 - c. tie rod ends.
 - d. rubber gromets and bushings.

37.10.04.01. cont.

7. Positive camber is tipping the tops of the wheels:
 - a. in.
 - b. out.
 - c. back.
 - d. forward.

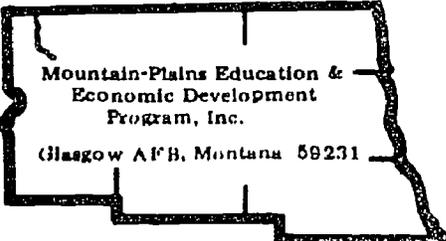
8. When removing coil springs that are under pressure:
 - a. lower the complete front-end.
 - c. keep the weight on the spring.
 - d. use a coil spring compressor.

9. A long bar of strong steel that is used to support suspension weight is referred to as a:
 - a. strut bar.
 - b. stabilizer bar.
 - c. torsion bar.
 - d. tie rod bar.

10. The term used for the weight of all parts of the car that are supported by the suspension system is:
 - a. drop-weight.
 - b. unsprung weight.
 - c. out-of-balance.
 - d. sprung weight.

LAP TEST ANSWER KEY: FUNDAMENTALS OF FRONT-END SUSPENSION

1. a
2. b
3. ~~a~~ C
4. ~~a~~ D
5. d
6. ~~a~~ D
7. b
8. d
9. ~~a~~ C
10. ~~a~~ D



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Glasgow AFB, Montana 59231

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacing Ball Joints

OBJECTIVE:

Identify the correct procedure for removing and replacing the ball joints. Replace a set of ball joints.

EVALUATION PROCEDURE:

80% correct on performance checklist.
LAP test after completion of LAP 37,10,04,03.

RESOURCES:

Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

Automobile needing new ball joints
Jack
Jack stands

Replacements parts
Special tools for installation of
ball joints
Tools, Basic Hand: (see Unit LEG)

PROCEDURE:

NOTE: Review pages 31-23 through 31-28 in Auto Service and Repair.

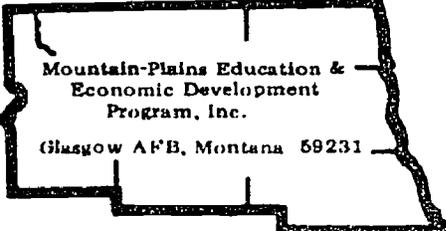
CAUTION: Extreme caution must be observed because of the coil springs.

1. Raise vehicle and secure it safely with jack stands.
2. Remove wheel and assembly.
3. Clean suspension parts and ball joints of dirt and grease to improve working conditions.
4. Obtain manual for the specific directions to follow for the particular make, model and year of the car being worked on.

NOTE: Due to the variety of suspension systems, the mechanic must learn to use the manual in working independently with each individual automobile.

Principal Author(s): J. Anderson/W. Osland

5. Follow the directions in the manual for changing the ball joints.
6. Return manual, tools and all equipment to their proper places after lowering the car.
7. Be sure new ball joints have a sufficient amount of grease before leaving the shop.
8. Upon completion, the instructor will inspect the job. If satisfactory, proceed to the next LAP.



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Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacement of Tie-Rod Ends

OBJECTIVE:

Demonstrate the correct procedure for replacement of tie-rod ends.

EVALUATION PROCEDURE:

80% correct on performance checklist.

Eight correct responses to a ten-item multiple choice objective test.

RESOURCES:

Automobile needing tie-rod replacement
Cotter keys
Grease
Jack
Jack stands
New Tie-Rod Ends
Tools, basic hand (See Unit LEG)

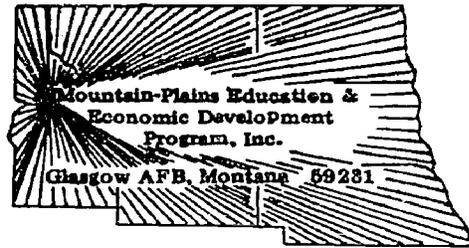
Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

PROCEDURE:

NOTE: Review pages 31-21 through 31-22 in Auto Service and Repair.

1. Raise front of vehicle and secure with jack stands.
2. Remove tie-rods. Refer to manual for correct removal procedure.
3. Compare new tie-rod end to the old one to be sure of exact replacement.
4. Install the new tie-rod end following the procedure from the repair manual.
5. Ask the instructor to evaluate your work.
6. Lower vehicle.
7. Clean and return all tools and equipment.
8. Clean work areas.
9. Take and score the LAP test.
10. Upon successful completion, proceed to the next LAP.

Principal Author(s): J. Anderson/W. Osland



LAP TEST: REPLACEMENT OF BALL JOINTS AND TIE-ROD-ENDS

37.10.04.02

1. Often the factory installed joints (original equipment):
 - a. are riveted into place and must be cut.
 - b. are pressed into place and must be cut out.
 - c. can only be replaced by replacing the entire control arm assembly.
 - d. must be cut out entirely with a torch.
2. In replacing a balljoint with the spring on the upper control arm:
 - a. the spring must be removed.
 - b. the weight of the car must be supported by the upper control arm.
 - c. a block or a support wedge should be used between the upper control arm and the frame.
 - d. a hydraulic jack must be used to lower the control arm after the ball stud nut is loosened.
3. Riveted mounted ball joints are replaced with:
 - a. bolts.
 - b. new rivets.
 - c. welding into place.
 - d. screw in ball joints.
4. Pressed ball joints are removed from the spindle:
 - a. with a special tool and a hammer.
 - b. with a special tool.
 - c. with a hammer.
 - d. by the use of heat.
5. After installation of the joint into the spindle:
 - a. a lock washer and nut should be quickly installed.
 - b. the nut should be hand tightened as much as possible and pinned.
 - c. the nut should be torqued.
 - d. the joint nut and a lock nut should be installed.
6. After ball joint installation, camber should be checked and adjusted on:
 - a. shim adjusting vehicles.
 - b. eccentric adjusting vehicles.
 - c. all types of suspension systems.
 - d. sliding slot adjustment vehicles.

37.10.04.02 (continued)

7. After joint installation:

- a. the new joint should be checked for amount of free play.
- b. the joint should be tested.
- c. the jack should be lowered slowly in releasing the car weight.
- d. the joint should be lubricated.

37.10.04.03

8. After first torquing the tie-rod-end nut to specifications:

- a. install a cotter key and bend the ends down flat.
- b. it is recommended to rap the spindle arm and retorque.
- c. adjust the tie rod sleeve to the correct length.
- d. also tighten the tie rod sleeve locking clamps.

9. The tie-rod-end should be threaded into the sleeve:

- a. at any time convenient.
- b. after installation into the tapered hole.
- c. by turning the sleeve.
- d. before installation into the tapered hole.

10. Toe-in adjustment can be almost unnecessary if the:

- a. the tie rod sleeve is measured before disassembly.
- b. tie rod sleeve is marked.
- c. tie rod length is measured before disassembly.
- d. the wheel and steering wheel are locked in the straight ahead position.

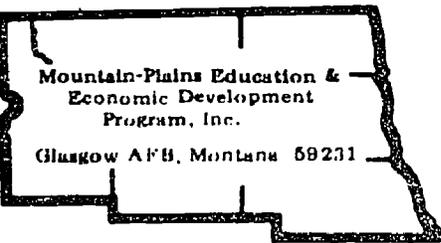
LAP TEST ANSWER KEY: REPLACEMENT OF BALL JOINTS AND TIE-ROD-ENDS

LAP .02

1. A or C
2. C
3. A
4. A or B
5. C
6. All
7. D

LAP .03

8. B or A
9. D
10. C



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacement of Idler Arms

OBJECTIVE:

Recognize the correct procedure for the removal and replacement of idler arms.

EVALUATION PROCEDURE:

80% correct on performance checklist.
LAP test after completion of LAP 37.10.04.05.

RESOURCES:

Automobile needing idler arm replacement
Cotter key
Creeper
Idler arm
Jack
Jack stands
Tools, Basic Hand: (See Unit LEG)

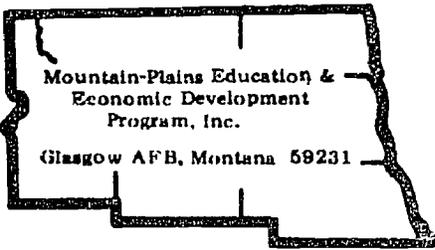
Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

PROCEDURE:

NOTE: Review page 31-22 in Auto Service and Repair.

1. Raise vehicle and secure stands.
2. Remove defective idler arm. Refer to repair manual for procedure.
3. Compare defective idler arm to the new idler arm to insure exact replacement.
4. Install new idler arm and cotter key.
5. Ask the instructor to evaluate your completed work.
6. Clean and return all tools and equipment.
7. Clean work area.
8. Proceed to next LAP.

Principal Author(s): J. Anderson/W. Osland



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Replacement of Control Arm Bushings

OBJECTIVE:

Demonstrate correct procedure for replacement of control arm bushings.

EVALUATION PROCEDURE:

80% correct on performance checklist.
Eight correct responses to a ten-item multiple choice objective test.

RESOURCES:

Automobile needing control arm bushing replacement
Jack
Jack stand
New control arm bushings
Tools, Basic Hand: (See Unit LEG)

Auto Service and Repair, Stockel
Motor's Auto Repair Manual.

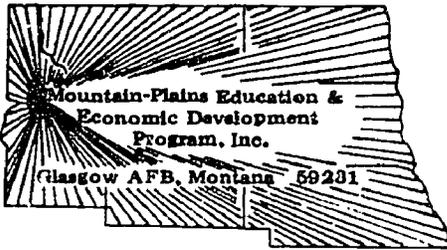
PROCEDURE:

NOTE: Review page 31-30 through 31-31 in Auto Service and Repair.

1. Raise front of vehicle and secure jack stands.
2. Remove front wheels for easier access to bushings.
3. Locate removal procedure in manual and follow the procedure step-by-step to safely and properly remove and replace the control arm bushings.
NOTE: Because of the variety of vehicles and safety precautions, it is mandatory to refer to a repair manual.
4. Ask the instructor to evaluate your work.
5. Lower car.
6. Clean and return all tools and equipment to tool room.
7. Clean work area.
8. Take and score the LAP test.

Principal Author(s): J. Anderson/W. Osland

9. Upon completion of LAP test obtain a copy of unit post test. Answer all of the questions and return test to the instructor for evaluation.
10. Upon successful completion of unit test, proceed to the next unit.



LAP TEST: REPLACEMENT OF IDLER ARMS AND CONTROL ARM BUSHINGS

37.10.04.04

1. The function of the idler arm is to:
 - a. support front-end suspension weight.
 - b. move the steering linkage to turn the wheels.
 - c. carry the steering linkage movement.
 - d. move the pitman arm in the direction necessary to turn.
2. The idler arm is bolted to:
 - a. the frame and linkage.
 - b. the frame and the pitman arm.
 - c. the pitman and the linkage.
 - d. the tie rod and tie rod center link.
3. Idler arm replacement can be done with:
 - a. pickle fork, hand tools, hammer.
 - b. hand tools, hammer.
 - c. hand tools, press, hammer.
 - d. hand tools, hydraulic hand jack.
4. For easier installation of idler arm repair kit components, a:
 - a. rubber lubricant can be used on the sliding bushings.
 - b. light coat of oil can be used on the sliding bushings.
 - c. light coat of heavy grease can be used on the sliding bushings.
 - d. application of clean solvent can be used.
5. As part of the installation, idler arms should be:
 - a. aligned.
 - b. oiled.
 - c. adjusted.
 - d. torqued.

37.10.04.05

6. If an upper control arm bushing is worn:
 - a. replace only the worn bushing.
 - b. replace both bushings.
 - c. replace upper and lower arm bushings.
 - d. it is necessary to replace the entire control arm assembly.

37.10.04.05 (continued)

7. While pressing the new bushings in the control arm pad to prevent collapsing the control arm around the bushing, it is recommended to use:
 - a. extreme caution.
 - b. a tube support.
 - c. a press ram.
 - d. a spacer block.

8. To install bushings into a double arm bushing control arm with a press, it is necessary to use what to prevent distortion?
 - a. spacer block.
 - b. stiffener plate.
 - c. tube.
 - d. puller.

9. In removing the control arm from the coil spring mounted type, it is mandatory to use:
 - a. a hydraulic floor jack.
 - b. a coil spring compressor.
 - c. a safety chain.
 - d. a jack stand on the control arm.

10. On a control arm bushing, the movement of the arm (up and down) is accomplished by:
 - a. the bushing outer sleeve rotating in the arm.
 - b. the bushing inner part rotating on the bolt.
 - c. the twisting of the rubber.
 - d. the pivot bolt rotating in the control arm.

LAP TEST ANSWER KEY: REPLACEMENT OF IDLER ARMS AND CONTROL
ARM BUSHINGS

LAP 04

1. C
2. A
3. ~~B~~ A 4/20 ~~B~~
4. A
5. D

LAP 05

6. B
7. D
8. B
9. B
10. ~~X~~ C 9/13 ~~X~~ D



UNIT POST TEST: FUNDAMENTALS OF SUSPENSION (A)

37.10.04.01

1. The integral type frame is constructed as a:
 - a. part of the body.
 - b. separate unit from the body.
 - c. part of the main suspension.
 - d. separate steel frame.
2. Spring oscillation is:
 - a. the forward and backward movement of the springs caused by the wheel hitting a bump.
 - b. the up and down movement of the spring caused by the wheel hitting a bump.
 - c. the upward movement of the spring caused by the wheel hitting a bump.
 - d. the downward motion of the spring caused by the wheel hitting a bump.
3. The purpose of the shock absorber is to:
 - a. eliminate swaying of the car.
 - b. keep the tires from bouncing.
 - c. fasten the body to the axles.
 - d. overcome spring oscillations.
4. Independent front suspension:
 - a. lets each front wheel turn independently.
 - b. allows the car to turn freely on corners.
 - c. allows either front wheel to move up and down independently.
 - d. allows the front wheels to move up and down at the same time.
5. When lubricating the suspension system, never grease:
 - a. ball joints.
 - b. kingpins.
 - c. tie rod ends.
 - d. rubber gromets and bushings.
6. Caster angle, as applied to the steering system, is the:
 - a. amount each tire points in at the front.
 - b. inward and outward tilt of the kingpin or ball joint at the top.
 - c. forward or backward tilt of kingpin or ball joint at the top.
 - d. amount each tire points out at the front.

37.10.04.01 (continued)

7. Positive camber is tipping the tops of the wheels:
 - a. in.
 - b. out.
 - c. back.
 - d. forward.

8. When removing coil springs that are under pressure:
 - a. lower the complete front-end.
 - b. stand clear as the last bolt is loosened.
 - c. keep the weight on the spring.
 - d. use a coil spring compressor.

9. The term used for the weight of all parts of the car that are supported by the suspension system is:
 - a. drop-weight.
 - b. unsprung weight.
 - c. out-of-balance.
 - d. sprung weight.

10. The disadvantage of solid axle front-ends is:
 - a. difficulty in aligning the front-ends.
 - b. costly front-end repairs.
 - c. bump action of the road will effect the other wheel.
 - d. leaf springs will sag under excessive weight.

37.10.04.02

11. To test a ball joint with the spring against the upper control arm, the mechanic would need a:
 - a. support wedge.
 - b. smaller jack.
 - c. spring compressor.
 - d. ball joint wrench.

12. When replacing a ball joint with the spring on the lower control arm and the ball joint stud loose in the knuckle:
 - a. place a safety stand under the lower control arm.
 - b. chain up the upper control arm.
 - c. remove the coil spring with a spring compressor.
 - d. lower the lower control arm carefully with a hydraulic jack.

13. Which of the following statements is true about a McPherson strut front suspension:
 - a. upper and lower control arms are used.
 - b. two ball joints are used.
 - c. camber and caster is adjusted by shimming the upper control arm.
 - d. the shock absorber is built into the strut.

37.10.04.02 (continued)

14. When lowering the disconnected ball joint arm with a jack, the jack should be:
- a quick release hydraulic hand jack.
 - parallel with the frame.
 - directly below the spring on the arm.
 - parallel with the length of the suspension arm.
15. After installation of the joint into the spindle:
- a lock washer and nut should be quickly installed.
 - the nut should be hand tightened as much as possible and pinned.
 - the nut should be torqued.
 - the joint nut and a lock nut should be installed.

37.10.04.03

16. Before tie-rod-end removal:
- the tie rod should be checked for being bent.
 - the length of the tie rod should be measured and recorded.
 - the tie-rod-end should be threaded out of the sleeve.
 - the steering wheel should be locked into position.

37.10.04.04

17. After installation, idler arms should be:
- aligned.
 - greased.
 - adjusted.
 - torqued.
18. Idler arm movement for wear testing can be done by:
- telescoping gauge.
 - use of a dial indicator.
 - eye observation.
 - torque wrench.

37.10.04.05

19. To install bushings into a double arm bushing control arm with a press, it is necessary to use what to prevent distortion?
- spacer block.
 - stiffener plate.
 - tube.
 - puller.
20. When replacing suspension arm bushings:
- replace the one needed.
 - always replace both bushings.
 - replace them with cast iron bushings.
 - replace upper and lower bushings.

POST TEST ANSWER KEY: FUNDAMENTALS OF SUSPENSION (A)

LAP .01

1. A
2. B
3. D
4. C
5. D
6. C
7. B
8. D
9. D
10. C

LAP .02

11. A
12. D
13. D
14. D
15. C

LAP .03

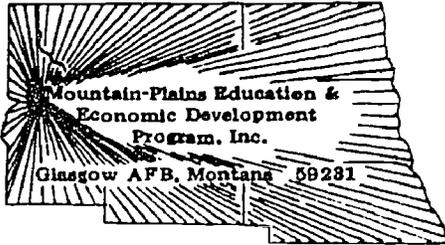
16. B

LAP .04

17. D
18. C

LAP .05

19. B
20. B



UNIT POST TEST: FUNDAMENTALS OF SUSPENSION (B)

37.10.04.01

1. The disadvantage of solid axle front-ends is:
 - a. difficulty in aligning the front-end.
 - b. costly front-end repairs.
 - c. bump action of the road will effect the other wheel.
 - d. leaf springs will sag under excessive weight.

2. The term used for the weight of all parts of the car that are supported by the suspension system is:
 - a. drop-weight.
 - b. unsprung weight.
 - c. out-of-balance.
 - d. sprung weight.

3. When removing coil springs that are under pressure:
 - a. lower the complete front-end.
 - b. stand clear as the last bolt is loosened.
 - c. keep the weight on the spring.
 - d. use a coil spring compressor.

4. Positive camber is tipping the tops of the wheels:
 - a. in.
 - b. out.
 - c. back.
 - d. forward.

5. Caster angle, as applied to the steering system, is the:
 - a. amount each tire points in at the front.
 - b. inward and outward tilt of the kingpin or ball joint at the top.
 - c. forward or backward tilt of kingpin or ball joint at the top.
 - d. amount each tire points out at the front.

6. When lubricating the suspension system, never grease:
 - a. ball joints.
 - b. kingpins.
 - c. tie rod ends.
 - d. rubber gromets and bushings.

37.10.04.01 (continued)

7. Independent front suspension:
 - a. lets each front wheel turn independently.
 - b. allows the car to turn freely on corners.
 - c. allows either front wheel to move up and down independently.
 - d. allows the front wheels to move up and down at the same time.
8. The purpose of the shock absorber is to:
 - a. eliminate swaying of the car.
 - b. keep the tires from bouncing.
 - c. fasten the body to the axles.
 - d. overcome spring oscillations.
9. Spring oscillation is:
 - a. the forward and backward movement of the springs caused by the wheel hitting a bump.
 - b. the up and down movement of the spring caused by the wheel hitting a bump.
 - c. the upward movement of the spring caused by the wheel hitting a bump.
 - d. the downward motion of the spring caused by the wheel hitting a bump.
10. The integral type frame is constructed as a:
 - a. part of the body.
 - b. separate unit from the body.
 - c. part of the main suspension.
 - d. separate steel frame.

37.10.04.02

11. After installation of the joint into the spindle:
 - a. a lock washer and nut should be quickly installed.
 - b. the nut should be hand-tightened as much as possible and pinned.
 - c. the nut should be torqued.
 - d. the joint nut and a lock nut should be installed.
12. When lowering the disconnected ball joint arm with a jack, the jack should be:
 - a. a quick release hydraulic hand jack.
 - b. parallel with the frame.
 - c. directly below the spring on the arm.
 - d. parallel with the length of the suspension arm.
13. When replacing a ball joint with the spring on the lower control arm and the ball joint stud loose in the knuckle:
 - a. place a safety stand under the lower control arm.
 - b. chain up the upper control arm.
 - c. remove the coil spring with a spring compressor.
 - d. lower the lower control arm carefully with a hydraulic jack.

37.10.04.02 (continued)

14. Which of the following statements is true about a McPherson strut front suspension?
- upper and lower control arms are used.
 - two ball joints are used.
 - camber and caster is adjusted by shimming the upper control arm.
 - the shock absorber is built into the strut.
15. To test a ball joint with the spring against the upper control arm, the mechanic would need a:
- support wedge.
 - smaller jack.
 - spring compressor.
 - ball joint wrench.

37.10.04.03

16. Before tie-rod-end removal:
- the tie rod should be checked for being bent.
 - the length of the tie rod should be measured and recorded.
 - the tie-rod-end should be threaded out of the sleeve.
 - the steering wheel should be locked into position.

37.10.04.04

17. Idler arm movement for wear testing can be done by:
- telescoping gauge.
 - use of a dial indicator.
 - eye observation.
 - torque wrench.
18. After installation, idler arms should be:
- aligned.
 - greased.
 - adjusted.
 - torqued.

37.10.04.05

19. When replacing suspension arm bushings:
- replace the one needed.
 - always replace both bushings.
 - replace them with case iron bushings.
 - replace upper and lower bushings.
20. To install bushings into a double arm bushing control arm with a press, it is necessary to use what to prevent distortion:
- spacer block.
 - stiffener plate.
 - tube.
 - roller.

UNIT POST TEST: FUNDAMENTALS OF SUSPENSION

LAP .01

1. C
2. D
3. D
4. B
5. C
6. D
7. C
8. D
9. B
10. A

LAP .02

11. C
12. D
13. D
14. D
15. A

LAP .03

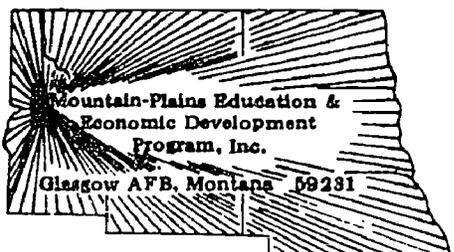
16. B

LAP .04

17. C
18. D

LAP .05

19. B
20. B



UNIT POST TEST: FUNDAMENTALS OF SUSPENSION (C)

37.10.04.01

1. The integral type frame is constructed as a :
 - a. part of the body.
 - b. separate unit from the body.
 - c. part of the main suspension.
 - d. separate steel frame.

2. The disadvantage of solid axle front-ends is:
 - a. difficulty in aligning the front-end.
 - b. costly front-end repairs.
 - c. bump action of the road will effect the other wheel.
 - d. leaf springs will sag under excessive weight.

3. When removing coil springs that are under pressure:
 - a. lower the complete front-end.
 - b. stand clear as the last bolt is loosened.
 - c. keep the weight on the spring.
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 - a. amount each tire points in at the front.
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 - a. eliminate swaying of the car.
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 - a. drop-weight.
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 - c. out-of-balance.
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37.10.04.01 (continued)

7. When lubricating the suspension system, never grease:
 - a. ball joints.
 - b. kingpins.
 - c. tie rod ends.
 - d. rubber gromets and bushing.

8. Positive camber is tipping the tops of the wheels:
 - a. in.
 - b. out.
 - c. back.
 - d. forward.

9. Spring oscillation is:
 - a. the forward and backward movement of the springs caused by the wheel hitting a bump.
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37.10.04.02

11. To test a ball joint with the spring against the upper control arm, the mechanic would need a:
 - a. support wedge.
 - b. smaller jack.
 - c. spring compressor.
 - d. ball joint wrench.

12. After installation of the joint into the spindle:
 - a. a lock washer and nut should be quickly installed.
 - b. the nut should be hand tightened as much as possible and pinned.
 - c. the nut should be torqued.
 - d. the joint nut and a lock nut should be installed.

13. When lowering the disconnected ball joint arm with a jack, the jack should be:
 - a. a quick release hydraulic hand jack.
 - b. parallel with the frame.
 - c. directly below the spring on the arm.
 - d. parallel with the length of the suspension arm.

37.10.04.02 (continued)

14. When replacing a ball joint with the spring on the lower control arm and the ball joint stud loose in the knuckle:
- place a safety stand under the lower control arm.
 - chain up the upper control arm.
 - remove the coil spring with a spring compressor.
 - lower the lower control arm carefully with a hydraulic jack.
15. Which of the following statements is true about a McPherson strut front suspension?
- upper and lower control arms are used.
 - two ball joints are used.
 - camber and caster is adjusted by shimming the upper control arm.
 - the shock absorber is built into the strut.

37.10.04.03

16. Before tie-rod-end removal:
- the tie rod should be checked for being bent.
 - the length of the tie rod should be measured and recorded.
 - the tie-rod-end should be threaded out of the sleeve.
 - the steering wheel should be locked into position.

37.10.04.04

17. After installation, idler arms should be:
- aligned.
 - greased.
 - adjusted.
 - torqued.
18. Idler arm movement for wear testing can be done by:
- telescoping gauge.
 - use of a dial indicator.
 - eye observation.
 - torque wrench.

37.10.04.05

19. To install bushings into a double arm bushing control arm with a press, it is necessary to use what to prevent distortion?
- spacer block.
 - stiffener plate.
 - tube.
 - puller.
20. When replacing suspension arm bushings:
- replace the one needed.
 - always replace both bushings.
 - replace them with cast iron bushings.
 - replace upper and lower bushings.

UNIT POST TEST ANSWER KEY: FUNDAMENTALS OF SUSPENSION (C)

LAP .01

1. A
2. C
3. D
4. C
5. D
6. D
7. D
8. B
9. B
10. C

LAP .02

11. A
12. C
13. D
14. D
15. D

LAP .03

16. B

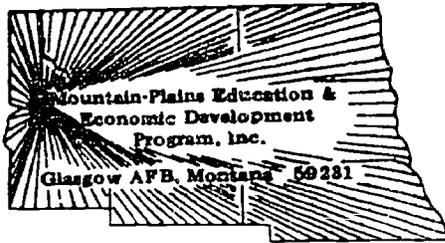
LAP .04

17. D
18. C
19. B
20. B

Student: _____ File Code: 37.10.04.00.81-5

Date: _____ Date Published: 3/10/76

Family Pay Number: _____ Sex: M F (Circle 1)



UNIT PERFORMANCE TEST: FRONT-END REPAIR

OBJECTIVE 1:

Inspect all front end parts as per checklist.

OBJECTIVE 2:

Repair front end parts as per checklist.

TASK:

The student will be assigned a vehicle needing front end repair. He will inspect ball joints, tie rod ends, idler arm, pitman arm, connecting link, control arm bushings, and stabilizer bushings for wear. He will replace those parts worn beyond specifications.

ASSIGNMENT:

CONDITIONS:

The student will use only those materials provided for the test and perform the activity in the auto shop.

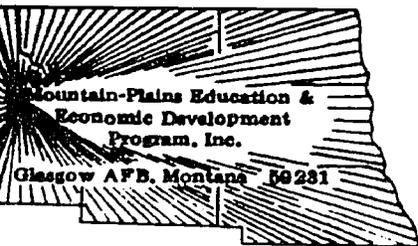
RESOURCES:

Car needing repairs
New parts as needed.
Jacks
Fender covers
Alignment Tables
Alignment gauge
Chalk
Tire pressure gauge
Pickle Fork
Air Chisel
Lug Wrench
Jack Stands
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

Student: _____ File Code: 37.10.04.00.B1-5

Date: _____ Date Published: 3/10/76

Family Pay Number: _____ Sex: M F (Circle 1)

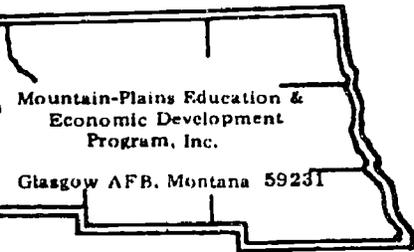


PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Inspect ball joints.		
Criterion: Compares to manufacturer's specifications.		
2. Inspect idler arm.		
Criterion: Compares to manufacturer's specifications.		
3. Inspect center link.		
Criterion: Compares to manufacturer's specifications.		
4. Inspect tie rod ends.		
Criterion: Compares to manufacturer's specifications.		
5. Inspect Pitman arm.		
Criterion: Compares to manufacturer's specifications.		
6. Inspect control arm bushings.		
Criterion: Compares to manufacturer's specifications.		
7. Inspect stabilizer bar bushings.		
Criterion: Compares to manufacturer's specifications.		

	CRITERION	
	Met	Not Met
Objective 2:		
8. Repair ball joints.		
Criterion: Must meet manufacturer's specifications.		
9. Repairs idler arm.		
Criterion: Must meet manufacturer's specifications.		
10. Repairs center link.		
Criterion: Must meet manufacturer's specifications.		
11. Repairs tie rod ends.		
Criterion: Must meet manufacturer's specifications.		
12. Repairs Pitman arm.		
Criterion: Must meet manufacturer's specifications.		
13. Repairs control arm bushings.		
Criterion: Must meet manufacturer's specifications.		
14. Repairs stabilizer bar bushings.		
Criterion: Must meet manufacturer's specifications.		
The student must complete 12/14 line items to pass test.		



Learning Experience Guide

UNIT: FRONT-END ALIGNMENT

RATIONALE:

The techniques in this unit will enable one to align front-ends.

PREREQUISITES:

Math at Level F
Communication at Level F

OBJECTIVE:

Recognize the components and use proper procedure for front-end alignment.

RESOURCES:

Printed Materials

Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Motor's Auto Repair Manual. Motor, The Hearst Corporation. 1972 or equivalent.
Operator's Manual for Alignment Equipment.

Audio/Visuals

Super 8 Sound Films: Wheel Alignment

DCA Educational Products, Inc.

Adjusting Torsion Bar Suspension (#FAA142).
Caster Camber Adjustment, Cam Assembly (#FAA102).
Caster Camber Adjustment, Shim (#FAA112).
Caster Camber Adjustment, Slide (#FAA122).
Checking Camber (#FAA072).
Checking Toe and Centering Steering (#FAA092).
Set Up and Suspension Checks (#FAA062).
Toe and Center Steering Adjustments (#FAA132).

Equipment

Alignment equipment
Automobile needing: toe adjustment
shim type wheel alignment
slide type adjustment
eccentric type adjustment
eccentric and strut adjustment

Fender covers
Jack & jack stands

Resources: Equipment Continued

Scribe

Special tools

Tools, Basic Hand:

Chisel and Punch Set

5/32" Pin Punch

3/16" Solid

Gauge, feeler (.002" - .025")

Hammer, ball peen

Hammer, plastic tip

Handle, speed

Hex Key Set

Pliers, diagonal cutting

Pliers, needle nose

Scraper, gasket

Screwdriver, standard (Set)

Screwdriver, phillips (Set)

Screw starter

Socket Set (3/8" drive)

extension (3")

ratchet

Socket Set (1/4" drive)

extension (3")

handle (6" flex)

ratchet

Socket, spark plug

extension (6")

Wrench, combination (Set)

Wrench, combination ignition (Set)

Tire pressure guage

GENERAL INSTRUCTIONS:

This unit consists of six Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

- (1) Read the first assigned Learning Activity Package (LAP).
- (2) Begin and complete the first assigned LAP.
- (3) Take and score the LAP test.
- (4) Turn in the LAP test answer sheet.
- (5) Determine the reason for any missed items on the LAP test.
- (6) Proceed to and complete the next assigned LAP in the unit.
- (7) Complete all required LAPs for the unit by following steps 3 through 6.

- (8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
- (9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
- (10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

- .01 Adjusting Camber
- .02 Adjusting Caster
- .03 Adjusting Toe-In
- .04 Adjusting Caster-Camber (eccentric and strut)
- .05 Adjusting Caster-Camber (eccentric)
- .06 Adjusting Caster-Camber (slide)

EVALUATION PROCEDURE:

When pretesting:

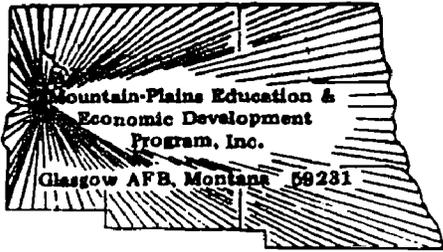
1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).



UNIT PRETEST: FRONT-END ALIGNMENT

37.10.05.01.

1. After shims are reshuffled and the bolts are tightened:
 - a. the car must be bounced and camber reread.
 - b. the caster must be adjusted.
 - c. the toe-in must be checked.
 - d. the camber must be reread.
2. Loose wheel bearings will least affect which alignment reading?
 - a. caster.
 - b. riding height.
 - c. camber.
 - d. toe-in.
3. Negative camber is increased by moving the top of the wheel towards the:
 - a. engine.
 - b. fender opening.
 - c. headlight.
 - d. taillight.
- 4.

37.10.05.02.

5. The vehicle manufacturer who has utilized caster-shim adjustment is:
 - a. American Motors.
 - b. Ford Motors Company.
 - c. General Motors.
 - d. Chrysler Corporation.
6. What holds the installed shim in place?
 - a. the placement groove on the suspension.
 - b. the slotted ends of the shims.
 - c. the tightened bolt.
 - d. the threaded wire through the shims.

37.10.05.02.

7. The removed shims after the alignment should be:
- cleaned and refilled.
 - discarded in the trash.
 - discarded in the scrap metal storage.
 - returned to the car owner.

37.10.05.03.

8. Standard tires have the toe reading usually set at:
- 1/8 to 1/4 toe-in.
 - 0 toe-in.
 - 0 to 1/16 toe-in.
 - 1/8 to 1/4 toe-out.
9. Radial tires have the toe reading usually set at:
- 0 toe-in.
 - 1/16 to 1/8 toe-in.
 - 1/16 toe-out
 - 1/8 toe-in.
10. Toe-in adjustment is accomplished by:
- adjusting the pitman arm.
 - turning one of the tie rod sleeves.
 - adjusting the steering knuckle.
 - changing the idler arm angle.
11. The adjusting tie rod sleeve tool is effective for turning the sleeve because it:
- is the only tool that can be used to turn the sleeve.
 - easily fits the sleeve.
 - is compact and fits into close working quarters.
 - spreads the sleeve as it grips it for turning.
12. Toe-in of the tires is desired over no toe-in because of the:
- resistance of the tires to roll.
 - crown of the highway.
 - vehicle's weight.
 - vehicle's speed capability.

37.10.05.04.

13. The eccentric strut rod adjustment is usually considered the:
- same as the others for ease of adjustment.
 - most difficult of the front-end adjustments.
 - easiest method of the front-end adjustments.
 - most time-consuming of all of the adjustments.

37.10.05.04. cont.

14. Adjustment of the strut rod with one hand tool would be a(n):
- box-end wrench.
 - open-end wrench.
 - deep socket.
 - vehicle overload.

37.10.05.05.

15. The eccentric adjuster is shaped somewhat:
- like a wedge.
 - oval.
 - octagonally.
 - like a cam lobe.
16. What must sometimes be done to turn a difficult eccentric?
- raise the wheel of the vehicle.
 - heat the eccentric.
 - use a power impact wrench.
 - hammer the eccentric head.
17. Eccentrics are held in place after alignment by:
- torqued lock bolts.
 - new lock bolts.
 - cotter keyed bolts.
 - pinned eccentrics.

37.10.05.06.

18. The slide adjustment type is usually found more often on the:
- Ford Motor cars.
 - General Motors cars.
 - American Motors cars.
 - Chrysler Corporation cars.
19. By moving the front slide in and the back slide out, you achieve more:
- negative camber.
 - positive camber.
 - positive caster.
 - negative caster.
20. By moving the front slide out and the back slide in, you achieve more:
- positive camber.
 - negative camber.
 - negative caster.
 - positive caster.

UNIT PRETEST ANSWER KEY: FRONT-END ALIGNMENT

LAP .01

1. a
2. a
3. a
4. a

LAP .02

5. c
6. c
7. a

LAP .03

8. a
9. a
10. b
11. d
12. a

LAP .04

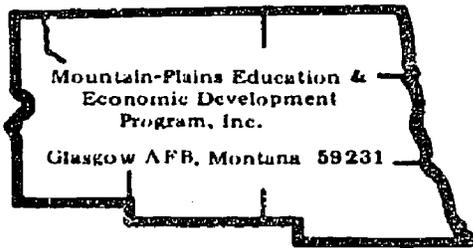
13. c
14. b

LAP .05

15. d
16. a
17. a

LAP .06

18. a
19. d
20. d



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Camber (Shim)

OBJECTIVE:

Use correct procedure for adjustment of camber (shim type).

EVALUATION PROCEDURE:

80% correct on performance evaluation.
LAP test after completing LAP 37.10.05.02.

RESOURCES:

Auto Service and Repair, Stockel.
Operator's Manual for Alignment Equipment.

Filmstrips:

Caster Camber Adjustments, (Shim)--FAA112.
Checking Camber--FAA072.
Checking Caster--FAA082.
Set Up and Suspension Checks--FAA062.

Automobile needing wheels aligned - Shim type
Alignment equipment
Alignment specifications

Fender covers
Tire pressure gauge
Tools, Basic Hand: (See Uni

PROCEDURE:

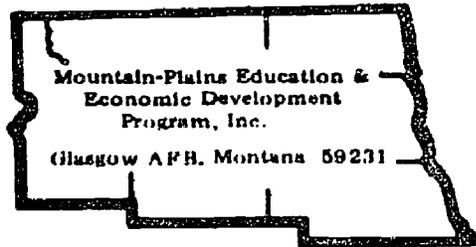
NOTE: Review pages 30-26 through 30-29 in Auto Service and Repair.

1. Place vehicle evenly on alignment rack.
2. Diagnose cause of defective wear on tire. Record diagnosis on work order.
Record what adjustments would be needed to correct the problem.

NOTE: Always determine what is the exact cause(s) of the abnormal tire wear. Check for unbalance, improper tire pressure, incorrect camber, incorrect toe-in, poor shocks, worn or damaged suspension components. Be sure to measure the amount of ball joint free-play wear. Also, test and adjust the wheel bearing tightness before continuing further with gauge attachment.
Record all test and diagnosis on the work order.

Principal Author(s): J. Anderson/W. Osland

3. Discuss your diagnosis with the instructor for evaluation.
4. Check tire inflation of the tires. Correct as necessary.
5. Measure standing height of vehicle to insure vehicle's natural stance. See manual for specifications and procedure of measuring.
6. Carefully attach alignment equipment. Follow set-up procedure of the equipment operator's manual.
7. Measure the camber and record readings on work order.
8. Compare readings to camber specifications to determine how the adjustment should be made to meet the manufacturer's recommended specifications.
9. Study the shim adjustment of the upper control arm to determine if shims need to be added or subtracted. Refer to the repair manual if a problem occurs in adjustment procedure.
10. Adjust the camber.
11. After the adjustment is completed, ask the instructor to inspect your work for approval.
12. With approval, proceed to the next LAP.



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Caster (shim)

OBJECTIVE:

Use the correct procedure for adjustment of caster (shim type).

EVALUATION PROCEDURE:

80% correct on performance checklist.
Eight correct responses to a ten-item multiple choice objective test.

RESOURCES:

Alignment equipment
Automobile needing caster adjustment--shim type
Fender covers
Tools, Basic Hand (see Unit LEG)
Operator's Manual for Alignment Equipment.
Motor's Auto Repair Manual.

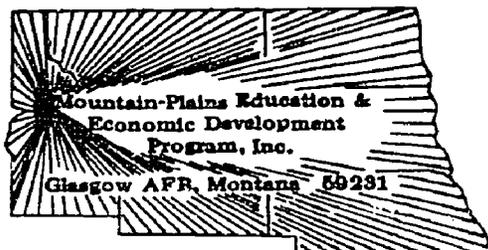
PROCEDURE:

NOTE: An Alignment Specification Chart comes with the alignment equipment can be found in Motor's Auto Repair Manual.

1. Follow the instructions with the alignment equipment and install on the vehicle.
2. Follow the Alignment Specification Chart to obtain the present caster reading of the left wheel. Record results.
3. Compare readings to manufacturer's specifications and analyze how the adjustment should be made without affecting the camber.
4. Make the adjustment.
5. Obtain another reading of the caster to see if the adjustment is satisfactory. Readjust if necessary.
6. Ask the instructor to evaluate your completed adjustment.
7. Repeat the steps to adjust the right wheel. Record present reading before adjustment.
8. Ask the instructor to evaluate the completed adjustments.

Principal Author(s): J. Anderson/W. Osland

9. Clean and return all tools and equipment.
10. Clean work area.
11. Take and score the LAP test.
12. Proceed to the next LAP.



LAP TEST: ADJUSTING CAMBER/CASTER (SHIM)

37.10.05.01

1. To change the camber without affecting the caster, shims:
 - a. should be removed or added from the forward bolt.
 - b. must be subtracted from one bolt and added to the other bolt.
 - c. must be added or subtracted in the same amounts on both bolts.
 - d. should be removed or added from the rear bolt.
2. After shims are reshuffled and the bolts are tightened:
 - a. the car must be bounced and camber reread.
 - b. the caster must be adjusted.
 - c. the toe-in must be checked.
 - d. the camber must be rereared,
3. Loose wheel bearings will least affect which alignment reading?
 - a. caster.
 - b. toe-out.
 - c. camber.
 - d. toe-in.
4. During alignment setup process, which component is not part of front-end check?
 - a. "U" joints.
 - b. ball joints.
 - c. tie-rod-ends.
 - d. control arm bushings.
5. Which vehicle manufacturer utilizes the shim's adjustment most?
 - a. General Motors.
 - b. Ford Motors.
 - c. American Motors.
 - d. Chrysler Corporation.

37.10.05.02

6. What steering factor is used in the steering suspension system to reduce the need for excessive positive camber?
 - a. caster.
 - b. toe-in.
 - c. steering axis inclination.
 - d. toe-out on turns.

7. Positive caster is with the top of the wheel moved in the direction of the:
- fender opening.
 - engine.
 - taillight.
 - headlight.
8. To reduce the tendency of the car to wander, you can increase the:
- positive camber.
 - negative camber.
 - negative caster.
 - positive caster.
9. The normal weight of the car tends to cause the front wheels to move toward
- negative caster.
 - negative camber.
 - positive camber.
 - positive caster.
10. What holds the installed shims in place?
- the placement groove on the suspension.
 - the slotted ends of the shims.
 - the tightened bolt.
 - the threaded wire through the shims.

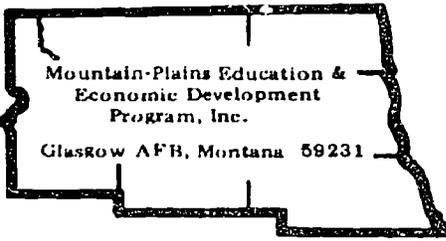
LAP TEST ANSWER KEY: ADJUSTING CAMBER/CASTER (SHIM)

LAP 01

1. C
2. A
3. A
4. A
5. A

LAP 02

6. C
7. C
8. D
9. B
10. C



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Glasgow AFB, Montana 59231

Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Toe-In

OBJECTIVE:

Use the correct procedures to adjust toe-in and toe-out.

EVALUATION PROCEDURE:

80% correct on performance evaluation.

Eight correct responses to a ten-item multiple-choice objective test.

RESOURCES:

Automobile needing toe adjustment
Jack
Jack stands
Scribe
Special tools
Tire pressure guage
Tools, basic hand (see Unit LEG)

Auto Service and Repair, Stockel.
Motor's Auto Repair Manual.

Super 8 filmstrips:

Adjusting Torsion Bar Suspension--FAA042.
Checking Toe and Centering Steering--FAA092.
Toe and Center Steering Adjustments--FAA132.

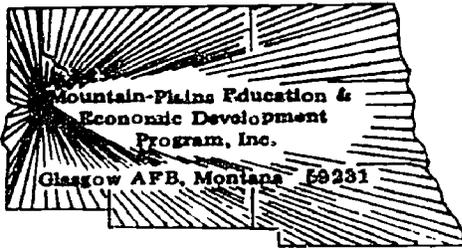
PROCEDURE:

NOTE: Review pages 30-7 through 30-10 in Auto Service and Repair.

- NOTE:**
- A. Determine first if the tires are radial or non-radial. Remember: Radial tires are set for zero toe-in unless otherwise specified by either the tire or vehicle manufacturer.
 - B. Examine and feel the flat surface of the tire to locate a "flathead edge." This feel will indicate if toe-in adjustment is needed, also the direction of needed adjustment.
 - C. Examine the tread surface for abnormal wear due to incorrect air pressure. Remember:
 1. Low pressure causes extreme wear of the sides of the tire and not in the center.
 2. High pressure causes extreme wear of the center of the tire and not on the sides.
 - D. Test and adjust tire air pressure as needed to correct wear pattern.

Remember: Record all information and adjustment on the work order in the "comments" section.

1. Raise front tires off floor and place jack stands.
2. With a scribe or thin marker, make a clean line along the tread of the tire. Brace the marker against the tire and turn the tire around to make the complete even line.
3. Repeat this on the other front tire.
4. Refer to the manual to find the recommended toe.
5. With assistance, measure from line to line on the front part of the tire, at an even height from the floor. Record measurement.
6. Now, measure the rear part of the tire. Record measurement.
7. Subtract the front measurement from the rear measurement. The difference should match the recommended toe from the specifications.
8. Adjust if required.
9. Ask the instructor to evaluate your work.
10. Clean and return all tools and equipment.
11. Clean work area.
12. Take and score the LAP test.
13. Upon successful completion, proceed to the next LAP.



LAP TEST: ADJUSTING TOE-IN

1. Standard tires have the toe reading usually set at:
 - a. $1/8$ to $1/4$ toe-in.
 - b. 0 toe-in.
 - c. 0 to $1/16$ toe-in.
 - d. $1/8$ to $1/4$ toe-out.
2. Tires with excessive toe-out will have the "feather edge" to:
 - a. both sides of the tire.
 - b. the tire's inside.
 - c. the tire's center.
 - d. the tire's outside.
3. Tires which have excessive toe-in will result with the "feather edge" on:
 - a. the outside.
 - b. the inside.
 - c. the tire center.
 - d. both sides of the tire.
4. Toe-in adjustment is accomplished by:
 - a. adjusting the pitman arm.
 - b. turning one of the tie rod sleeves.
 - c. adjusting the steering knuckle.
 - d. changing the idler arm angle.
5. Before adjusting the toe-in, the what should be centered?
 - a. front tires.
 - b. right tire.
 - c. left tire.
 - d. steering wheel.
6. After toe-in is adjusted, the front-end should:
 - a. be bounced and measured again.
 - b. be measured again.
 - c. test driven.
 - d. greased.
7. If alignment equipment is not available, what can be used to easily set toe?
 - a. tape measure.
 - b. yardstick.
 - c. string.
 - d. a steel rod

8. Setting toe with a measurement tool (not regular alignment equipment) requires measuring from the tire's:
 - a. circular scribed lines.
 - b. outside edges.
 - c. center tread marks.
 - d. inside rim edge.

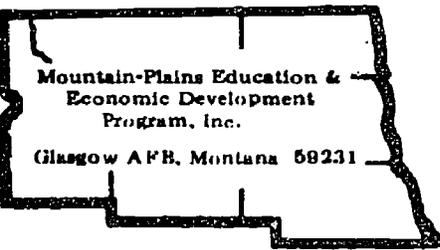
9. Toe measurement and adjustment (to be satisfactory) must be done with:
 - a. the vehicle front up on two jack stands.
 - b. the vehicle sitting normally on a flat surface.
 - c. the vehicle up on four jack stands.
 - d. the vehicle jacked up on an alignment rack.

10. Toe-in of the tires is desired over no toe-in because of the:
 - a. resistance of the tires to roll straight down the road.
 - b. crown of the highway.
 - c. vehicle's weight.
 - d. vehicle's speed capability.

LAP TEST ANSWER KEY: ADJUSTING TOE

LAP .03

1. a
2. d
3. b
4. b
5. d
6. a
7. a
8. a
9. b
10. a



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Caster-Camber (eccentric and strut)

OBJECTIVE:

Use the correct procedure for adjustment of 'caster-camber' (eccentric and strut).

EVALUATION PROCEDURE:

80% correct on performance checklist.

Eight correct responses to a ten-item multiple choice objective test.

RESOURCES:

Motor's Auto Repair Manual. (if not assigned)

Alignment equipment

Automobile with eccentric and strut adjustment

Fender covers

Tire pressure gauge

Tools, Basic Hand (see Unit LEG)

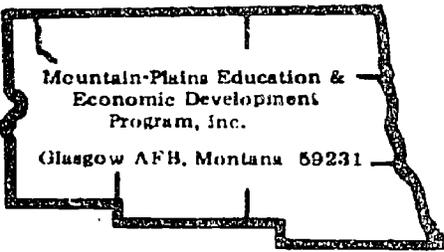
PROCEDURE:

Steps

1. Center the vehicle properly on the alignment area.
2. Diagnose the tire wear to determine what adjustments are needed. Record results on work order.
3. Check tire pressure. Correct as necessary.
4. Inspect vehicle stand height for unevenness of suspension.
5. Attach and adjust the alignment equipment.
6. Obtain the vehicle's present readings of caster and camber. Record on work order.
7. Obtain the manufacturer's specifications from the manual and record on work order.
8. Place fender covers.

Principal Author(s): J. Anderson/W. Csland

9. Refer to the repair manual for the correct procedure of adjusting the cam and strut-rod to obtain the correct alignment readings.
 10. Complete the necessary adjustments to have the vehicle caster and camber meet the manufacturer's specifications.
 11. When the adjustments are completed, ask the instructor to evaluate your work.
 12. Clean and return all tools and equipment.
 13. Clean alignment area.
 14. Proceed on to next LAP.
-



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Caster-Camber (eccentric)

OBJECTIVE:

Use the correct procedure for adjustment of caster-camber (eccentric and strut).

EVALUATION PROCEDURE:

80% correct on performance checklist.
LAP test after the completion of LAP 37.10.05.06.

RESOURCES:

Motor's Auto Repair Manual.

Alignment equipment
Automobile with eccentric and street adjustment
Fender covers
Tire pressure guage
Tools, Basic Hand (see Unit LEG)

PROCEDURE:

Steps

1. Center vehicle on alignment area.
2. Inspect tire wear to determine needed adjustment. Record on work order.
3. Check tire air pressures. Adjust if necessary.
4. Inspect vehicle curb height for proper suspension setting level.
5. Attach and adjust alignment equipment.
6. Obtain and record the present camber and caster readings.
7. Obtain the alignment specifications from the reference manual and record on work order.
8. Refer to the repair manual for the proper procedure of adjusting the eccentric cams.
9. Place fender covers.

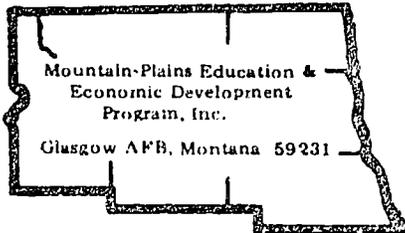
Principal Author(s): J. Anderson/W. Osland

10. Complete the caster and camber adjustments as needed to meet the manufacturer's specifications.

NOTE: The caster and camber are adjusted by the same eccentric cams.

Care must be taken not to disturb one adjustment while making the other.

11. When the adjustments are completed, ask the instructor to evaluate your work.
12. Clean and return all tools and equipment.
13. Clean alignment area.
14. Proceed to next LAP.



Learning Activity Package

Student: _____

Date: _____

PERFORMANCE ACTIVITY: Adjusting Caster-Camber (slide)

OBJECTIVE:

Use the correct procedure for adjustment of caster-camber (slide type).

EVALUATION PROCEDURE:

80% correct performance checklist.

LAP test. _____

RESOURCES:

Operator's Manual for Alignment Equipment: signed to you
Motor's Auto Repair Manual: alignment equipment

Filmstrips:

Caster Camber Adjustment, Cam Assembly--FAA102.

Caster Camber Adjustment, Slide--FAA122.

Alignment equipment

Automobile with slide adjustment

Fender covers

Tire pressure guage

Tools, Basic Hand (see Unit LEG)

PROCEDURE:

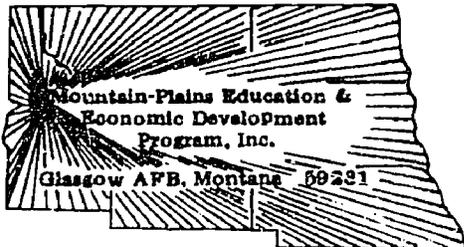
1. Locate vehicle properly on alignment stall.
2. Examine tire wear to determine adjustments needed.
3. Check tire air pressure. Adjust to correct pressure if necessary.
 NOTE: Determine if abnormal wear is caused by improper tire air pressure, unbalanced tires, poor shocks, incorrect camber or toe-in, worn or damaged suspension components. Record diagnosis on work order.
4. Check curb height of vehicle to be sure of level suspension.
5. Attach and adjust alignment equipment. (Follow the instructions with the alignment equipment.)
6. Obtain alignment specifications from reference manual and record on work order.
7. Obtain the present readings of camber and caster.
8. Place fender covers.

Principal Author(s): J. Anderson/W. Osland

9. Make the necessary adjustments to meet the alignment specifications. Loosen the retaining lock bolt enough to use the slide tool to move the upper control arm to the direction of required adjustment. Tighten bolt to prevent slipping when slide tool is released.

NOTE: Caster and camber are adjusted by this slide procedure. In some cases, it is necessary to loosen both retaining lock bolts.

10. After adjustments are completed, ask the instructor to evaluate your work.
11. Clean and return all tools and equipment.
12. Clean alignment area.
13. Proceed to next LAP.



LAP TEST: ADJUSTING CASTER/CAMBER (SLIDE, ECCENTRIC, STRUT)

37.10.05.06

1. By moving both slides out the same amount, you achieve more:
 - a. positive caster.
 - b. negative caster.
 - c. positive camber.
 - d. negative camber.
2. By moving the front slide in and the back slide out, you achieve more:
 - a. negative camber.
 - b. positive camber.
 - c. positive caster.
 - d. negative caster.
3. In moving the slide adjustment, it is easier to:
 - a. loosen bolts enough to move both slides at the same time.
 - b. loosen one bolt a little to pivot and loosen the other more to slide.
 - c. loosen only the one slide that you intend to move.
 - d. loosen one and tap the other with a hammer.

37.10.05.05

4. Camber is adjusted by moving the eccentrics (without affecting caster):
 - a. one at a time in opposite directions.
 - b. in opposite directions at the same amount.
 - c. in the same direction and the same amount.
 - d. in the same direction, but move the back 1/3 farther than the other.
5. Before the eccentric can be turned, what must be done?
 - a. oil the eccentric slide surface.
 - b. loosen the lock bolt.
 - c. remove the cotter key.
 - d. loosen the lock nut.
6. Eccentrics are held in place after alignment by:
 - a. lock nuts.
 - b. new lock bolts.
 - c. cotter keyed bolts.
 - d. pinned eccentrics.

37.10.05.04

7. Of the eccentric and strut adjustment, camber is usually adjusted by:
 - a. the eccentric and strut rod.
 - b. the strut rod.
 - c. the eccentrics.
 - d. the slide bolt.

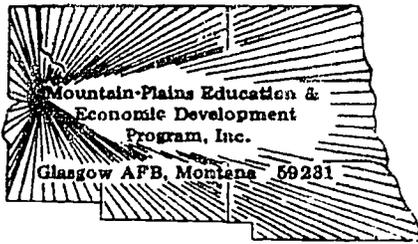
8. Of the eccentric and strut adjustment, caster is usually adjusted by:
 - a. the strut rod.
 - b. the eccentric.
 - c. eccentric and strut rod.
 - d. the slide bolt.

9. The eccentric strut rod adjustment is usually considered the:
 - a. same as the others for ease of adjustment.
 - b. most difficult of the front-end adjustments.
 - c. easiest method of the front-end adjustments.
 - d. most time-consuming of all the adjustments.

10. Adjusting the caster (strut rod):
 - a. has no affect upon camber.
 - b. has no affect upon the toe-in.
 - c. will change the camber slightly.
 - d. will change steering axis inclination.

LAP TEST ANSWER KEY: ADJUSTING CASTER/CAMBER (SLIDE, ECCENTRIC, STRUT)

1. C
2. D
3. B
4. C
5. D
6. A
7. C
8. A
9. C
10. C



UNIT POST TEST: FRONT-END ALIGNMENT (A)

37.10.05.01

1. Which of the following is not part of alignment precheck?
 - a. air pressure
 - b. shocks
 - c. trunk weight
 - d. riding height
2. The turn tables are not necessary to adjust the:
 - a. caster
 - b. riding height
 - c. camber
 - d. toe-in
3. Negative camber is increased by moving the top of the wheel towards the:
 - a. engine
 - b. fender opening
 - c. headlight
 - d. taillight
4. Positive camber is increased by moving the tops of the wheel towards the:
 - a. engine
 - b. headlight
 - c. fender opening
 - d. taillight

37.10.05.02

5. Negative caster is with the top of the wheel moved in the direction of the:
 - a. fender opening
 - b. headlight
 - c. engine
 - d. rear taillight
6. If the specifications call for a difference between the left and right wheel camber settings it would be to compensate for:
 - a. engine torque
 - b. road resistance
 - c. drivers weight
 - d. road crown

37.10.05.02 cont.

7. Which of the following is most responsible for steering stability on a level road?
- caster
 - camber
 - steering axis inclination
 - toe-out

37.10.05.03

8. Radial tires have the toe reading usually set at:
- 0 toe-in
 - 1/16 to 1/8 toe-in
 - 1/16 toe-out
 - 1/8 toe-in
9. Proper toe-in will allow the tires to move forward without:
- setting up a wheel tramp
 - a scrubbing, scraping action between tire and road
 - going into a wheel shimmy
 - causing a front-end vibration
10. Toe-in adjustment is accomplished by:
- adjusting the pitman arm
 - turning one of the tie rod sleeves
 - adjusting the steering knuckle
 - changing the idler arm angle
11. The adjusting tie rod sleeve tool is effective for turning the sleeve because it:
- is the only tool that can be used to turn the sleeve
 - easily fits the sleeve
 - is compact and fits into close working quarters
 - spreads the sleeve as it grips it for turning
12. Setting toe with a measurement tool (not regular alignment equipment) requires measuring from the tire's:
- circular scribed lines
 - outside edges
 - center tread marks
 - inside rim edge

37.10.05.04

13. A car may have a tendency to pull to the side having:
- more positive caster
 - less positive caster
 - less negative caster
 - less positive camber

37.10.05.04 cont.

14. It is best to start out by adjusting the:

- a. strut rod
- b. camber first
- c. caster-camber together
- d. caster first

15. Strut rod adjustment can vary from each other to allow for:

- a. road crown
- b. road resistance
- c. vehicle weight
- d. vehicle overload

37.10.05.05

16. Which reading can be observed at the same time it is being adjusted?

- a. negative caster
- b. caster
- c. camber
- d. positive caster

17. What must sometimes be done to turn a difficult eccentric?

- a. raise the vehicle off the wheel
- b. heat the eccentric
- c. use a power impact wrench
- d. hammer the eccentric head

37.10.05.06

18. A car has a strut rod from the front of the frame to the lower control arm. Which of the following is true about this system?

- a. shortening the rod changes camber
- b. the length of the rod will not affect caster or camber
- c. the rod acts as a stabilizer bar
- d. lengthening the rod reduces positive caster

19. By moving the front slide in and the back slide out, you achieve more:

- a. positive camber
- b. negative camber
- c. negative caster
- d. positive caster

20. What prevents the slides from moving when the alignment is completed?

- a. cotter pinned slide bolts
- b. torqued down sliding bolts
- c. lock nuts on the slide bolts
- d. the weight of the car

UNIT POST TEST ANSWER KEY: (A)

Lap .01

1. B
2. B
3. A
4. C

Lap .02

5. B
6. D
7. A

Lap .03

8. A
9. B
10. B
11. D
12. A

Lap .04

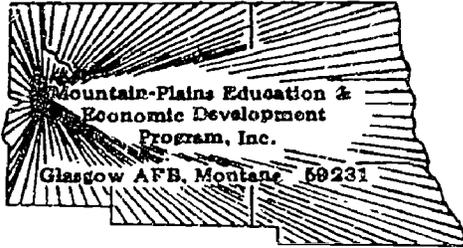
13. C
14. D
15. A

Lap .05

16. C
17. A

Lap .06

18. D
19. C
20. B



UNIT POST TEST: FRONT-END ALIGNMENT (B)

37.10.05.01

1. Positive camber is increased by moving the tops of the wheel towards the:
 - a. engine
 - b. headlight
 - c. fender opening
 - d. taillight

2. Negative camber is increased by moving the top of the wheel towards the:
 - a. engine
 - b. fender opening
 - c. headlight
 - d. taillight

3. The turn tables are not necessary to adjust the:
 - a. caster
 - b. riding height
 - c. camber
 - d. toe-in

4. Which of the following is not part of alignment precheck?
 - a. air pressure
 - b. shocks
 - c. trunk weight
 - d. riding height

37.10.05.02

5. Which of the following is most responsible for steering stability on a level road?
 - a. caster
 - b. camber
 - c. steering axis inclination
 - d. toe-out

6. If the specifications call for a difference between the left and right wheel camber settings, it would be to compensate for:
 - a. engine torque
 - b. road resistance
 - c. driver's weight
 - d. road crown

37.10.05.02 (continued)

7. Negative caster is with the top of the wheel moved in the direction of the:
- fender opening
 - headlight
 - engine
 - rear taillight

37.10.05.03

8. Setting toe with a measurement tool (not regular alignment equipment) requires measuring from the tire's:
- circular scribed lines
 - outside edges
 - center tread marks
 - inside rim edge
9. The adjusting tie rod sleeve tool is effective for turning the sleeve because it:
- is the only tool that can be used to turn the sleeve
 - easily fits the sleeve
 - is compact and fits into close working quarters
 - spreads the sleeve as it grips it for turning
10. Toe-in adjustment is accomplished by:
- adjusting the pitman arm
 - turning one of the tie rod sleeves
 - adjusting the steering knuckle
 - changing the idler arm angle
11. Proper toe-in will allow the tires to move forward without:
- setting up a wheel tramp
 - a scrubbing, scraping action between tire and road
 - going into a wheel shimmy
 - causing a front-end vibration
12. Radial tires have the toe reading usually set at:
- 0 toe-in
 - 1/16 to 1/8 toe-in
 - 1/16 toe-out
 - 1/8 toe-in

37.10.05.04

13. Strut rod adjustment can vary from each other to allow for:
- road crown
 - road resistance
 - vehicle weight
 - vehicle overload

37.10.05.04 (continued)

14. It is best to start out by adjusting the:
- strut rod
 - camber first
 - caster-camber together
 - caster first
15. A Car may have a tendency to pull to the side having:
- more positive caster
 - less positive caster
 - less negative caster
 - less positive camber

37.10.05.05

16. What must sometimes be done to turn a difficult eccentric?
- raises the vehicle off the wheel
 - head the eccentric
 - use a power impact wrench
 - hammer the eccentric head
17. Which reading can be observed at the same time it is being adjusted?
- negative caster
 - caster
 - camber
 - positive caster

37.10.05.06

18. What prevents the slides from moving when the alignment is completed?
- cotter pinned slide bolts
 - torqued down sliding bolts
 - lock nuts on the slide bolts
 - the weight of the car
19. By moving the front slide in and the back slide out, you achieve more:
- positive camber
 - negative camber
 - negative caster
 - positive caster
20. A car has a strut rod from the front of the frame to the lower control arm. Which of the following is true about this system?
- shortening the rod changes camber
 - the length of the rod will not affect caster or camber
 - the rod acts as a stabilizer bar
 - lengthening the rod reduces positive caster

UNIT POST TEST ANSWER KEY: FRONT-END ALIGNMENT (B)

LAP 01

1. c
2. a
3. b
4. b

LAP 02

5. a
6. d
7. b

LAP 03

8. a
9. d
10. b
11. b
12. a

LAP 04

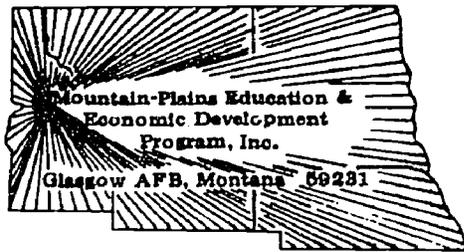
13. a
14. d
15. ~~bc~~

LAP 05

16. a
17. c

LAP 06

18. b
19. c
20. d



UNIT POST TEST: FRONT-END ALIGNMENT (C)

37.10.05.01

1. Negative camber is increased by moving the top of the wheel towards the:
 - a. engine
 - b. fender opening
 - c. headlight
 - d. taillight

2. Which of the following is not part of alignment precheck?
 - a. air pressure
 - b. shocks
 - c. trunk weight
 - d. riding height

3. The turn tables are not necessary to adjust the:
 - a. caster
 - b. riding height
 - c. camber
 - d. toe-in

4. Positive camber is increased by moving the tops of the wheel towards the:
 - a. engine
 - b. headlight
 - c. fender opening
 - d. taillight

37.10.05.02

5. If the specifications call for a difference between the left and right wheel camber settings, it would be to compensate for:
 - a. engine torque
 - b. road resistance
 - c. driver's weight
 - d. road crown

6. Negative caster is with the top of the wheel moved in the direction of the:
 - a. fender opening
 - b. headlight
 - c. engine
 - d. rear taillight

37.10.05.02 (continued)

7. Which of the following is most responsible for steering stability on a level road?
- a. caster
 - b. camber
 - c. steering axis inclination
 - d. toe-out

37.10.05.03

8. Radial tires have the toe reading usually set at:
- a. 0 toe-in
 - b. 1/16 to 1/8 toe-in
 - c. 1/16 toe-out
 - d. 1/8 toe-in
9. Setting toe with a measurement tool (not regular alignment equipment) requires measuring from the tire's:
- a. circular scribed lines
 - b. outside edges
 - c. center tread marks
 - d. inside rim edge
10. The adjusting tie rod sleeve tool is effective for turning the sleeve because it:
- a. is the only tool that can be used to turn the sleeve
 - b. easily fits the sleeve
 - c. is compact and fits into close working quarters
 - d. spreads the sleeve as it grips it for turning
11. Proper toe-in will allow the tires to move forward without:
- a. setting up a wheel tramp
 - b. a scrubbing, scraping action between tire and road
 - c. going into a wheel shimmy
 - d. causing a front-end vibration
12. Toe-in adjustment is accomplished by:
- a. adjusting the pitman arm
 - b. turning one of the tie rod sleeves
 - c. adjusting the steering knuckle
 - d. changing the idler arm angle

37.10.05.04

13. It is best to start out by adjusting the:
- a. strut rod
 - b. camber first
 - c. caeter-camber together
 - d. caster first

37.10.05.04 (continued)

14. A car may have a tendency to pull to the side having:
- more positive caster
 - less positive caster
 - less negative caster
 - less positive camber
15. Strut rod adjustment can vary from each other to allow for:
- road crown
 - road resistance
 - vehicle weight
 - vehicle overload

37.10.05.05

16. Which reading can be observed at the same time it is being adjusted?
- negative caster
 - caster
 - camber
 - positive caster
17. What must sometimes be done to turn a difficult eccentric?
- raise the vehicle off the wheel
 - heat the eccentric
 - use a power impact wrench
 - hammer the eccentric head

37.10.05.06

18. By moving the front slide in and the back slide out, you achieve more:
- positive camber
 - negative camber
 - negative caster
 - positive caster
19. What prevents the slides from moving when the alignment is completed:
- cotter pinned slide bolts
 - torqued down sliding bolts
 - lock nuts on the slide bolts
 - the weight of the car
20. A car has a strut rod from the front of the frame to the lower control arm; Which of the following is true about this system?
- shoring the rod changes camber
 - the length of the rod will not affect caster or camber
 - the rod acts as a stabilizer bar
 - lengthening the rod reduces positive caster

UNIT POST TEST ANSWER KEY: FRONT END ALIGNMENT (C)

LAP 01

1. a
2. b
3. **eb**
4. c

LAP 02

5. d
6. b
7. a

LAP 03

8. a
9. a
10. d
11. b
12. b

LAP 04

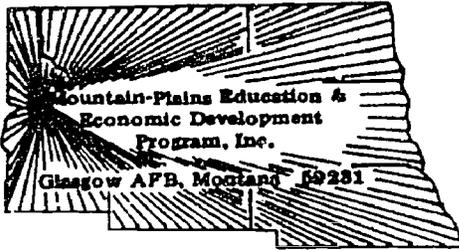
13. d
14. **ac**
15. a

LAP 05

16. c
17. a

LAP 06

18. c
19. b
20. d



Family Pay Number: _____ Sex: M F (Circle 1)

UNIT PERFORMANCE TEST: FRONT END ALIGNMENT

OBJECTIVE 1:

Align front end.

TASK:

The student will be assigned a vehicle on which he must align the front end by adjusting camber, caster, and toe.

ASSIGNMENT:

CONDITIONS:

The student will perform the test using only those materials provided for the test and perform the test in the auto shop.

RESOURCES:

- Alignment Machine
- Special Alignment Wrenches
- Service Manual
- Parts and Time Guide
- Jack
- Scribe or Chalk

RESOURCES: (Cont)

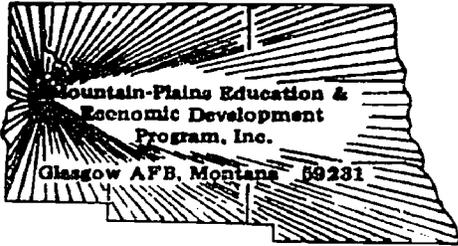
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Elastic Tip Hammer
Crew Starter
Chisel and Punch Set
3/32" Pin Punch - 3/16" Solid
Basket scraper
1/8" Drive Ratchet
" Extension
Spark Plug Socket
" Extension
Speed Handle
1/8" Drive Socket Set

Student: _____

File Code: 37.10.05.00.81-5

Date: _____

Date Published: 3/10/76



Family Pay Number: _____ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

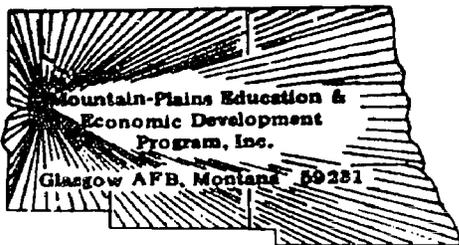
OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Inspect front end for wear.		
2. Adjust caster.		
3. Adjust camber.		
4. Adjust toe.		
Criterion: Must meet manufacturer's specifications.		
5. Road test.		
Criterion: Must drive straight with no wander or shimmy.		
6. Must perform test in allotted time.		
Criterion: Must meet flat rate for assigned vehicle.		
Student must meet all 6 line items to achieve an overall score of satisfactory.		

Student: _____ File Code: 37.12.01.00.81-5

Date: _____ Date Published: 3/4/76

Family Pay Number: _____ Sex: M F (Circle 1)



UNIT PERFORMANCE TEST: DETAILING AND SERVICING

OBJECTIVE:

Detail and service a vehicle.

TASK:

The student will be assigned a vehicle on which he must change oil and filter, clean windshield, check water in battery and radiator, check air filter, vacuum interior, check all belts, check power steering fluid, and lubricate door hinges.

ASSIGNMENT:

CONDITIONS:

The student will use only those materials provided for the test and perform the test in the auto shop.

RESOURCES:

Windshield cleaner
Lubrication sticker
Oil
Oil filter
Service manual
Time and parts manual
Oil filter wrench
Drain pan
Fender covers
Jack
Jack stands

RESOURCES: (Continued)

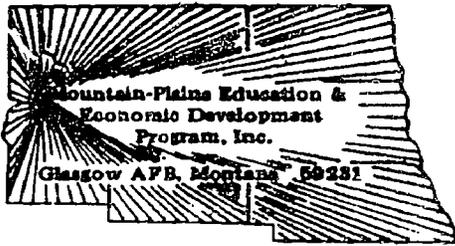
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

Student: _____

File Code: 37.12.01.00.B1-5

Date: _____

Date Published: 3/4/76



Family Pay Number: _____

Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION	
	Met	Not Met
Objective:		
1. Change oil and filter.		
Criterion: Read full on dip stick, no leaks on drain plug or filter.		
2. Clean windshield and interior.		
Criterion: Be clean for instructor inspection.		
3. Inspect under hood.		
Criterion: Note any problems on work order; have belts tight.		
4. Complete test in allotted time.		
Criterion: Complete in one hour.		
Student must satisfactorily complete 3 of 4 line items to pass test.		