

Video User's Guide

DIFFERENTIAL CONSTRUCTION AND OPERATION

INTRODUCTION

This video will summarize and explain the operation and construction of various differential and drive axle designs. It will use live action video and computer animation to make your study of this particular topic fun and educational. In this program you will learn about gear reduction, rear drive differentials, front-wheel drive transaxles, positraction differentials, pinion gears, ring gears, helical gears, spider gears, four-wheel drive systems, all-wheel drive systems and much more. This tape will show you how certain differential and transaxle designs actually operate. By observing the actual operation of these drive train components, you will better prepare yourself for diagnosing, servicing and repairing the several types of differential and drive axle variations used today.

SHOPWARE

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STUDENT OBJECTIVES

After viewing this video, the student will be able to:

- Name the important functions of a differential.
- Describe several types of differential designs.
- Explain the term "gear reduction."
- Describe the construction and purpose of a differential "pinion gear" and "ring gear."
- Describe the operation of a conventional rear drive differential.
- Explain the operation and construction of front-wheel drive, four-wheel drive and all-wheel drive designs.
- Define the term "rear axle ratio."
- Describe the purpose of "hypoid gears."
- Explain the importance of differential "spider gears."
- Define the term "limited slip differential."

TO THE INSTRUCTOR

This video is designed to be a valuable supplement to your curriculum. Since young people are extremely acclimated to television, it is a natural way to help present important aspects of your subject matter. This video is designed to give a detailed, yet broad coverage of the topic.

Most educators agree that it is best to use as many instructional methods as possible. Utilize quality textbooks, workbooks, videos, lectures, demonstrations, overheads, and other methods to present the technical information. This will hold interest and help pupils understand the large amount of information required to succeed in today's complex world.

This video is organized into major sections or topics. Each section covers one major segment of the subject. Graphic breaks are given between each section so that you can stop the video for class discussion, demonstrations, to answer questions, or to ask questions. This allows you to only watch a portion of the program each day or to present the complete video, depending on your curriculum requirements.

The video is designed to simplify the complex. Concise wording and carefully selected graphics are used to provide maximum learning in minimum time.

Close-up shots of components and service procedures are used to make every second of viewing instructional, as if each student was standing right behind you, watching over your shoulder while you were working or giving a demonstration.

Computer animation is used to explain difficult to comprehend principles or techniques. These images show how parts work, how they fit together, or how they vary in design.

QUIZ ANSWER KEY

1. c 2. c 3. a 4. d 5. c 6. a 7. b 8. b 9. d 10. c 11. b
12. d 13. b 14. c 15. b

Use your own judgment to evaluate the definitions, short answer questions and discussion topics.

TECHNICAL TERMS

Write definitions for the following terms. Use a textbook or review the video if needed.

rear drive differential / differential case / pinion gear / ring gear
gear reduction / drive axles / axle housing / gear oil
automotive suspension system / independent rear suspension
flexible swing axles / drive wheels / torque / wheel rotating speeds
rear-wheel drive / drive shaft / transmission / differential carrier
solid rear axle assembly / four-wheel drive / universal joint
front-wheel drive transaxle / bell housing / stub axle shafts
differential inspection cover / CV joint / CV joint housing
CV drive axles / male splines / female splines / axle flange
lug studs / pinion spacer / pinion gear depth / pinion shaft
pinion side movement / pinion pilot bearing / rear axle ratio
heel / toe / hypoid gears / spiral bevel gears / helical gears
transverse mounted engine / transaxle / spider gears
worm gears / positraction differential / Torson-Gleason unit
viscous coupling / all-wheel drive system / front-wheel drive vehicles
central multiplate transfer clutch / clutch pack differential
cone clutch differential

VIDEO DISCUSSION TOPICS

Here are a few topics that might be used for a class discussion:

1. Do all differential designs perform the same functions?
2. Name some of the basic parts of a conventional rear drive differential.
3. What is the advantage of having a removable carrier on a differential?
4. Describe the construction of a solid drive axle.
5. What allows a pinion gear to spin freely inside the differential carrier?
6. Describe the construction of a ring gear.
7. Why are spider gears so important to differential operation?
8. What types of changes do you think will take place in differential designs twenty years from now?

SHORT ANSWER

Briefly answer the following questions in your own words:

1. Where is the differential case located?
2. Describe the operation of a rear drive differential.
3. Explain the term "gear reduction."
4. Describe the basic function of a differential "ring gear."
5. What is the purpose of a differential carrier?
6. Name two types of "positraction" differentials.
7. What is the difference between an all-wheel drive system and a four-wheel drive system?
8. What would happen if a rear-wheel drive automobile just used straight axles and no differential to power the drive wheels?
9. What is normally used to lubricate a conventional rear drive differential?
10. If a pinion gear has twenty teeth and a ring gear has forty teeth, what is the differential ratio?

VIDEO QUIZ

Choose the most correct answer after reading the statement:

1. A differential is needed to transfer _____ power to the drive axle shafts and drive wheels.
a. shafts b. differential c. engine d. yoke
2. The _____ gear is mounted on a case that houses the guts of the differential assembly.
a. worm b. helical c. ring d. pinion
3. The _____ shaft connects the transmission to the differential.
a. drive b. rocker c. pilot d. clutch
4. A(n) _____ is a steel or aluminum enclosure around the differential.
a. yoke b. axle c. strut d. carrier
5. Rear axle _____ is determined by comparing the number of teeth on the pinion drive gear and on the ring gear.
a. size b. shape c. ratio d. length
6. The _____ gear turns the ring gear when the drive shaft is rotating.
a. pinion b. spiral c. axle d. transmission
7. Most new cars use constant velocity drive _____.
a. gears b. axles c. belts d. sprockets.
8. The ring and _____ gears are the "big boys" of the drive axle assembly.
a. transmission b. pinion c. strut d. flex

VIDEO QUIZ

(Continued)

9. With a transverse mounted _____, the differential does not have to transfer power through a ninety degree angle.
a. case b. strut c. coupling d. engine

10. Under most driving conditions, a _____ is needed to prevent excess tire wear and drive train damage when cornering.
a. pulley b. gear c. differential d. sprocket

11. The key to differential operation is a set of _____ gears mounted inside the case.
a. aluminum b. spider c. steel d. plastic

12. A limited slip _____ is used to help improve traction by preventing total free-wheeling or slipping of one tire on slick pavement or under rapid acceleration.
a. axle b. sprocket c. pulley d. differential

13. An all-wheel drive system uses two or more _____ to power all four wheels and tires.
a. sprockets b. differentials c. shafts d. joints

14. _____ gears have the pinion gear centerline below the ring gear centerline.
a. Spiral b. Aluminum c. Hypoid d. Steel

15. _____ axles are used when the differential is attached solidly to the frame of the car.
a. Steel b. Swing c. Aluminum d. Chrome