LEARNING OBJECTIVES
After studying this chapter, students will be able to:
- Identify several types of fasteners.
- Explain why inch-based fasteners are not interchangeable with metric-based fasteners.
- Describe how some fasteners are used.
- Select the proper fastening technique for a specific job.
- Describe chemical fastening techniques.

INSTRUCTIONAL MATERIALS
Text: pages 127–142
  Test Your Knowledge Questions, pages 140–141
Workbook: pages 47–50
Instructor’s Resource: pages 121–130
  Guide for Lesson Planning
  Research and Development Ideas
  Reproducible Masters:
    7-1 Identifying Metric Fasteners
    7-2 Relative Strength of Hex Head Cap Screws
    7-3 Various Types of Cap Screws
    7-4 Test Your Knowledge Questions
  Color Transparencies (Binder/CD only)

GUIDE FOR LESSON PLANNING
This chapter serves to present the numerous types of fasteners that a machinist will use as well as their proper handling and installation. Although every type of fastener cannot be illustrated in the space available, the basic types are defined and illustrated.

The following items will aid in teaching this chapter:
- A selection of fasteners for examination.
- Examples showing how several types of fasteners are used.
- A selection of adhesives suitable for bonding metal.
  Have students read and study Chapter 7, Fasteners. They should pay particular attention to the illustrations. Review the material and discuss the following:
  - Why there are so many types of fasteners.
  - How threaded fasteners are measured.
  - Why there is a need for metric fasteners.
  - How to identify metric fasteners.
  - Thread nomenclature.
  - The various fasteners available in the shop/lab.
  Ask the following questions during the discussion:
  - What unusual fasteners have students observed?
  - Why is it not possible to substitute metric-based fasteners for inch-based fasteners?
- Where are metric fasteners used today?
- What problems are encountered when inch-based and metric-based fasteners are used on the same product? (Some automobiles use both types of fasteners.)
- Why are metric fasteners used today?
- Where would stainless steel fasteners be used?
- Why are the special fasteners used on aircraft so expensive?
- Is any student/trainee aware of a product where adhesives are used to join metal parts?
- A specially designed fastener is used to mount alloy wheels on some automobiles. Why are they used? How do they differ from conventional fasteners?

Technical Terms

Review the terms introduced in the chapter. New terms can be assigned as a quiz, homework, or extra credit. These terms are also listed at the beginning of the chapter.

- adhesives
- assembly
- cyanoacrylate quick setting adhesives
- fastener
- keyway
- machine bolts
- permanent assemblies
- setscrews
- threaded fasteners
- washers

Review Questions

Assign Test Your Knowledge questions. Copy and distribute Reproducible Master 7-4 or have students use the questions on pages 140–141 and write their answers on a separate sheet of paper.

Workbook Assignment

Assign Chapter 7 of the Machining Fundamentals Workbook.

Research and Development

Discuss the following topics in class or have students complete projects on their own.

1. Prepare samples of work using various threaded and nonthreaded fasteners. Mount them on a panel or arrange them on a table for the class to examine.
2. Secure samples of fasteners not described in this chapter. Classify them according to the material on which they are used and their recommended applications.
3. Develop a paper on how early fasteners were made. Use drawings to show how they looked.
4. Contact a manufacturer of fasteners and request samples of a machine bolt or cap screw in the various stages it must pass through until becoming a finished product. If it is not possible to secure actual samples, make a drawing showing the various stages of bolt manufacture.
5. Make a display of the various fasteners explained and described in this chapter. Mount and label them on a display panel.
6. Collect catalogs on fasteners for the school’s technical library.
7. Secure samples of several adhesives suitable for joining metal to metal. Demonstrate the proper and safe way to use these materials.
8. Devise a test method that will determine the strength of the various adhesives.
9. Organize and label the storage of fasteners in your training area. Inventory them and determine which fasteners will have to be reordered.

TEST YOUR KNOWLEDGE ANSWERS, Pages 140–141

1. 1 1/2
2. Evaluate individually. Refer to Section 7.1.
3. Machine
4. Identification marks (inch size) and Class number (metric size) indicate bolt strength.
5. An application of penetrating oil.
6. setscrew
7. stud
8. Rivets, adhesives
9. To prevent nuts and/or bolts from vibrating loose.
10. retaining rings
11. To lock a full size nut in place.
12. wing
13. f. Used to make permanent assemblies.
14. h. Locks a regular nut in place.
15. e. Is hammered into a drilled or punched hole.
16. i. Eliminate costly tapping operations.
17. d. Protects projecting threads.
18. b. Used where parts must be aligned accurately and held in absolute relation with one another.
19. a. Developed for use in confined area, where a joint is only accessible from one side.
20. g. Slot cut in gear or pulley to receive "c."
21. j. Slot cut in shaft to receive "c."
22. c. Prevents a pulley or gear from slipping on a shaft.
23. Evaluate individually. Refer to Section 7.3.1.
24. Evaluate individually. Refer to Section 7.4.

**WORKBOOK ANSWERS, Pages 47–50**

1. c. they permit work to be assembled and disassembled without damage to the parts
2. bolts
3. Cap
4. A. Clutch
   B. Cross Recess Type 1
   C. Cross Recess Type 2
   D. Flat
   E. Oval
   F. Fillister
   G. Truss
   H. Socket
   I. Slotted
   J. Round
   K. Pan
   L. Socket
5. d. All of the above.
6. square, hexagonal
7. jam, lock
8. washer
9. permanent
10. A. Internal-external
    B. Internal
    C. External
    D. Countersunk
    E. Split-ring
11. c. the joint is available from only one side
12. cotter pin
13. retaining, machining
14. They are hammered into a drilled or punched hole of the proper size.
15. When parts must be accurately positioned and held in absolute relation to one another.
16. key
17. keyseat, keyway
18. A. Surface preparation
    B. Adhesive preparation
    C. Adhesive application
    D. Assembly
    E. Bond development
19. Evaluate individually. Refer to Section 7.4.
20. A. Thread symbol for ISO (metric) thread
    B. Major diameter of threads in millimeters
    C. Pitch of threads in millimeters
    D. Thread tolerance class symbol (class of fit)
    E. Major diameter of thread in inches
    F. Threads per inch (pitch = 1/number of threads per inch)
    G. Thread series (Unified National Coarse)
    H. Class of fit (thread tolerance)
Identifying Metric Fasteners

Metric fasteners are manufactured in the same variety of head shapes as inch-based fasteners. However, there is a problem in finding an easy way to distinguish between the two fastener types. Bottom—Some larger size hex-head metric fasteners have the size stamped on the head. Top—A twelve-spline flange head is under consideration for use on eight sizes of metric fasteners: 5, 6.3, 8, 10, 13, 14, 16, and 20 mm.
Relative Strength of Hex Head Cap Screws

Identification marks (inch size) and class numbers (metric size) are used to indicate the relative strength of hex head cap screws. As identification marks increase in number, or class numbers become larger, increasing strength is indicated.
Various Types of Cap Screws

- Flat Head
- Hexagonal Head
- Socket Head
- Fillister Head
- Button or Round Head
Fasteners

1. For maximum strength, a threaded fastener should screw into its mating part a distance equal to ____ times the diameter of the thread.

2. There are many ways of joining material. List four types of threaded fasteners. Describe how each is used.

   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________

3. _____ screws are used for general assembly work.

4. How is the strength of hex-head cap screws indicated?

   ______________________________________________________________________

5. When removing stubborn sheared bolts, what can be done to make their removal easier?

   ______________________________________________________________________

6. To prevent a pulley from slipping on a shaft, a _____ is often employed.

7. The _____ bolt is threaded at both ends.

8. _____ or _____ are employed when the parts are to be joined permanently.

9. Why are lock washers used?

   ______________________________________________________________________

10. While most _____ must be seated in grooves, a self-locking type does not require the special recess.

11. When is a jam nut employed?

   ______________________________________________________________________

12. The shape of the _____ nut permits it to be loosened and tightened without a wrench.
Name: ______________________________________________

- Match each word in the left column with the most correct sentence in the right column. Place the appropriate letter in the blank.

  ____ 13. Rivet  
  ____ 14. Jam nut  
  ____ 15. Drive screw  
  ____ 16. Thread-cutting screw  
  ____ 17. Acorn nut  
  ____ 18. Dowel pin  
  ____ 19. Blind rivet  
  ____ 20. Keyway  
  ____ 21. Keyseat  
  ____ 22. Key

  a. Developed for use in confined area, where a joint is only accessible from one side.
  b. Used where parts must be aligned accurately and held in absolute relation with one another.
  c. Prevents a pulley or gear from slipping on a shaft.
  d. Protects projecting threads.
  e. Is hammered into a drilled or punched hole.
  f. Used to make permanent assemblies.
  g. Slot cut in gear or pulley to receive “c.”
  h. Locks a regular nut in place.
  i. Eliminate costly tapping operations.
  j. Slot cut in shaft to receive “c.”

23. List the steps, in their proper sequence, that must be used to join metals with adhesives.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

24. List at least five safety precautions that must be observed when using fasteners.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________