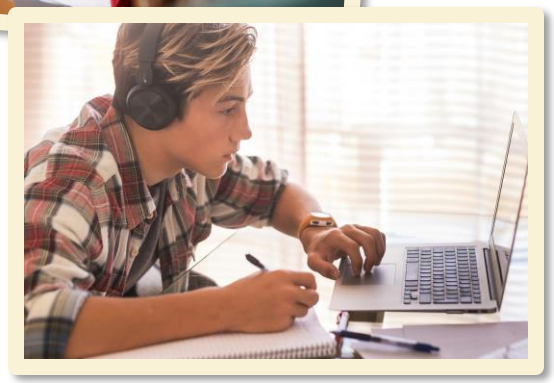
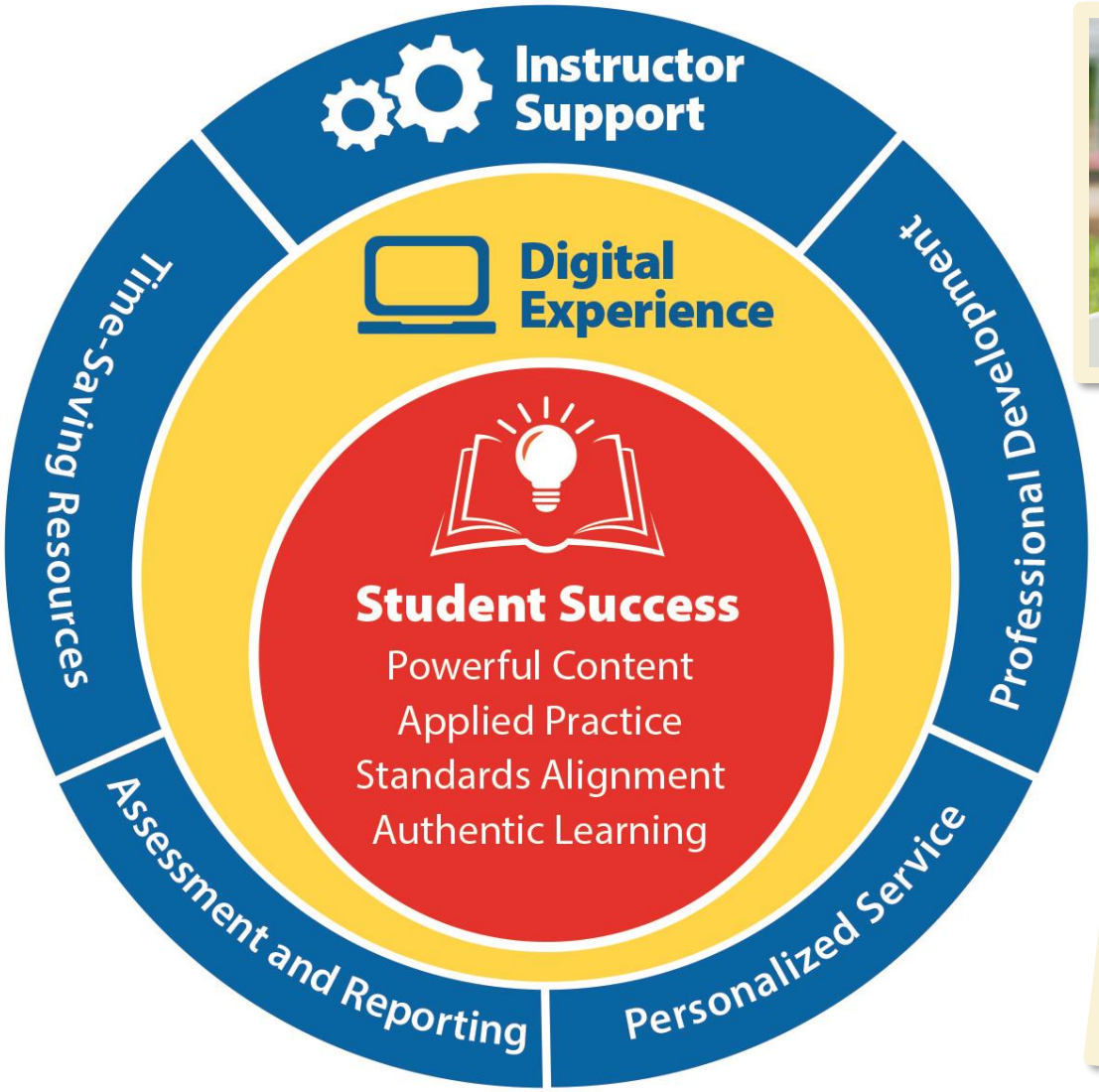
G-W PUBLISHER

Diesel Engine Technology

Together, We Build the Future

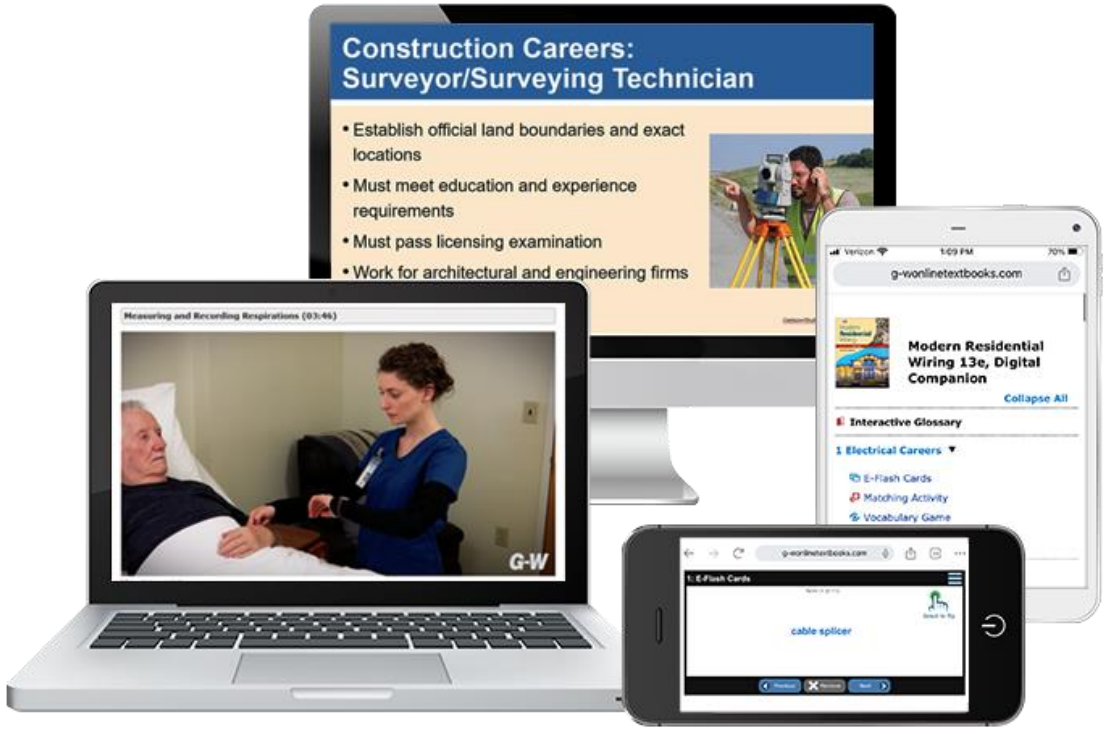
G-W PUBLISHER





Student Success Is At the Heart of What We Do

G-W PUBLISHER



*Shown are examples across various titles

- ✓ Prepare for class
- ✓ Reinforce new concepts
- ✓ Assess learning

Ready-to-Implement Online Instructor Resources

Diesel Engine Technology: Lesson Plan

Instructor: *Date:*
Course: *Unit:*

Chapter 1: Introduction to Diesel Engines

Learning Outcomes

- 1.1 Identify the design characteristics of a diesel engine, including its operating cycle, the method air and fuel is supplied, and how the fuel is ignited in the cylinders.
  - 1.1 The Diesel Engine
- 1.2 List five advantages of diesel engines over gasoline engines.
  - 1.2 Advantages of Diesel Engines Over Gasoline Engines
- 1.3 Describe drawbacks of powering implements with diesel engines.
  - 1.3 Diesel Drawbacks
- 1.4 Name the major applications for diesel engines in modern industry and transportation.
  - 1.4 Diesel Engine Applications
- 1.5 Name several key inventors and milestones in the development of the diesel engine and explain the significance of electronics in the development of the diesel engine.
  - 1.5 Diesel Engine History

Materials, Equipment, and Supplies

- Materials:

Safety Notes

- There are no specific safety notes t
  always be observed.

Instructional Resources

- Textbook/eBook: Chapter 1
- Instructor Resources: Chapter 1 In
- Instructor Resources: Chapter 1 An
- Other instructional resource:

Resources for Practice and Applica

- Digital Companion: Interactive Acti
- Digital Companion: E-Flash Cards
- Textbook/eBook: Chapter 1 Review
- Textbook/eBook: Chapter 1 Review
- Textbook/eBook: Chapter 1 Review
- Textbook/eBook: Chapter 1 Review
- Workbook: Chapter 1–Chapter Rev
- Workbook: Chapter 1– ASE-Type C
- Other resource:

Assessment

Lesson Plans, PowerPoint Presentations, and Answer Keys

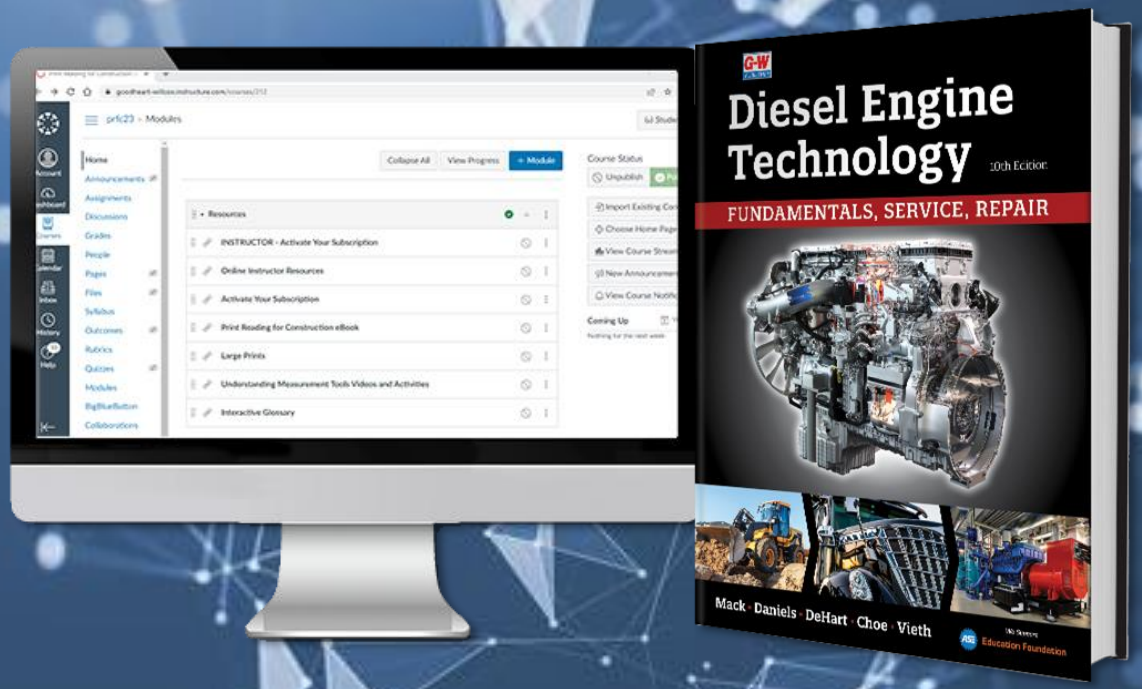
G-W Assessment

Assess learning • Gain insights • Build skills

- **Utilize a cloud-based assessment platform** that can seamlessly integrate with your LMS and Google Classroom
- **No more downloads, uploads, or imports** needed!
- **Access G-W Assessment with one quick click** from any device

NEW for 2026 Copyrights!

G-W PUBLISHER



Print • Digital • Bundle Options Available

Blackboard

D2L BRIGHTSPACE

canvas

moodle

schoology

Additional LTI-Compliant Platforms

Clever

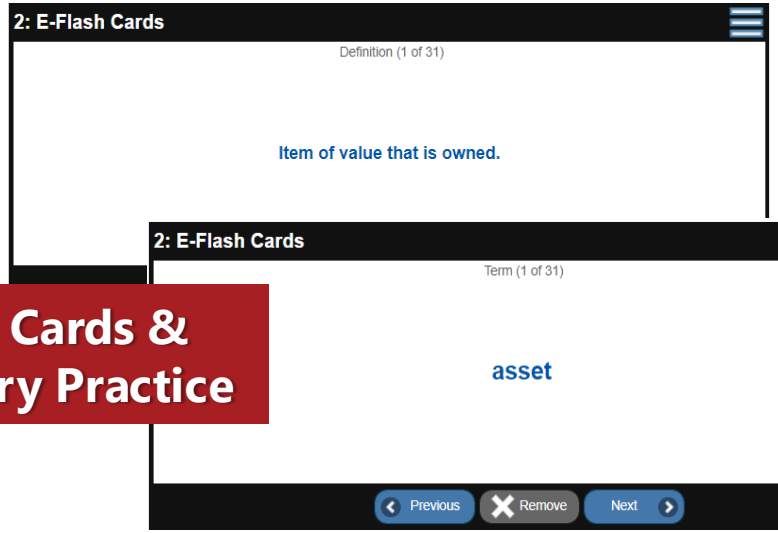
ClassLink

1EDTECH CERTIFIED

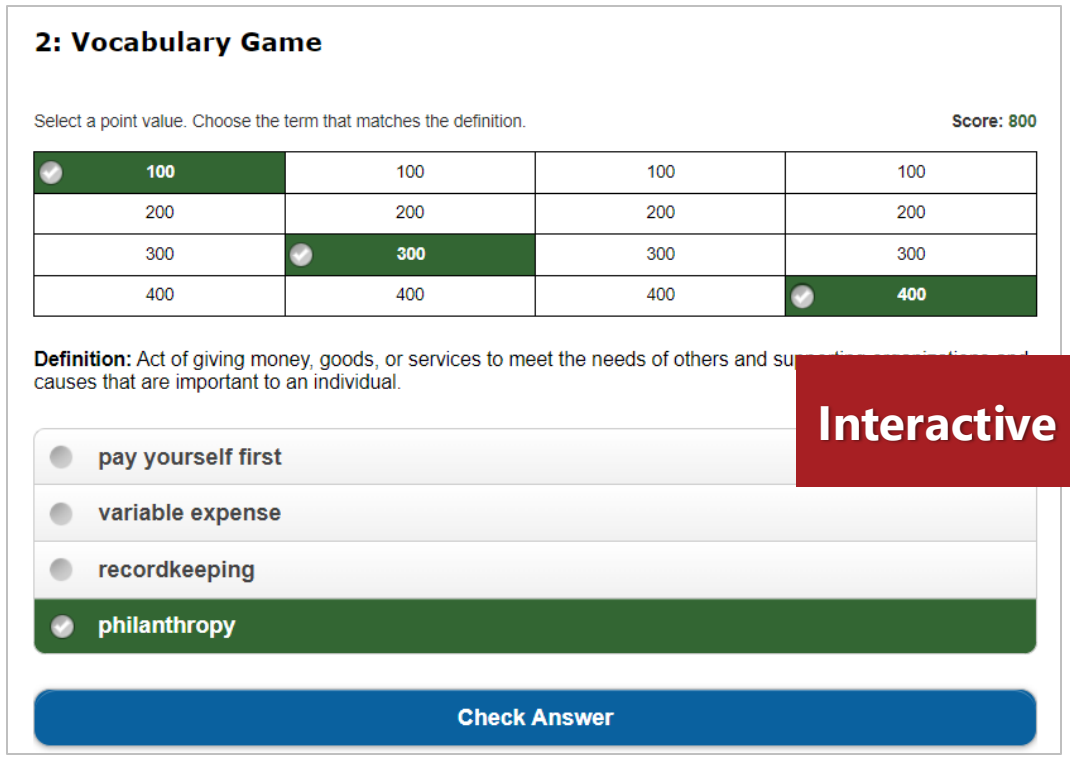
Google Classroom

LMS and CMS Integration Easy Navigation

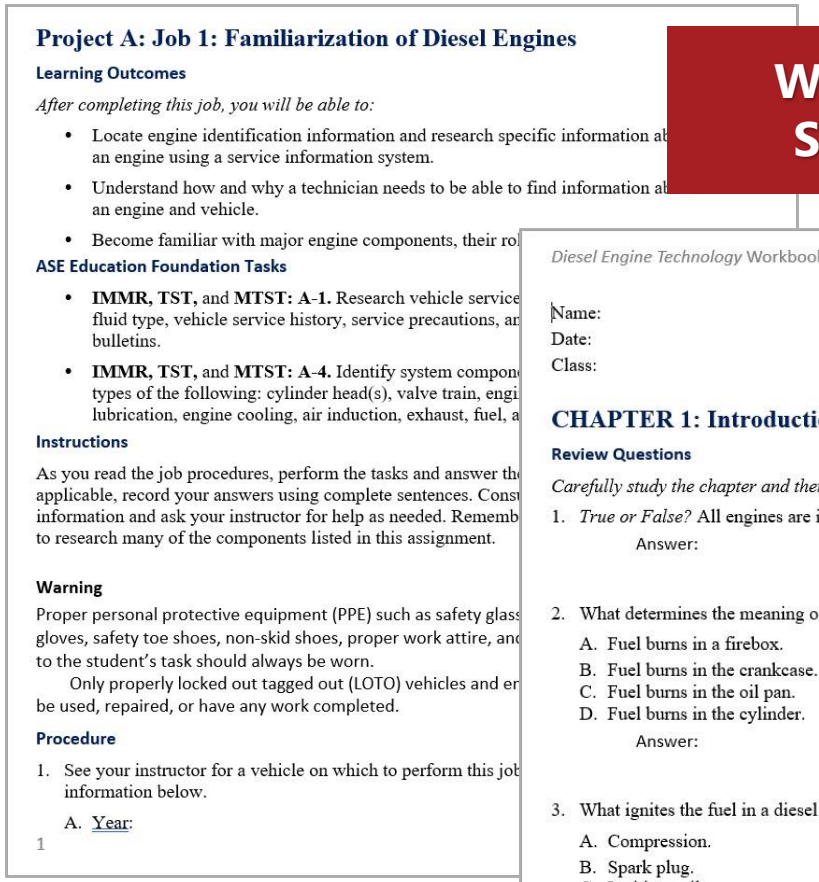
G-W PUBLISHER



E-Flash Cards & Vocabulary Practice



Interactive Activities



Project A: Job 1: Familiarization of Diesel Engines

Learning Outcomes

After completing this job, you will be able to:

- Locate engine identification information and research specific information ab an engine using a service information system.
- Understand how and why a technician needs to be able to find information ab an engine and vehicle.
- Become familiar with major engine components, their ro

ASE Education Foundation Tasks

- **IMMR, TST,** and **MTST: A-1.** Research vehicle service fluid type, vehicle service history, service precautions, ar bulletins.
- **IMMR, TST,** and **MTST: A-4.** Identify system compon types of the following: cylinder head(s), valve train, engi lubrication, engine cooling, air induction, exhaust, fuel, a

Instructions

As you read the job procedures, perform the tasks and answer th applicable, record your answers using complete sentences. Cons information and ask your instructor for help as needed. Rememb to research many of the components listed in this assignment.

Warning

Proper personal protective equipment (PPE) such as safety glas gloves, safety toe shoes, non-skid shoes, proper work attire, an to the student's task should always be worn.

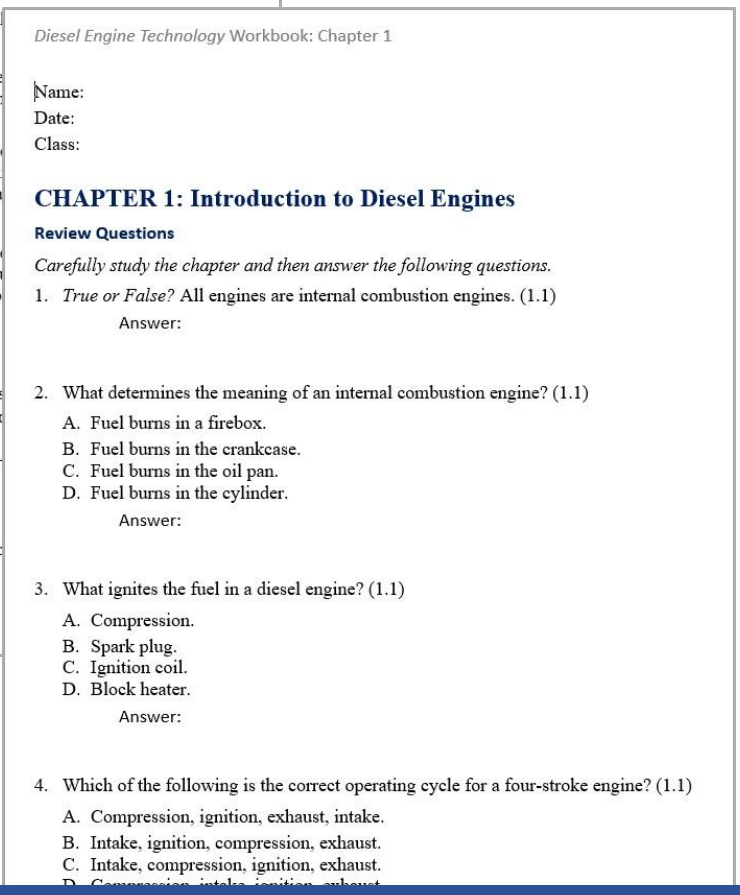
Only properly locked out tagged out (LOTO) vehicles and er be used, repaired, or have any work completed.

Procedure

1. See your instructor for a vehicle on which to perform this job information below.

   A. Year:

1



Diesel Engine Technology Workbook: Chapter 1

Name:
Date:
Class:

CHAPTER 1: Introduction to Diesel Engines

Review Questions

Carefully study the chapter and then answer the following questions.

1. *True or False?* All engines are internal combustion engines. (1.1)
   Answer:

2. What determines the meaning of an internal combustion engine? (1.1)
   A. Fuel burns in a firebox.
   B. Fuel burns in the crankcase.
   C. Fuel burns in the oil pan.
   D. Fuel burns in the cylinder.
   Answer:

3. What ignites the fuel in a diesel engine? (1.1)
   A. Compression.
   B. Spark plug.
   C. Ignition coil.
   D. Block heater.
   Answer:

4. Which of the following is the correct operating cycle for a four-stroke engine? (1.1)
   A. Compression, ignition, exhaust, intake.
   B. Intake, ignition, compression, exhaust.
   C. Intake, compression, ignition, exhaust.

Workbook and Shop Manual

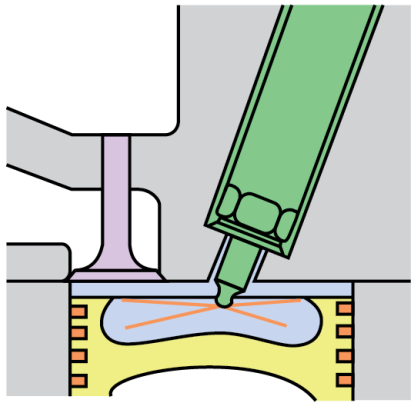
Integrate G-W Digital Student Resources

Diesel Engine Technology

G-W PUBLISHER

Brief Contents

Student Textbook



ASE-Type Questions

1. Technician A says that most modern diesel engines use the internal force-feed lubrication system. Technician B says that the splash system is found in some older industrial applications. Who is right? (16.2)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
2. Depending on the application, oil pans may be designed to permit an engine inclination of up to _____. (16.2)
   A. 15°
   B. 30°
   C. 45°
   D. 90°
3. The _____ gear pump is the most common type of oil pump used in a diesel lubricating system. (16.2)
   A. internal
   B. external
   C. gerotor
   D. crescent
4. Which type of oil cooler is usually mounted internally in the engine or the crankcase? (16.2)
   A. Tube.
   B. Plate.
   C. Gear.
   D. All of the above.

fuel in a separate furnace or firebox. In a ***diesel engine***, fuel is injected into the cylinder and heat generated from compression ignites the fuel charge, **Figure 1-1**. Expanding gases created by the burning fuel charge power the engine.

Bright/Shutterstock.com

Figure 1-1. Modern diesel engines are available in a wide range of sizes and configurations. All use the heat of compression to ignite the fuel charge.

Diesel Engine Operating Cycle

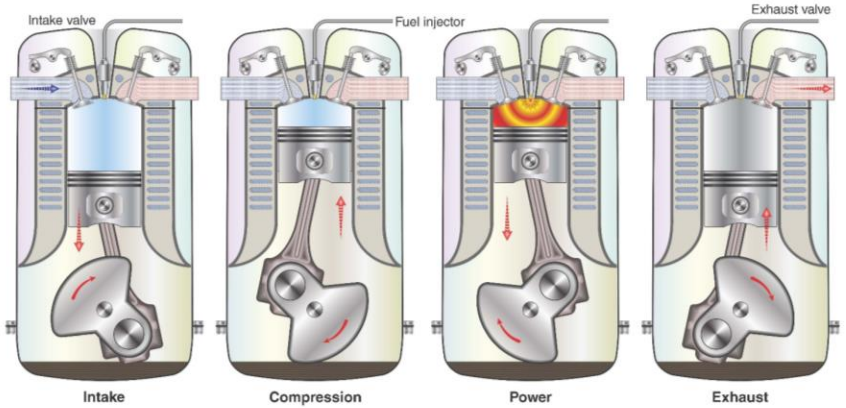
An engine's ***operating cycle*** is the sequence of events that produces power in an engine. A complete operating cycle includes intake, compression, power, and exhaust events. The operating cycle occurs repeatedly as an engine runs.

Diesel engines can be designed to operate on a four-stroke cycle or a two-stroke cycle. Each ***stroke*** in the cycle corresponds to the up or down movement of the piston within the cylinder. ***Four-stroke engines*** use four piston strokes to complete one operating cycle—one stroke each for intake, compression, power, and exhaust events. See **Figure 1-2**. ***Two-stroke engines*** accomplish intake, compression, power, and exhaust using only two piston strokes, one upward and one downward.

All modern on-highway diesel engines are four-stroke engines. In the past, two-stroke diesel engines were popular in marine, power generation, and industrial applications. In a two-stroke diesel engine, intake and compression occur on the upward piston stroke, while power and exhaust occur during the downward piston stroke. See **Figure 1-3**. Given the decline in popularity of two-stroke diesel engines, this text will focus on modern four-stroke designs, with occasional reference to the older two-stroke models that might still be found in operation.

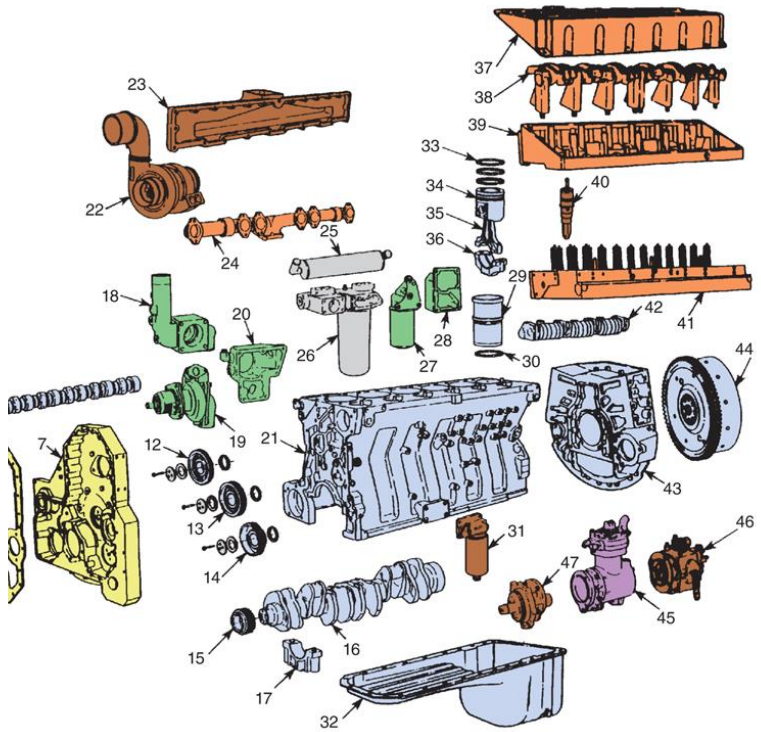
Supplying Air and Fuel

Diesel engines are fuel injected, and ignition is caused by the heat generated during the compression stroke. Air is drawn into the diesel engine cylinder through the intake manifold and compressed by the piston. As the air is compressed, its temperature increases. An atomized mist of liquid fuel is then sprayed into the cylinder at the



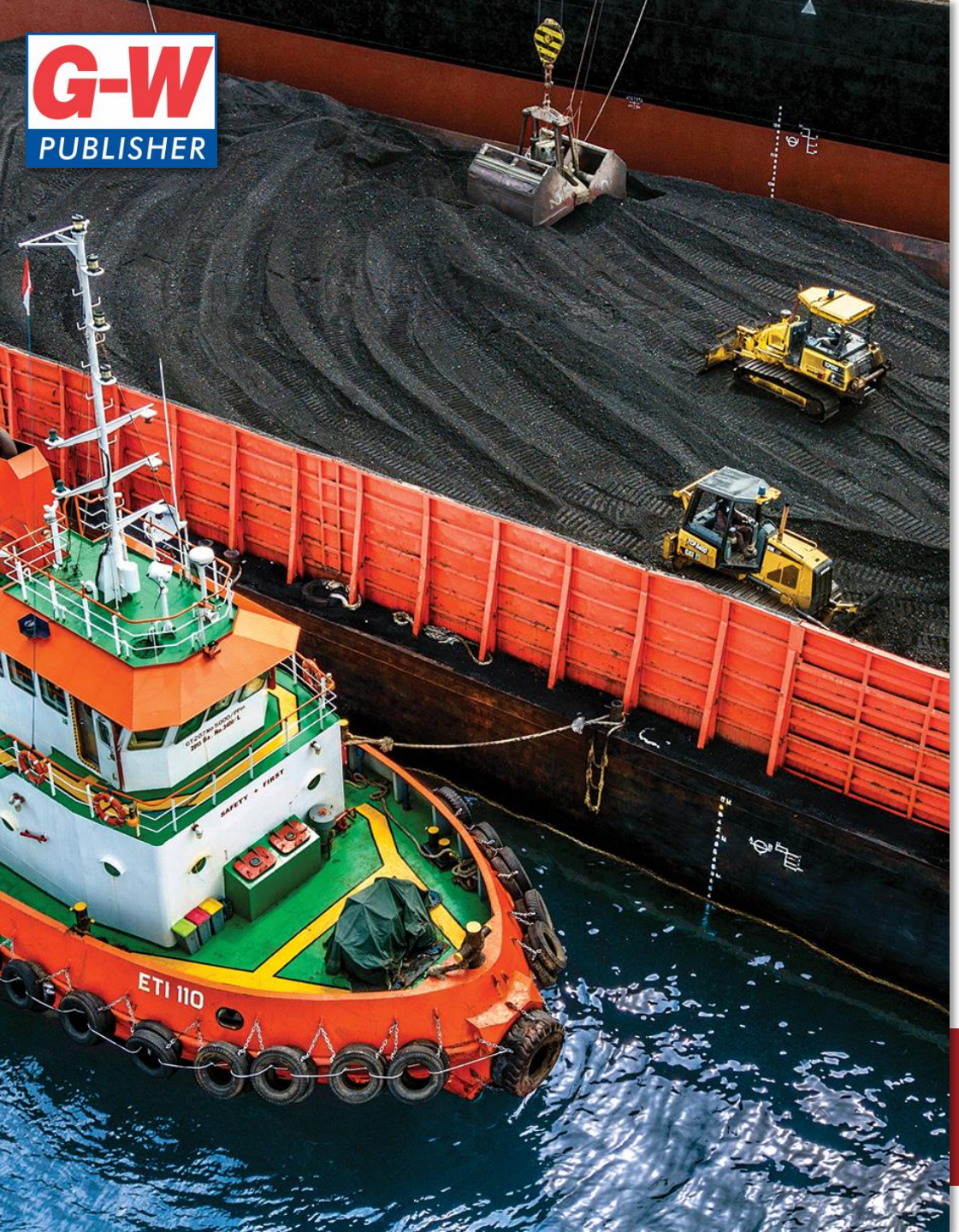
Fouad A. Saad/Shutterstock.com

Figure 1-2. The four piston strokes of a four-stroke diesel engine.



13. Idler gear assembly
14. Idler gear assembly
15. Crankshaft gear
16. Crankshaft
17. Cap, main bearing
18. Thermostat housing
19. Water pump
20. Thermostat housing
21. Cylinder block
22. Turbocharger
23. Charge air cooler housing
24. Exhaust manifold
25. Lubricating oil cooler
26. Lubricating oil filter assembly
27. Coolant filter
28. Coolant filter head assembly
29. Cylinder liner
30. O-ring, liner
31. Fuel filter
32. Oil pan
33. Piston rings
34. Piston
35. Connecting rod
36. Connecting rod
37. Rocker housing cover
38. Rocker arm assemblies
39. Rocker arm housing
40. Fuel injector
41. Cylinder head
42. Cam follower assembly
43. Flywheel housing
44. Flywheel
45. Air compressor
46. Fuel pump (PT)
47. Fuel pump (transfer)

What's New to the Edition



CHAPTER 1

Introduction to Diesel Engines

photostar72/Shutterstock.com
Top band: Media Whale Stock/Shutterstock.com

LEARNING OUTCOMES

After studying this chapter, you will be able to:

1.1 Identify the design characteristics of a diesel engine, including its operating cycle, the method air and fuel is supplied, and how the fuel is ignited in the cylinders.
1.2 List five advantages of diesel engines over gasoline engines.
1.3 Describe drawbacks of powering implements with diesel engines.
1.4 Name the major applications for diesel engines in modern industry and transportation.
1.5 Name several key inventors and milestones in the development of the diesel engine and explain the significance of electronics in the development of the diesel engine.

KEY TERMS

actuators
cold starting aid
compression ignition
compression ratio
computer
diesel engine
diesel fuel
electronically controlled fuel injection systems
emission controls
four-stroke engines
governor
high-pressure common rail (HPCR)
internal combustion engine
mobile applications
operating cycle
power takeoff (PTO)
power units
Rudolf Diesel
sensors
stationary applications
stroke
turbochargers
two-stroke engines
vacuum

Introduction

While the gasoline engine and diesel engine are the two most widely used internal combustion engines in the world, the diesel engine has grown to be the power source relied on in the heavy truck and heavy equipment and automotive. This chapter covers the basic operating principles of these diesel engines and lays the foundation for the material presented in the later chapters.

1.1 The Diesel Engine

Chapter-Opening Materials

Caution

Do not remove a cylinder head that is still warm. Doing so may cause the head to warp. Always allow the head to cool before disassembly.

Tech Tip

The ASE-type questions at the end of each chapter in this textbook are presented in much the same format as ASE test questions.

Warning

When conducting the air pressure test, be sure all persons in the area are adequately protected against any stream of pressurized air that could come from a rupture in the fitting, hose, or oil cooler core. Always use an air pressure regulator.

Textbook Features

10. The first company to introduce an electronically controlled diesel fuel injection system in its Series 60 engine was _____. (1.5)
    A. Cummins
    B. Caterpillar
    C. Detroit Diesel
    D. John Deere
11. Modern fuel injection systems have been improved to allow for _____ pressures and _____ control than older systems. (1.5)
    A. higher, more precise
    B. higher, slower
    C. lower, slower
    D. more precise, higher
12. Which is not an emission control technology? (1.5)
    A. Exhaust gas recirculation
    B. Oxidation catalysts
    C. Particulate trap filters
    D. Muffler coolant

Apply and Analyze

1. How does the way the air-fuel mixture is ignited in a diesel engine differ from the way it is ignited in a gasoline engine? (1.1)

ASE-Type Questions

1. Typical compression ratios in diesel engines range between _____. (1.1)
   A. 7.5:1 and 9.5:1
   B. 10:1 and 14:1
   C. 15:1 and 24:1
   D. 19.5:1 and 27:1
2. Technician A states that both four-stroke and two-stroke diesel engines are used for modern high-horsepower applications. Technician B states that only four-stroke engines are used for modern high-horsepower applications. Who is correct? (1.1)
   A. A only.
   B. B only.
   C. Both A and B.
   D. Neither A nor B.
3. All of the following are characteristics of diesel engines, *except*: (1.1)
   A. they are more durable than gasoline engines.
   B. diesel engines operate at lower compression ratios than gasoline engines.
   C. all diesel engines are fuel injected.
   D. diesel engines convert a higher percentage of fuel into useful power.

2. Define *compression ratio* and explain how it differs in gasoline and diesel engines. (1.1)
3. Describe the similarities and differences between the operating cycles of four-stroke and two-stroke diesel
4. How engi
5. Wha wher envir

Critica

1. After truck the r diese gaso custo
2. How and truck

4. Tech fuel i comp requi need
   A. A
   B. B
   C. B
   D. N
5. All o engi
   A. d rp
   B. p of
   C. th en
   D. en

- Diesel engines can be difficult to start in cold environments if a suitable cold starting aid, such as glow plugs or a preheater, is not used. (1.3)
- The many applications of the modern diesel engine can be grouped into two broad categories: mobile applications and stationary applications. (1.4)
- In mobile applications, the engine propels the vehicle or machine upon which it is mounted from one location to another. (1.4)
- A power takeoff (PTO) is essentially a supplemental drive. The PTO may drive another machine that is pulled behind the first one. (1.4)
- Diesel engines used in stationary applications produce power from a fixed location for industrial use. They are often called power units and are mounted on a stand, transmitting their power to the load through a coupler or driveline. (1.4)
- The diesel engine came into existence over 125 years ago, thanks primarily to the efforts of Rudolf Diesel, the German inventor for whom the engine is named. (1.5)
- The first diesel engines were very bulky, making them best suited for use in stationary applications. (1.5)
- In 1927, Robert Bosch developed a compact, reliable fuel injection pump. This opened the door to smaller, lighter, faster diesel engines that could power trucks and automobiles. (1.5)
- Concerns over exhaust emissions and the need to conform to strict emissions standards led diesel manufacturers to design electronically controlled fuel injection systems and emission controls. (1.5)
- Modern diesel engines continue to change as technology progresses. New materials and advances in electronics are consistently being incorporated into the design of diesel engines to further improve efficiency and decrease any negative environmental impact. (1.5)

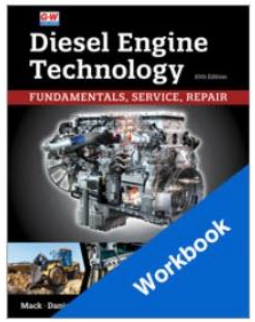
REVIEW QUESTIONS

Answer the following questions using the information provided in this chapter.

Know and Understand

1. Which of the following would be classified as a diesel engine? (1.1)
   A. An external combustion engine with compression ignition.
   B. An external combustion engine with spark ignition.
   C. An internal combustion engine with compression ignition.
2. *True or False?* All on-highway diesel engine manufacturers now incorporate the fuel governing function into the engine's electronic control system. (1.1)
3. A _____ is a device that senses engine speed and load and adjusts fuel delivery accordingly to control engine rpm. (1.1)
   A. throttling valve
   B. governor
   C. fuel injector
   D. power takeoff
4. Identify whether each statement is true for a gasoline (G) or diesel (D) engine: (1.1, 1.2)
   A. _____ Fuel is mixed with air prior to entering the combustion chamber.
   B. _____ Speed is controlled by regulating the amount of fuel delivered to the cylinders.
   C. _____ There is always an excess of air in the combustion chamber.
   D. _____ This engine "throttles" air entering the engine.
   E. _____ This engine's fuel has more Btus per gallon.
5. All of the following are advantages of diesel engines over gasoline engines, *except*: (1.2)
   A. durability.
   B. a lower compression ratio.
   C. compression ignition.
   D. intake manifold vacuum remains constant at all engine speeds.
6. To prevent damage to injection system components, the temperature of the diesel fuel should not exceed _____. (1.3)
   A. 100°F (38°C)
   B. 125°F (52°C)
   C. 135°F (57°C)
   D. 150°F (66°C)
7. Which of the following is *not* an example of a mobile diesel engine application? (1.4)
   A. Trucks
   B. Air compressors
   C. Farm tractors
   D. Railcars
8. *True or False?* Electric power generation, mining, and irrigation are all areas that came to rely heavily on diesel power. (1.4)
9. What invention was significant in allowing the diesel engine to be used in smaller, lighter mobile applications? (1.5)
   A. Robert Bosch fuel injection pump
   B. Roosa Master fuel distributor
   C. Ultra-low sulfur diesel fuel

End-of-Chapter Content



Activities ▼

- 1 Review Questions
- 2 Review Questions
- 3 Review Questions
- 4 Review Questions
- 5 Review Questions
- 6 Review Questions
- 7 Review Questions
- 8 Review Questions
- 9 Review Questions
- 10 Review Questions

Name:
Date:
Class:

CHAPTER 1: Introduction to Diesel Engines

Review Questions

Carefully study the chapter and then answer the following questions.

1. *True or False?* All engines are internal combustion engines. (1.1)

   Answer:

2. What determines the meaning of an internal combustion engine? (1.1)

   A. Fuel burns in a firebox.
   B. Fuel burns in the crankcase.
   C. Fuel burns in the oil pan.
   D. Fuel burns in the cylinder.

   Answer:

3. What ignites the fuel in a diesel engine? (1.1)

   A. Compression.
   B. Spark plug.
   C. Ignition coil.
   D. Block heater.

   Answer:

4. Which of the following is the correct operating cycle for a four-stroke engine? (1.1)

   A. Compression, ignition, exhaust, intake.
   B. Intake, ignition, compression, exhaust.
   C. Intake, compression, ignition, exhaust.
   D. Compression, intake, ignition, exhaust.

   Answer:

Workbook

G-W PUBLISHER

Name:
Date:
Class:

PROJECT 3: Performing Oil Changes and Checking an Engine for Leaks

Introduction

Periodic oil and filter changes can greatly prolong the l
changes are relatively simple, but must be done correctly. It
coolant leaks be found and promptly fixed. In Job 6, you wi
oil and change the oil filter. In Job 7, you will observe the e
leaks.

Project 3 Jobs

- Job 6—Change Oil and Filter
- Job 7—Inspect an Engine for Leaks

Tools and Materials

The following list contains the tools and materials that may
jobs in this project. The items used will depend on the make
serviced.

- Vehicle in need of service.
- Applicable service information.
- Oil filter wrench.
- Oil drain pan.
- Oil filter.
- Correct type and grade of oil.
- Leak detection equipment.
- Shop towels.
- Hand tools as needed.
- Safety glasses and other protective equipment as nee

Safety Notice

Before performing this job, review all pertinent safety i
review safety information with your instructor.

Name:
Date:
Class:

Project A: Basic Understanding of the Diesel Engine

Introduction

The diesel engine was invented by Rudolf Diesel with the first prototype completed in 1897. He continued to develop and improve the design, patenting the compression engine in 1892. The diesel engine has had many improvements and developments since Diesel's first prototype and will continue to improve going forward.

Understanding the basic subsystems and components is a necessity when servicing modern engines. Even though today's engines are extremely advanced and diagnostic procedures continue to improve, a technician must be able to understand the subsystems, fluids, engine design, and how to utilize a service information system to properly perform diagnosis and repair.

The following jobs research the vehicles or engines service information, including fluids and technical service bulletins that are related to the engine being serviced. The student will also learn how to properly check fluid levels and fluid conditions and will understand how these relate to inspecting or diagnosing engine-related issues.

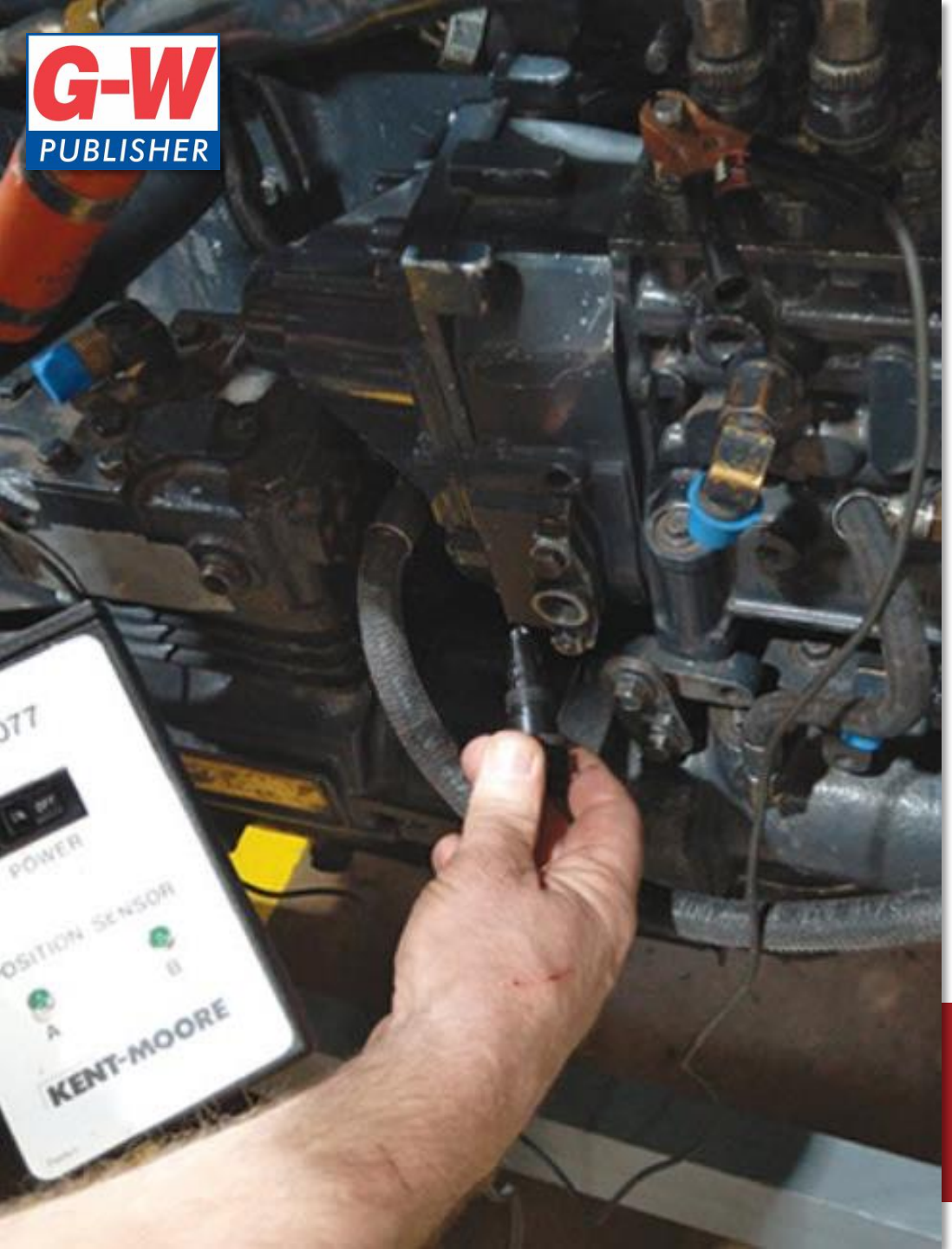
Project A Jobs

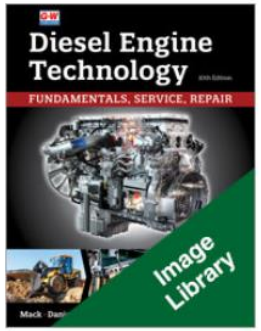
- Job 1—Familiarization of Diesel Engines
- Job 2—Inspection of Fluid Levels and Fluid Leaks

Project A Tools and Equipment

- Service information system (SIS).
- Diesel engine (this can be a run stand, truck, or equipment).
- A service history of the engine.
- Wheel chocks.
- Lock out tag out (LOTO).
- Personal protective equipment (PPE).
- General shop tools such as creepers, lights, shop towels, etc.

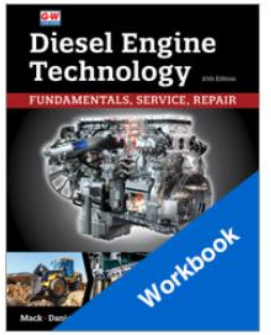
Shop Manual



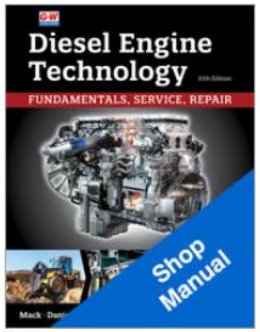


Diesel Engine Technology 10e, Image Library

Diesel Engine Technology 10e, Digital Companion



Diesel Engine Technology 10e, Workbook

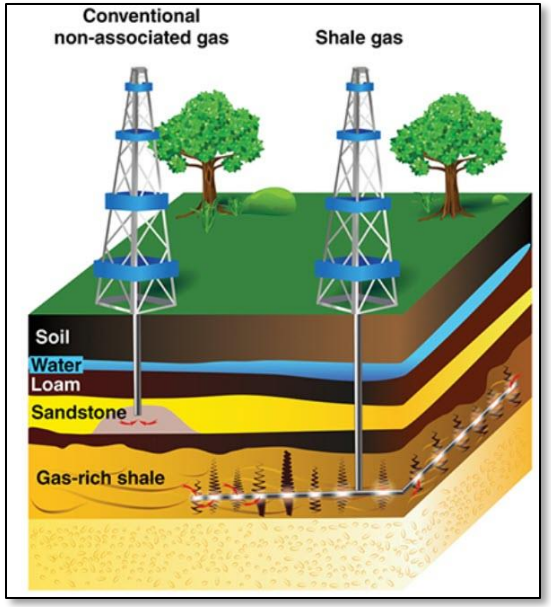


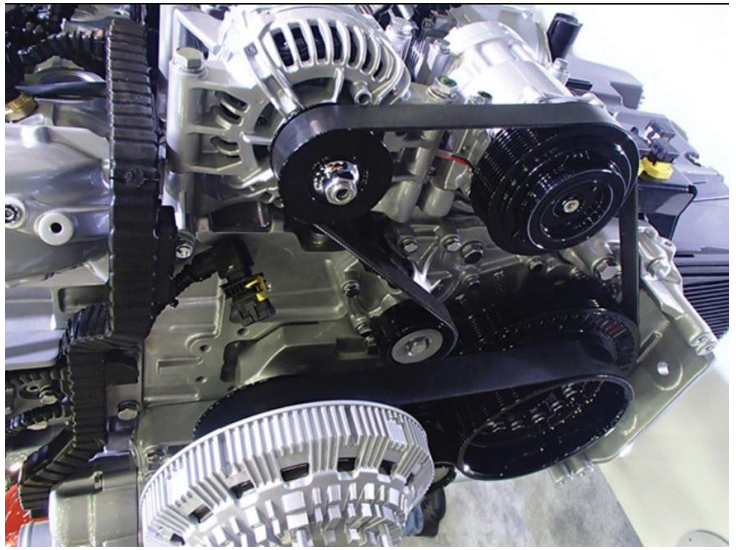
Diesel Engine Technology 10e, Shop Manual

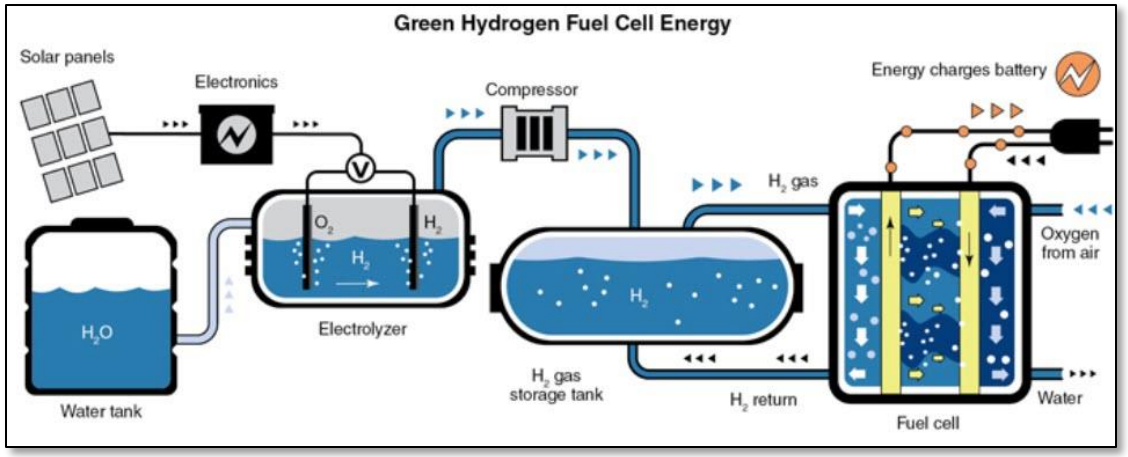
Medium/Heavy Duty Truck Virtual Toolbox

Multimeter Simulations

Digital Assets







Images and Illustrations

G-W PUBLISHER

Diesel Engine Technology E-Flash Cards

Term (1 of 20)

©Snap-on Incorporated

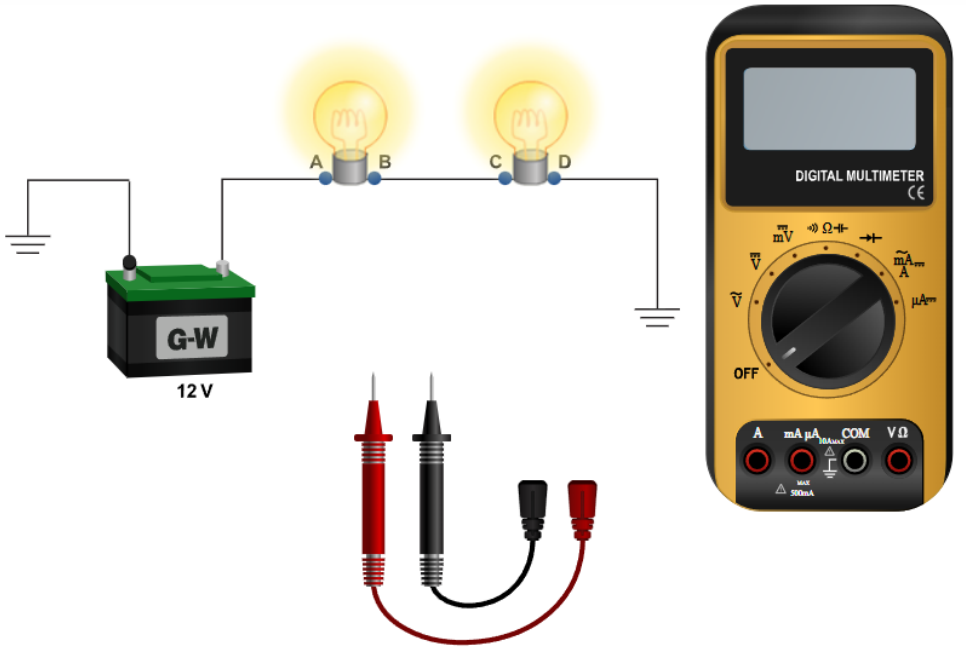
Previous | Remove | Next

Measuring Resistance in a Series Circuit: Problem 1

Battery
- Connected
- Disconnected

Multimeter Red Lead
- A
- mAμA
- VΩ
- Disconnected

Multimeter Black Lead
- COM
- Disconnected



Multimeter Setting: OFF

Multimeter Red Probe: Disconnected

Multimeter Black Probe: Disconnected

Virtual Toolbox and Simulations

G-W PUBLISHER

Home Favorite History New Narrated Goodheart-Willcox

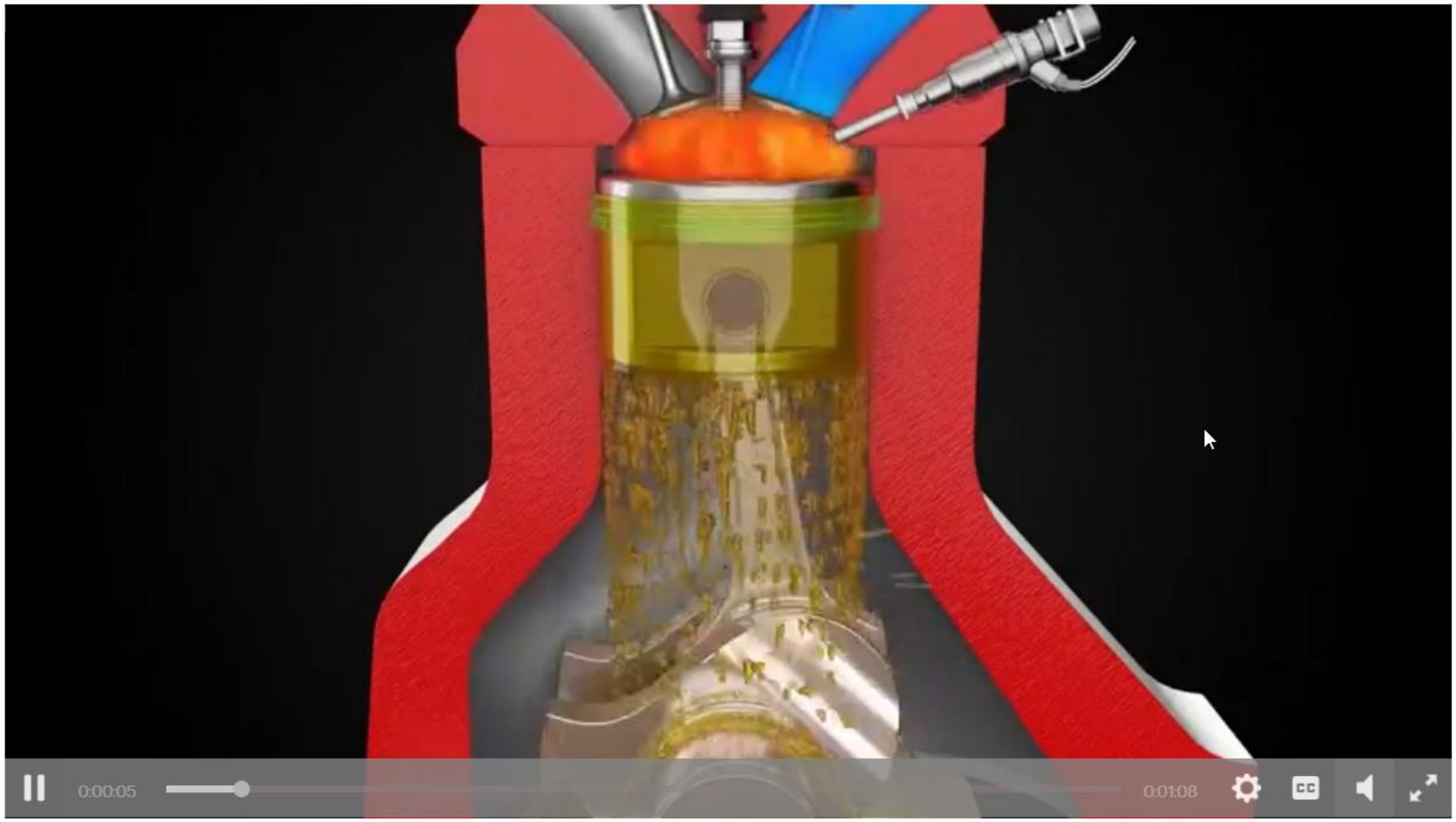
INTERACTIVE VIDEOS

Engine

Engine Oil System

Timing Belt

Timing Chain



NARRATED VIDEOS

Engine Oil S... 01:54

Timing Belt 01:17

Timing Chain

Engine

Basic Description

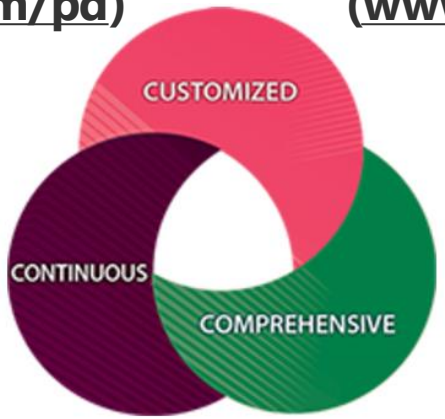
Internal combustion engines co
pistons, a crankshaft, and valve

MotoVisuals from Advance Auto Parts

Empowering Educators to Inspire Learners

Professional Development
(www.g-w.com/pd)

Instructional Design
(www.g-w.com/id)



G-W Training Center (www.g-w.com/training)

G-W Professional Services

Tools for Educators:

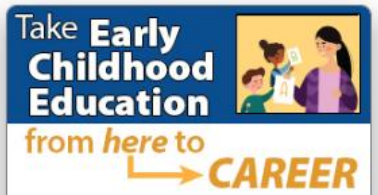
Activities, Posters, and Professional Development Videos

From Here to Career: IT

Type: Infographic / Poster
Grade: 13-14
Subject: Computer Science and Information Technology

Download

Learn More



From Here to Career: Early Childhood Education

Type: Infographic / Poster
Grade: 9-14
Subject: FCS-Education and Training

Download

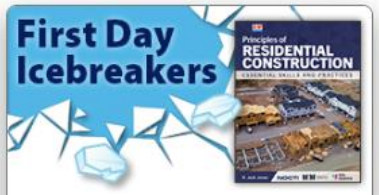
Learn More

From Here to Career: Automotive

Type: Infographic / Poster
Grade: 13-14
Subject: Transportation, Distribution, and Logistics

Download

Learn More

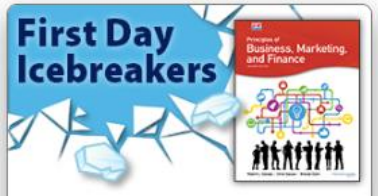


Snap, Clap, Pop: Construction

Type: Downloadable Activities
Grade: 9-12
Subject: Architecture and Construction

Download

View Product



Snap, Clap, Pop: Business, Marketing, Finance

Type: Downloadable Activities
Grade: 9-12
Subject: Business, Marketing, and Finance

Snap, Clap, Pop: Health Science

Type: Downloadable Activities
Grade: 9-12
Subject: Health and Physical Education

www.g-w.com/tools-for-educators

Welcome to the G-W Training Center!

A well-prepared educator is at the cornerstone of every successful learning environment—and G-W is here to support you every step of the way. Our resources equip teachers with the knowledge and skills necessary to maximize the impact of our programs in your classrooms. By providing tools that range from simple, user-friendly training resources that directly align to your textbook to high-impact instructional practices, we want every educator to feel confident using G-W resources as a powerful gateway to student-centered learning.

Learn more about Knowledge-Base Articles and using training resources.

Questions? Connect with Support

www.g-w.com/training

Customer Service & Support

G-W needs instructors for:

- Content Reviews
- Digital Reviews
- Authors
- Subject Matter Experts
- Advisory Boards
- Focus Groups

www.g-w.com/engage-with-us

Engage with Us

GoodheartWillcox

GWPublishe
r

company/gwpublisher

GWPublisher

Connect with G-W!

blog.g-w.com

GoodheartWillcox

Connect with G-W!