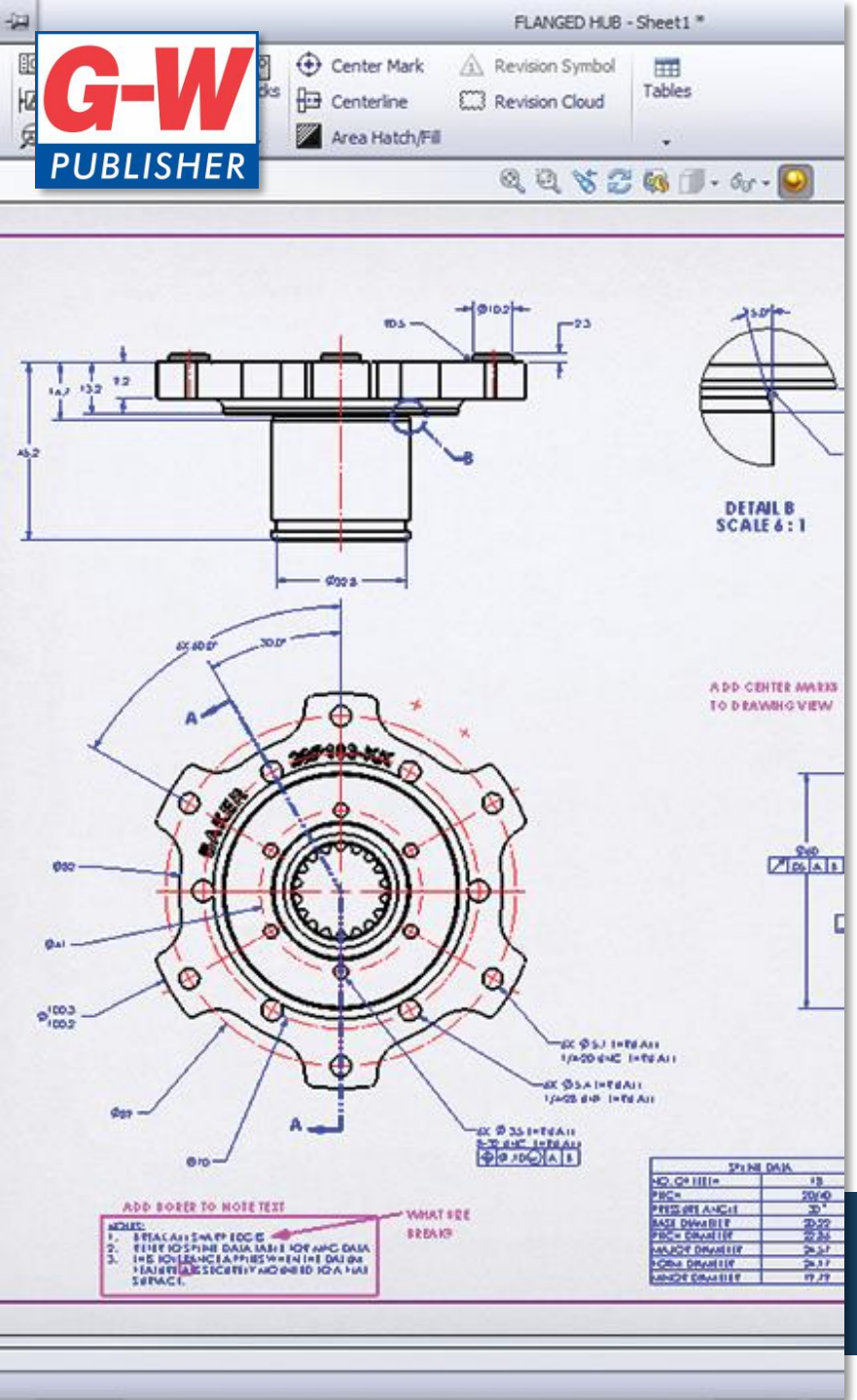

Machine Trades Print Reading

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Machine Trades Print Reading: Lesson Plan

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

Unit 1: Drawings and Prints

Learning Outcomes

- 1.1 Describe the two primary phases of the manufacturing process.
  - The Manufacturing Process
- 1.2 Explain the roles of various members of a design team.
  - The Manufacturing Process
- 1.3 Describe potential uses for a 3D part model.
  - The Manufacturing Process
- 1.4 Identify potential benefits of manual drafting skills for workers in the manufac
  - The Manufacturing Process
- 1.5 Explain the importance of understanding detail and assembly drawings, whe screen.
  - The Manufacturing Process
- 1.6 Identify occupations that require print reading skills.
  - Print Reading Applications

Instructional Resources

- Textbook/eBook: Unit 1
- Instructor Resources: Unit 1 Instructor's Presentation for PowerPoint
- Instructor Resources: Unit 1 Answer Key
- Other instructional resource:

Resources for Practice and Application

- Digital Companion: Interactive Activities
- Digital Companion: E-Flash Cards
- Digital Companion: Image Library
- Textbook/eBook: Unit 1 Review and Assessment, Know and Understand
- Textbook/eBook: Unit 1 Review and Assessment, Critical Thinking
- Other resource:

Assessment

- Assessment Suite
  - Unit 1 Pretest
  - Unit 1 Posttest
  - Unit 1 Exam
- Other assessment:

Teaching Suggestions

- Demonstrate the correct procedure for folding different size prints.
- Show students how a copy of a print original is produced. Obtain a Mylar or vellum pri to students.

1

Machine Trades Print Reading: Unit 1 Answer Key

Unit 1: Drawings and Prints

Unit Review

Know and Understand

1. B. design
2. A. engineer
3. A. machinists, inspectors
4. D. All are correct.
5. True
6. False
7. True
8. C. Detail
9. C. Assembly
10. True

Critial Thinking

1. Student answers will vary. Evaluate individually.
2. Student answers will vary. Evaluate individually.

Lesson Plans, Assessments, and Answer Keys

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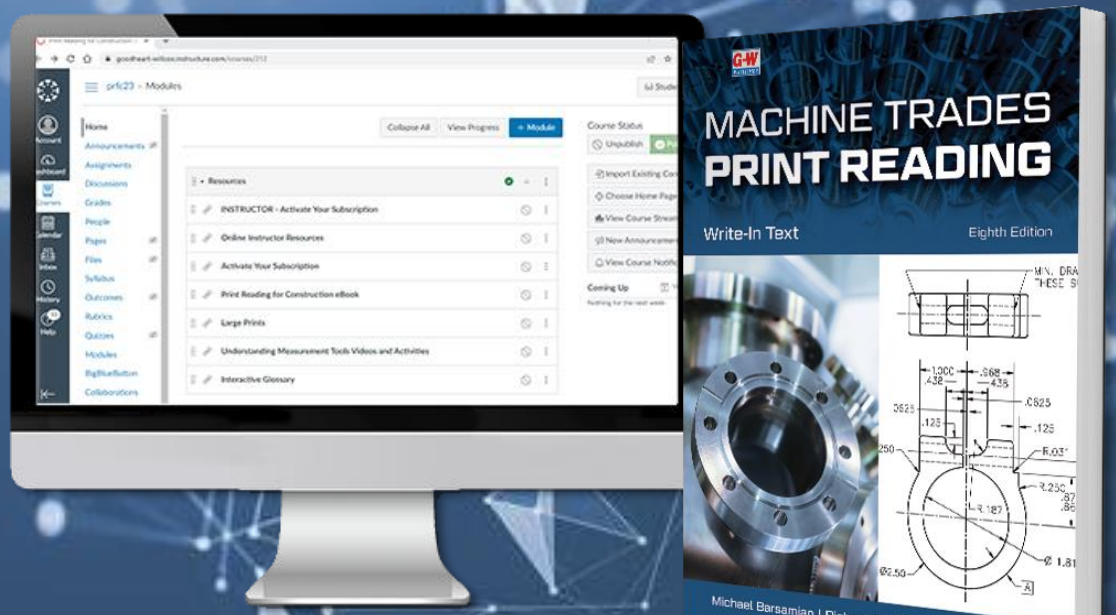

Print • Digital • Bundle Options Available

Blackboard

D2L BRIGHTSPACE

canvas

moodle

schoology

Additional LTI-Compliant Platforms

Clever

ClassLink

1EDTECH CERTIFIED

Google Classroom

LMS and CMS Integration Easy Navigation

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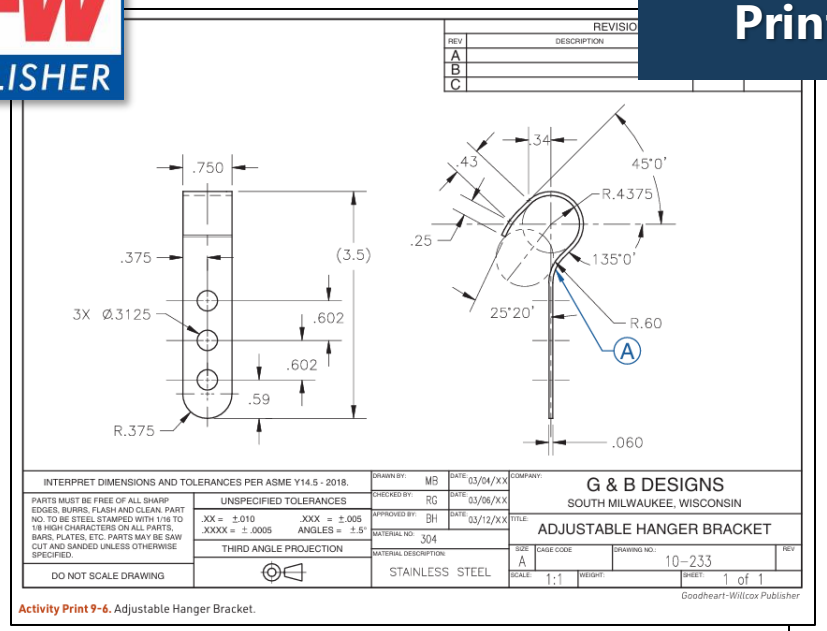
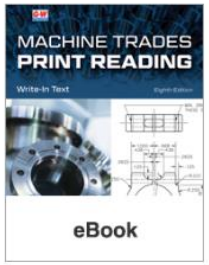
Print PDFs

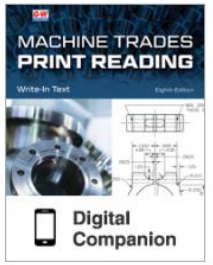


Activity Print 9-6. Adjustable Hanger Bracket.

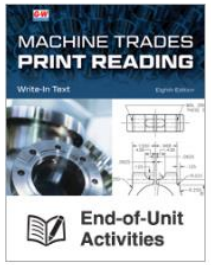
Machine Trades Print Reading 8e, Online Instructor Resources Suite



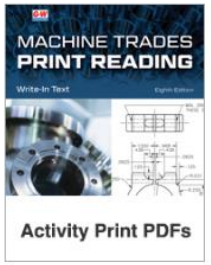
Machine Trades Print Reading 8e, eBook



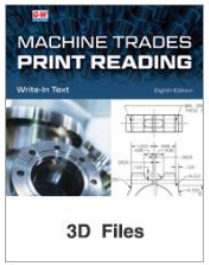
Machine Trades Print Reading 8e, Digital Companion



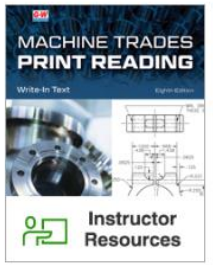
Machine Trades Print Reading 8e, End-of-Unit Print Activities



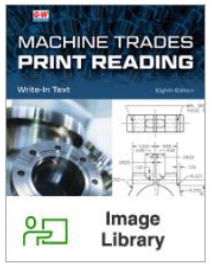
Machine Trades Print Reading 8e, Activity Print PDFs



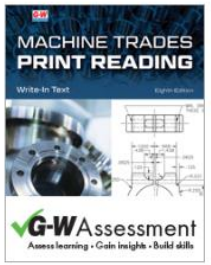
Machine Trades Print Reading 8e, 3D Files



Machine Trades Print Reading 8e, Instructor Resources

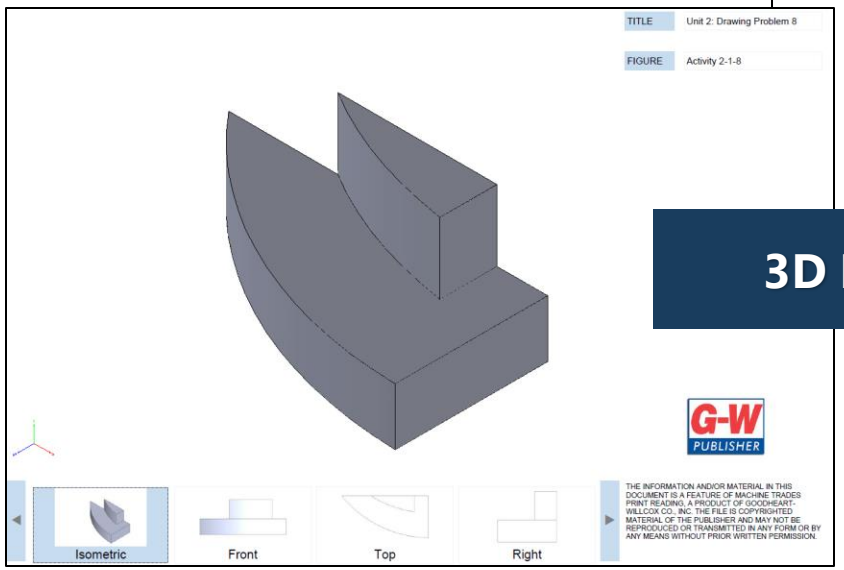


Machine Trades Print Reading 8e, Image Library

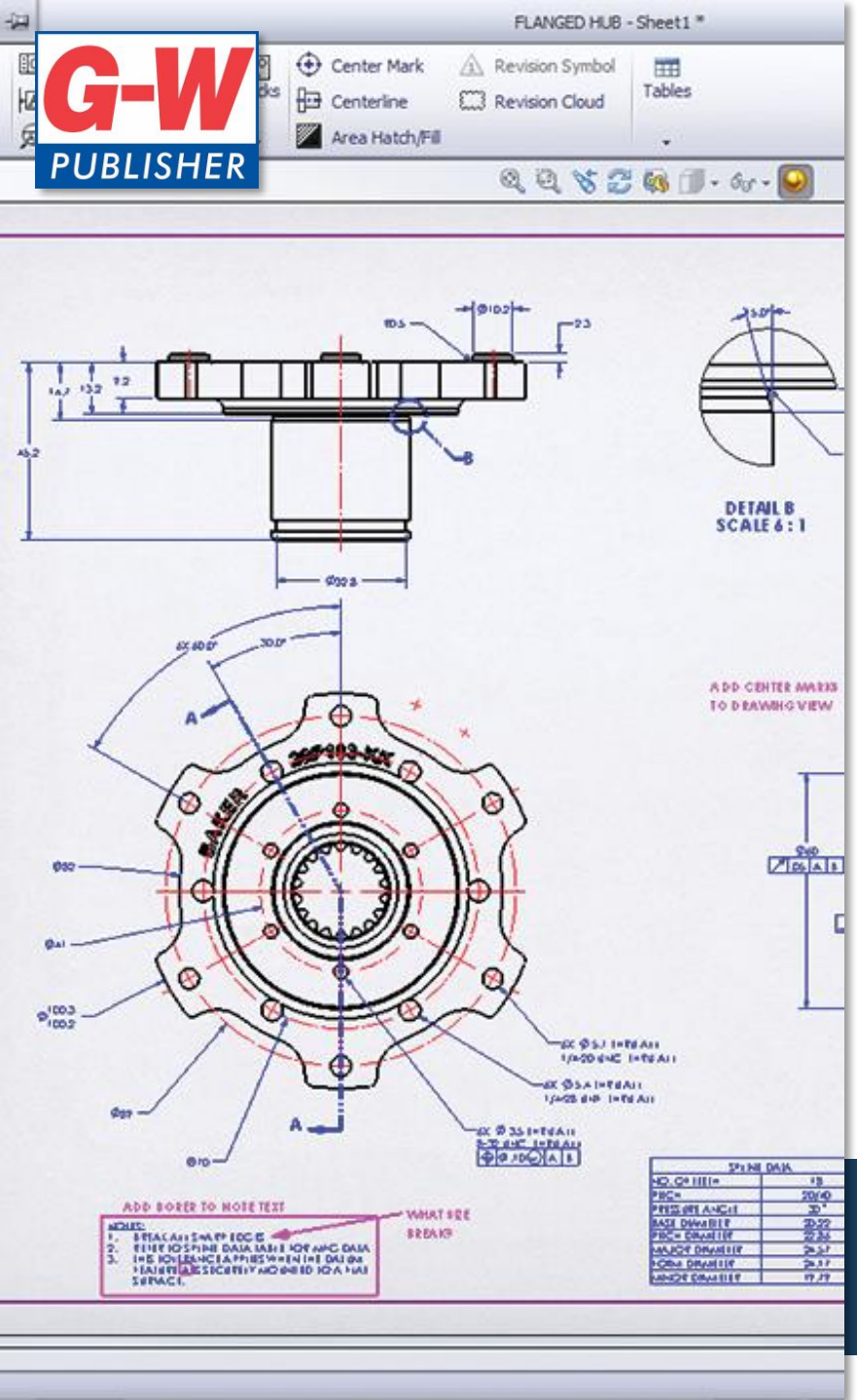


Machine Trades Print Reading 8e, G-W Assessment

3D Prints

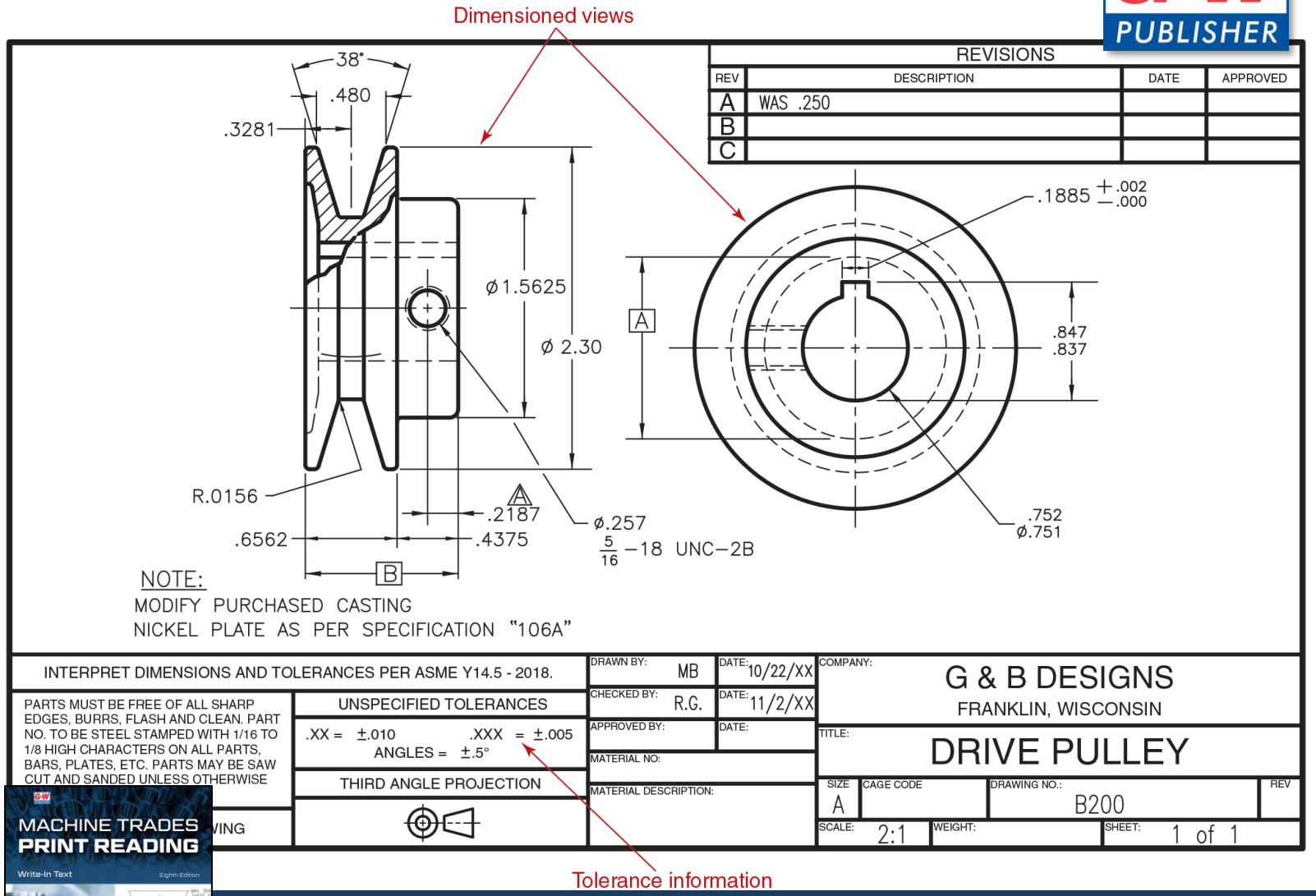


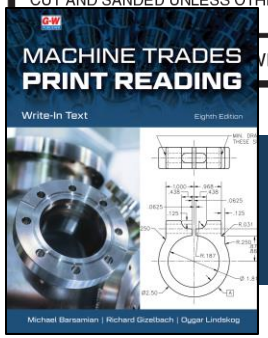
Integrate G-W Digital Resources



Brief Contents

1 Drawings and Prints . . . . . .
2 Visualizing Shapes . . . . . .
3 Line Usage . . . . . .
4 Title Blocks and Notes . . . . . .
5 Applied Math . . . . . .
6 Measurement Basics . . . . . .
7 Dimensions and Tolerances . . . . . .
8 Holes . . . . . .
9 Contours and Angles. . . . . .
10 Threads . . . . . .
11 Machining Details . . . . . .
12 Sectional Views . . . . . .
13 Auxiliary Views . . . . . .
14 GD&T Introduction . . . . . .
15 GD&T Applications . . . . . .
16 Detail Drawings . . . . . .
17 Assembly Drawings . . . . . .
18 Print Reading Review . . . . . .

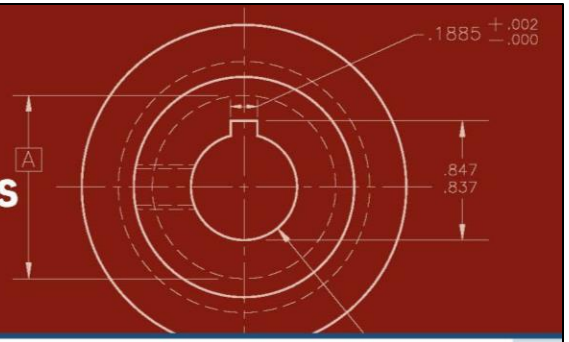




Student Textbook

UNIT 9

Contours and Angles



LEARNING OUTCOMES

After studying this unit, you will be able to:

- **9.1** Identify an arc on a drawing and understand its elements.
- **9.2** Explain how a blend radius is formed.
- **9.3** Know the difference between a fillet and a round.
- **9.4** Identify the size of a fillet, round, or part contour on a drawing.
- **9.5** Demonstrate the ability to distinguish different types of angles.
- **9.6** Recognize a bevel and determine its measurement.
- **9.7** Identify a chamfer and interpret its size.
- **9.8** Describe how tapers are dimensioned.

KEY TERMS

angle
angular dimensioning
arc
bevel
blend radius
chamfer
contour
fillet
round
tangent
taper
vertex

Introduction

Many parts featured in industrial prints will have contours and angles. A ***contour*** is a curved outline of an object that has a shape other than a circle. An ***angle*** is the amount of rotation or turn, measured in degrees, between two lines that meet at a point. The point at which the lines converge is known as the ***vertex***. The division of a circle into 360° defines the measurement of an angle. The types of angles applied to parts and features are bevels, chamfers, and tapers.

Arcs

An ***arc*** is any curved edge with a constant radius and an angle less than 360°, as shown in **Figure 9-1.** An arc is a portion of a circle's circumference. Arcs are dimensioned with leader lines and radii. On a drawing, a leader line identifies an arc, while the radius indicates the arc's size. Most radii have a defined origin at the center point, as shown in **Figure 9-2.**

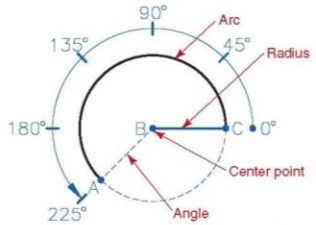


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Figure 9-1. An arc is defined by its radius and angle. The radius is the distance from the center point to the outer edge, as shown by the line connecting points B and C. The angle determines the arc length, as shown by the distance along the arc from point A to point C.

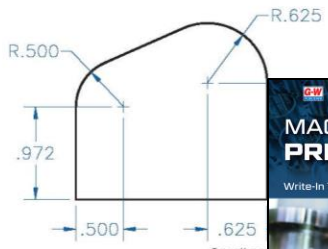
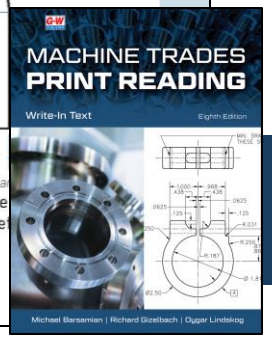
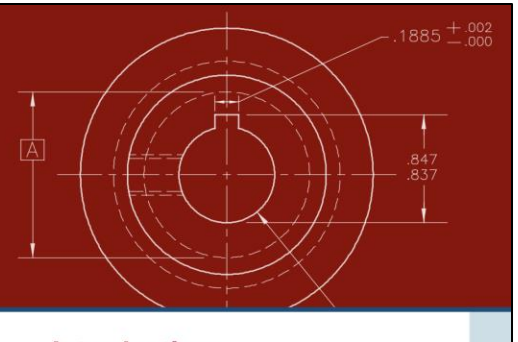


Figure 9-2. The linear dimensions locate the radii, while the radius dimensions de the arcs.



UNIT 7

Dimensions and Tolerances



LEARNING OUTCOMES

After studying this unit, you will be able to:

- **7.1** Define terms that apply to dimensioning and tolerancing.
- **7.2** Identify and understand dimensioning systems used on drawings.
- **7.3** Identify different methods used to apply tolerances.
- **7.4** Calculate tolerances for limit dimensions.
- **7.5** Determine tolerances on fractional, decimal, angular, and metric dimensions.

KEY TERMS

angular dimensioning
basic size
bilateral tolerance
datum
decimal inch
decimal inch dimension
degree
dimension
direct tolerancing
dual dimensioning
fractional dimension
limits
metric dimension
nominal size
plus and minus tolerancing
polar coordinate dimensioning
rectangular coordinate dimensioning without dimension lines
reference dimension
specified tolerance
tabular dimensioning
tolerance
unilateral tolerance
unspecified tolerance

Introduction

Dimensions define the size and location of features on a part. Properly dimensioned drawings make it possible to manufacture and assemble parts accurately. This unit covers different methods and established practices for dimensioning engineering drawings. This unit also covers tolerancing methods and explains how tolerances are calculated.

Dimensions

A ***dimension*** is a measurement of the distance between two given points on an object. Dimensions describe the size and shape of a part, as well as the location of its features. Typical dimensions include width, height, depth, angular, radius, and diameter dimensions. Dimension values on a drawing can be decimal, fractional, angular, or metric.

Fractional Dimensions

Fractional dimensions are measurements based on fractional numbers. The ASME Y14.5 standard does not recommend fractional dimensioning except for specifying nominal sizes. ***Nominal size*** is a general or stock size used for the identification of a part. It may not be the actual size of the part. For example, a 3/4-10 UNC bolt has a 3/4″ nominal size diameter, but the actual diameter size may vary from .7288 to .750.

Decimal Inch Dimensions

Decimal inch dimensions are measurements based on decimal inches. The ***decimal inch*** is the standard unit of linear measurement in the United States. A decimal inch is expressed in bases of ten, such as .1 = 1/10 (tenths), .01 = 1/100 (hundredths), .001 = 1/1000 (thousandths), and so forth, **Figure 7-1.**

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Unit-Opening Materials

f Lines

ntain various types of lines. Understanding the alphabet of lines allows the reader to visualize the intent of a drawing.

A line can have different characteristics. It can be continuous (solid line with no breaks), dashed (short lines separated by spaces), or a combination of both. Each type has a specific meaning and communicates information about the part to the reader.

Line width, or line weight, is another characteristic of a line. There are primarily two line widths used in mechanical drawing. A thick line is twice the width of a thin line. In the following sections, you will learn about the different types of lines and what information they provide about the part.

Visible Lines

Visible lines, also referred to as *object lines* or *outlines*, define the shape and surfaces of an object. They show all edges of an object that are visible in a view. Visible lines define the outside borders of a part as well as the surfaces within the borders. Visible lines are thick, continuous lines that visually stand out on a drawing, **Figure 3-2**.

Hidden Lines

Hidden lines show edges or surfaces that are otherwise not visible when viewing a part from a specific view. A hidden line, as shown in **Figure 3-3**, is a series of evenly spaced, thin dashed lines. The spaces between the lines are short.

Centerlines

A ***centerline*** shows the location of the center point of a hole or an axis of a part. A centerline may also show the center of an arc or a path of motion. Centerlines are thin lines with alternating long and short dashes, **Figure 3-4**. Centerlines are critical to machinists during layout, machining, and inspection.

Symmetry Lines

Symmetry lines are attached to the center axis of a part where both sides are symmetrical. They are common in partial views (sectional views that show details of an object without showing the complete view) and sections. Symmetry lines are two short, thick parallel lines placed perpendicular to the centerline at both ends, **Figure 3-5**.

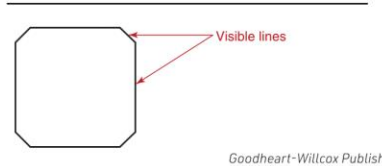

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Figure 3-2. Visible lines outline all edges and surfaces of an object seen in a view.

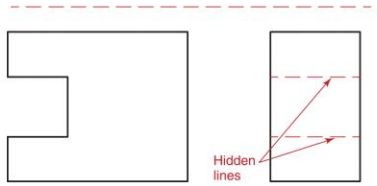

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Figure 3-3. Hidden lines show edges and surfaces not seen in a view.

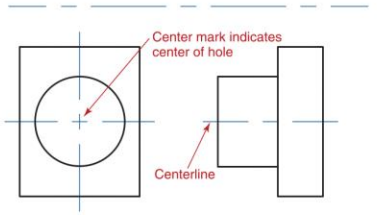

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Figure 3-4. Centerlines indicate center locations of holes, arcs, and axes of symmetrical parts.

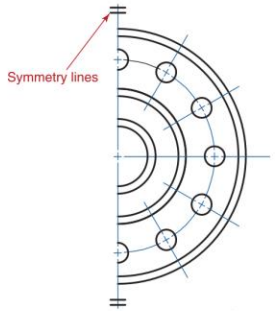

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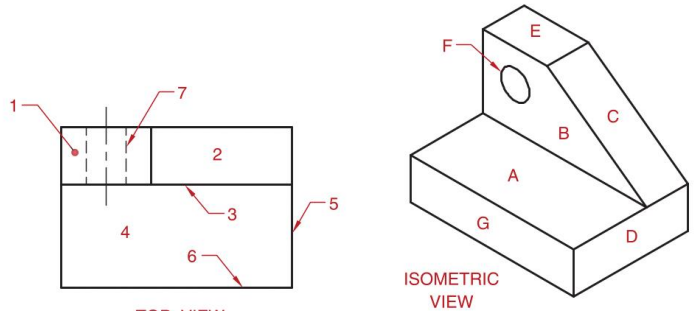
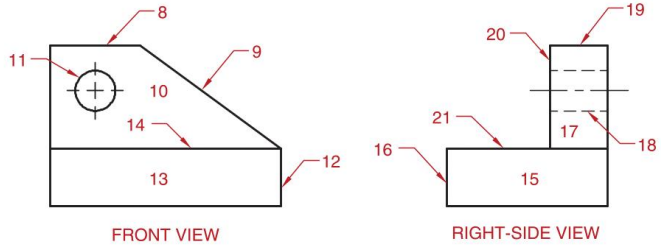
Figure 3-5. A divided partial view using symm signifies the part is symmetrically shaped.





Surface	Top	Front	Right Side
A	4	14	21
B	3	10	20
C	2	9	17
D	5	12	15
E	1	8	19
F	7	11	18
G	6	13	16

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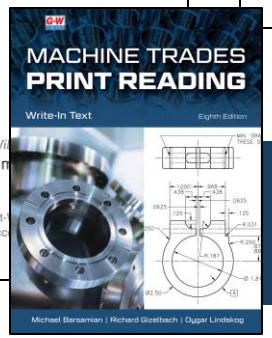

Visual Elements Reinforce Content

In addition, when a dimension value exceeds a whole number by a fraction of one millimeter, a trailing zero is not shown following the last digit to the right of the decimal point. This rule applies except when metric limit dimensions or bilateral tolerances are shown. When specifying limit dimensions and bilateral tolerances, plus and minus values are given with the same number of decimal places, with trailing zeros added as needed.

Pro Tip

Alternate Units of Measurement

The abbreviations IN (for inches) and mm (for millimeters) appear on a drawing only when an alternate unit of measurement is used. Only the alternate unit's abbreviation is shown on the drawing.

Angular Dimensioning

Angular dimensioning is a system of dimensioning angles that measures the angle of a line or surface from a given reference point. The reference point can be the vertex of an angle (the point where two lines intersect or meet) or an intersecting line, ray, or plane. The ***degree*** is the unit of measurement for angles and is based on 360 divisions of a circle's circumference. Each division (1/360 of a circle) is a degree, **Figure 7-4.** Degrees are represented by the symbol °.

A degree can be broken down into minutes (represented by the symbol ′) and seconds (represented by the symbol ″). There are 60 minutes in one degree and 60 seconds in one minute.

Circle = 360 degrees (360°)
Degree = 60 minutes (60′)
Minute = 60 seconds (60″)

Figure 7-5A shows an angle measured in degrees, minutes, and seconds.

Decimal units can also represent parts of a degree, **Figure 7-5B.** To convert minutes into a decimal, divide the minutes by 60. To convert seconds into a decimal, divide the seconds by 3600. The following example shows the procedure for converting an angular measurement in degrees, minutes, and seconds to decimal degrees.

Example

Convert 45°1′30″ to decimal degrees. Use the following formula:

Decimal degrees° = Degrees° + (minutes ÷ 60)° + (seconds ÷ 3600)°
Decimal degrees° = 45° + (1 ÷ 60)° + (30 ÷ 3600)°
Decimal degrees° = 45° + .0166° + .0083° = 45.0249°
Decimal degrees° = 45.025° (rounded to three places)

Pro Tip

Calculator

An inexpensive scientific calculator has the ability to convert between degrees, minutes, seconds and decimal degrees with the push of a few buttons.

Coordinates can also locate angles. Linear dimensions locate the coordinates for an angular feature, as shown in **Figure 7-5C.**

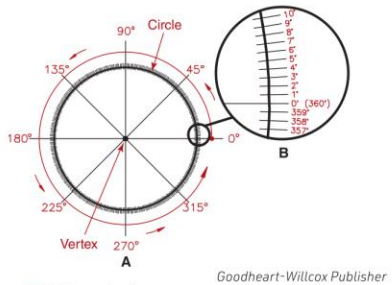

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Figure 7-4. The unit of measurement for angles is the degree (°). A–The circumference of a circle is divided into 360°. B–An angle is any measurement from 0° to 360°.

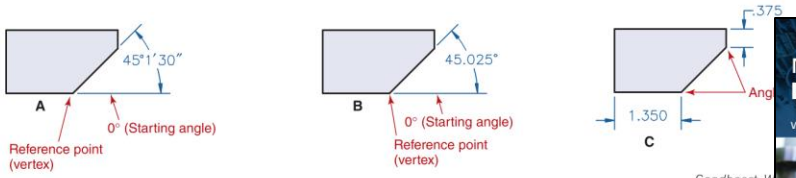

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Figure 7-5. Several methods can be used to dimension the same angle. A–Angular dimension in degrees, and seconds. B–Angular dimension in decimal degrees. C–Linear dimensions used to locate the angular f

Pro Tip

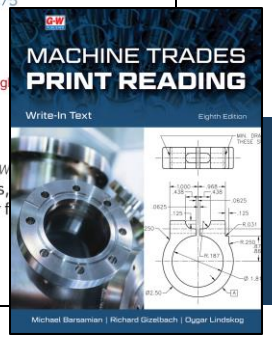
Stock Size Dimension

When a dimension is a stock size, the basic size may be the nominal size. Any specified or unspecified tolerances will apply to the given dimension.

Pro Tip

Nominal Size Fastener

Certain features on a part may not require high-precision measurements, such as a drilled hole for a nominal size fastener. Using a precise machining operation, such as milling, will increase manufacturing costs. Therefore, drilling a standard size hole is preferred.



Features Enhance Chapter Content and Extend Learning

Unit Review

Name _____ Date _____ Class _____

Know and Understand

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

1. ____ A(n) ____ is a portion of a circle's circumference. (9.1)
   A. diameter
   B. chamfer
   C. radius
   D. arc
2. ____ A radius dimensioned with a(n) ____ line indicates the origin is located outside the drawing area. (9.1)
   A. extension
   B. dimension
   C. leader
   D. break
3. ____ A ____ joins curved contours to lines, arcs, or other contours as smoothly as possible to form a continuous surface or edge. (9.2)
   A. fillet
   B. spherical radius
4. ____
5. ____
6. ____
7. ____ *True or False?* The angular method uses two linear dimensions to define an angle. (9.5)
8. ____ A ____ is used to denote an angle machined on a part that is not cylindrical. (9.6)
   A. bevel
   B. fillet
   C. taper
   D. round
9. ____ A ____ is a beveled edge or angle applied to a hole, a shaft, or an edge to remove sharp edges. (9.7)
   A. chamfer
   B. fillet
   C. taper
   D. vertex
10. ____ ____ are defined by a linear dimension and an angle or by two linear dimensions. (9.7)
    A. Tapers
    B. Rounds
    C. Chamfers

Critical Thinking

1. Give an example of a curved part with a radius dimension where the origin of the radius is outside of the drawing. (9.1)

2. Chamfering processes are commonly used to remove sharp edges on machined features such as gear teeth. What are some other applications for chamfers in manufacturing? (9.7)

Apply and Analyze

Activity 9-2

Trim Blade-OS

Refer to Activity Print 9-2. *Study the drawing and familiariz and notes. Read the questions, refer to the print, and write y*

1. What is the unspecified tolerance for angles?
2. What is the largest radius listed on the part?
3. At what angle are the cutting edges ground?
4. What is the angle between each tooth?
5. List the radius and diameter dimensions of the hole.
6. List the radii shown in the right-side view.
7. List the radii shown in the front view.
8. What is the approximate depth of each tooth?

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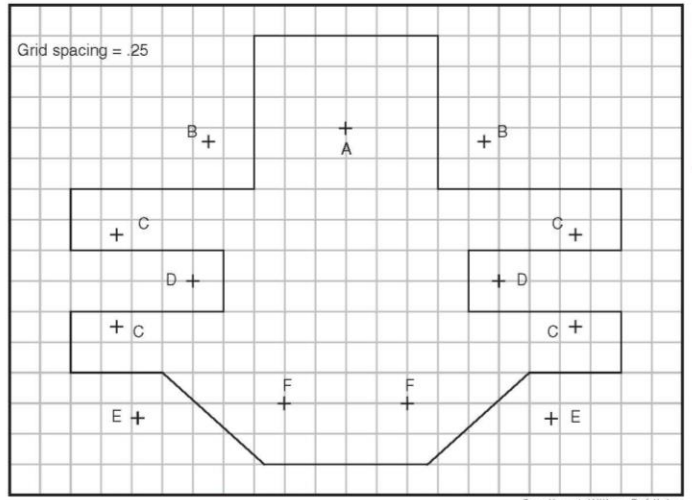
11.
12.
13.
14.
15.

Apply and Analyze

Drawing Problem 9-1

Sketching Fillets and Rounds

Sketch the part in the space provided on the next page. Sketch straight construction lines to form the outer boundary lines. Then, using the center points and radii indicated, sketch fillets and rounds to smooth the edges of the part. When finished sketching arcs, erase the construction lines that extend past arcs to complete the part. (9.1, 9.2, 9.3, 9.4)



A	R.75
B	R.375
C	R.375
D	R.25
E	R.375
F	R.5

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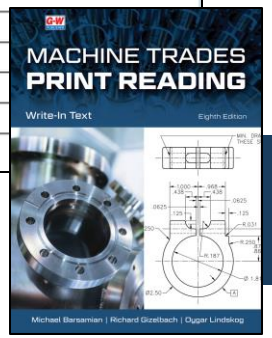
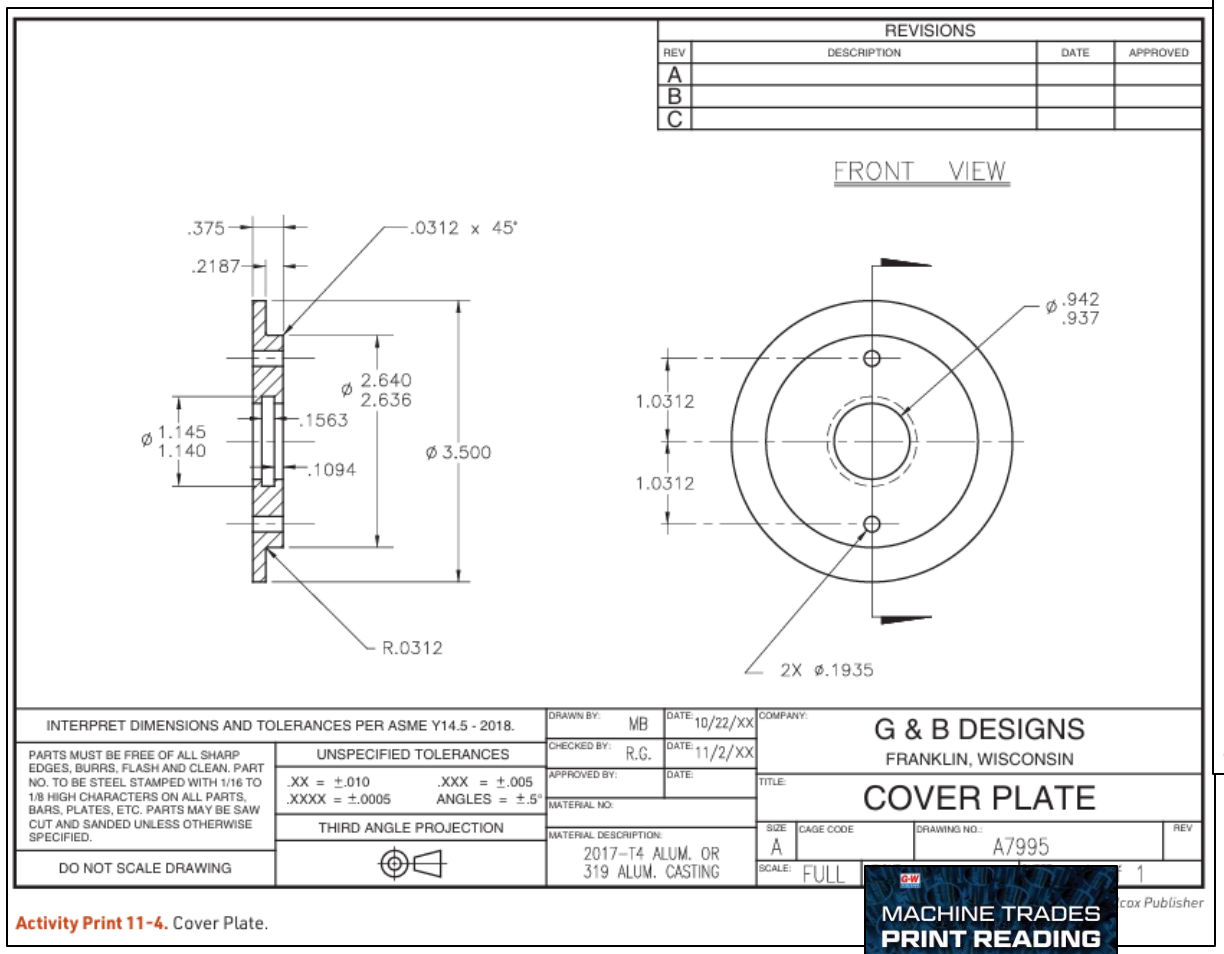
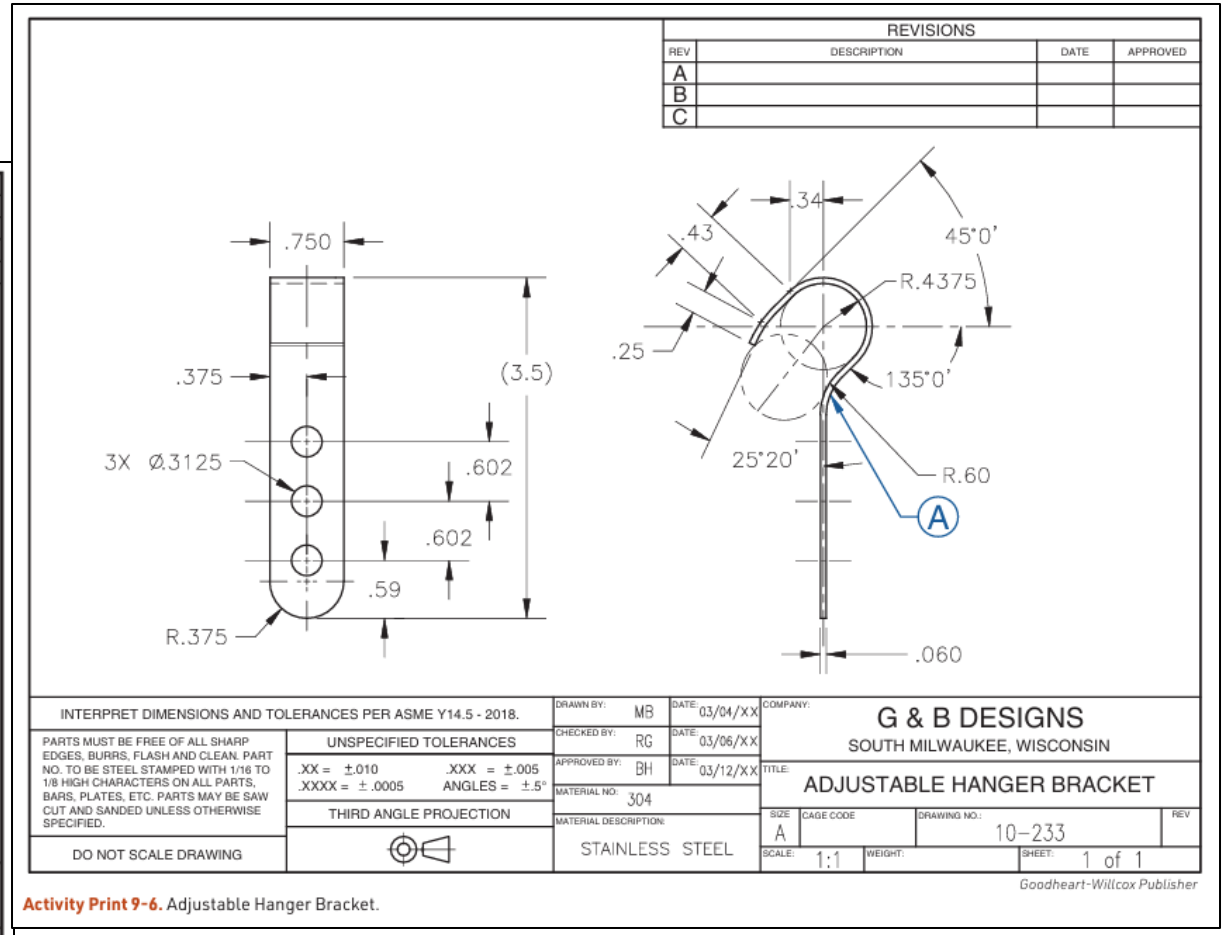


End-of-Unit Review



Activity Print 11-4. Cover Plate.



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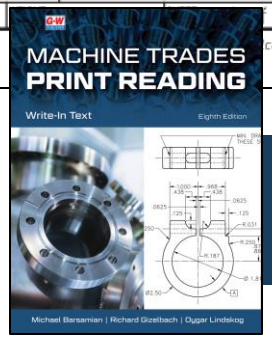
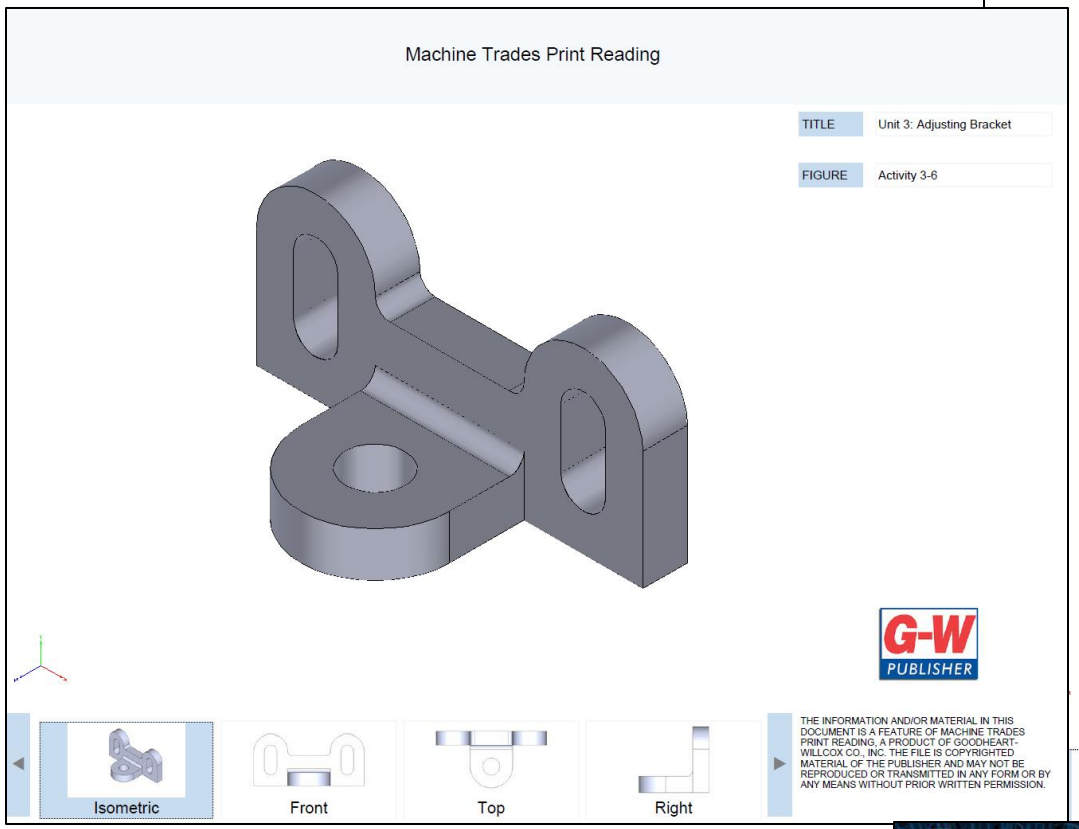
Activity Print 9-6. Adjustable Hanger Bracket.



Activity Print PDFs


Machine Trades Print Reading
TITLE
Unit 3: Adjusting Bracket
FIGURE
Activity 3-6
Isometric
Front
Top
Right
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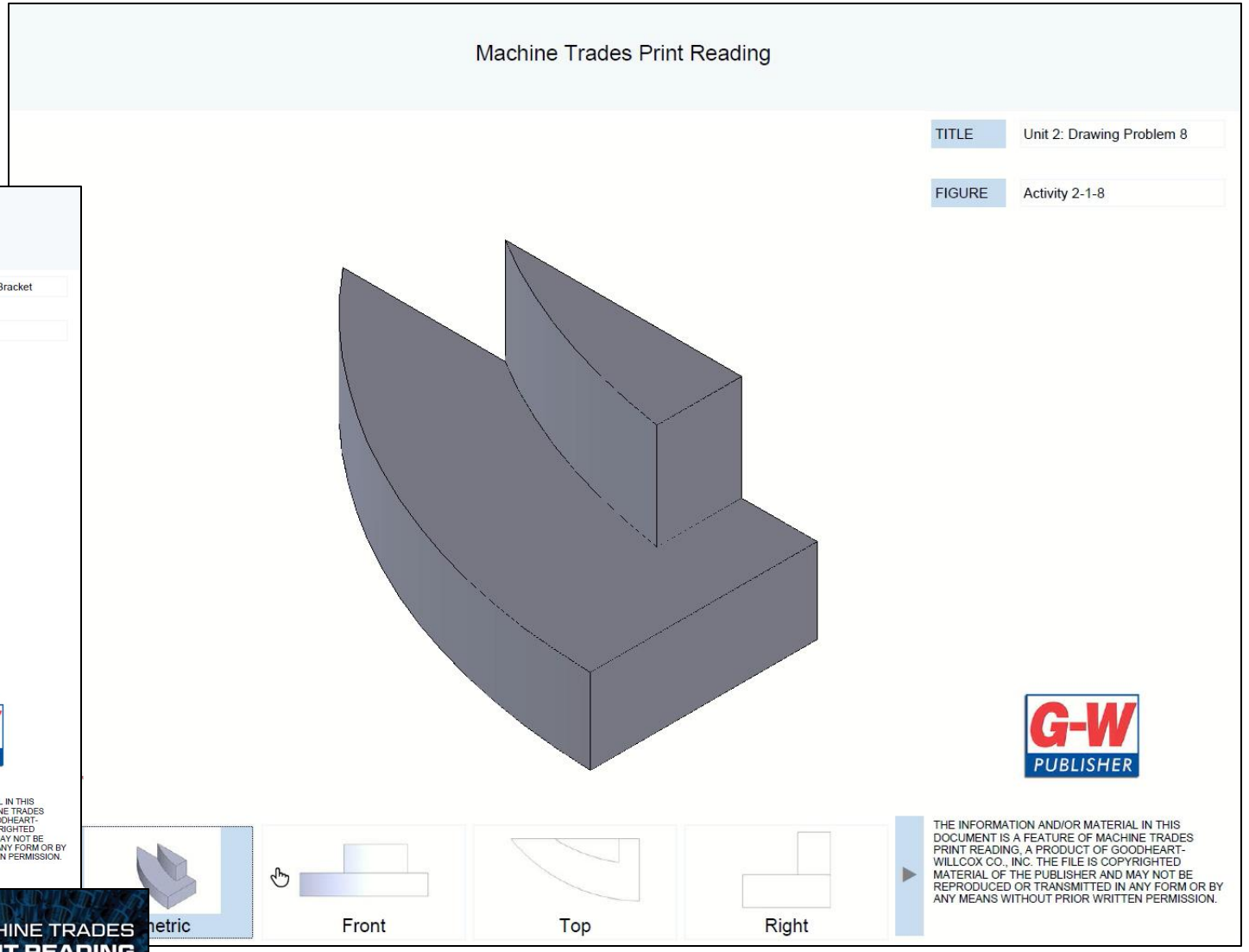
Machine Trades Print Reading
TITLE
Unit 2: Drawing Problem 8
FIGURE
Activity 2-1-8
Front
Top
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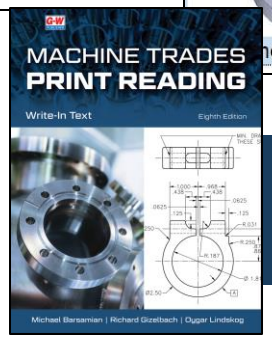
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3D Files

Machine Trades Print Reading 8e, Image Library

Unit 6 Measurement Basics

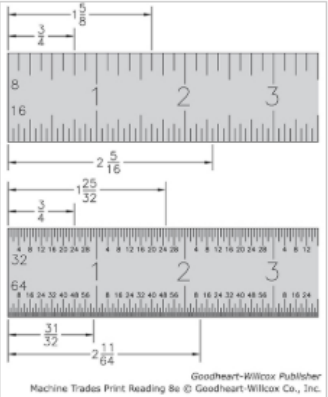


Figure 6-2 - *Goodheart-Willcox Publisher*

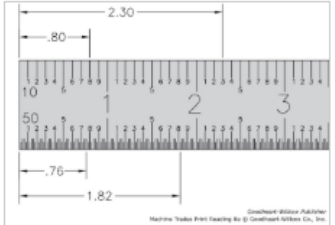


Figure 6-3 - *Goodheart-Willcox Publisher*

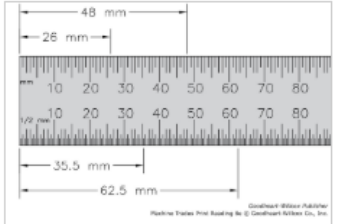


Figure 6-4 - *Goodheart-Willcox Publisher*

Figure 6-5a - *Steve Collender/Shutterstock*

Figure 6-5b - *Peter Kotoff/Shutterstock*

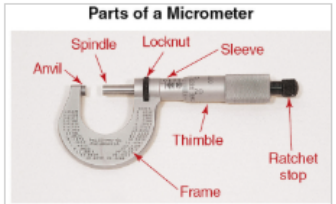
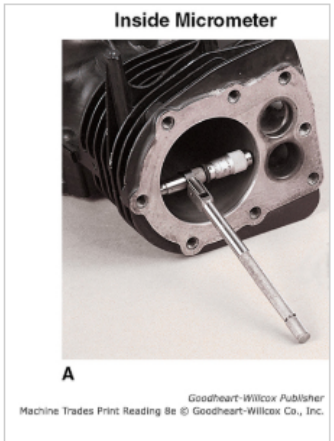
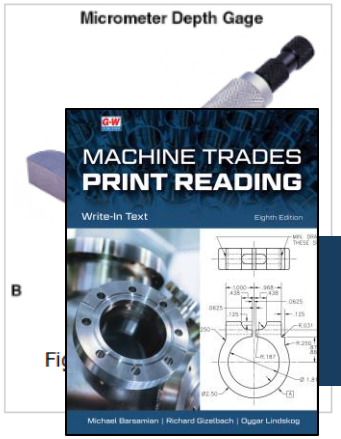


Figure 6-6a - *Goodheart-Willcox Publisher*

Figure 6-6b - *AlexLMX/Shutterstock.com*





Machine Trades Print Reading 8e, Image Library

Unit 1 Drawings and Prints

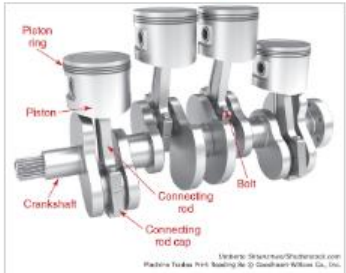


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Figure 1-2 - *Gunpreet/Shutterstock.com*

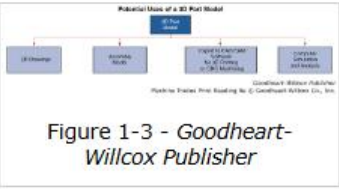

Figure 1-3 - *Goodheart-Willcox Publisher*

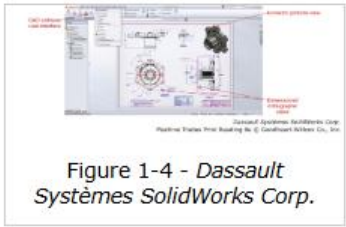

Figure 1-4 - *Dassault Systèmes SolidWorks Corp.*

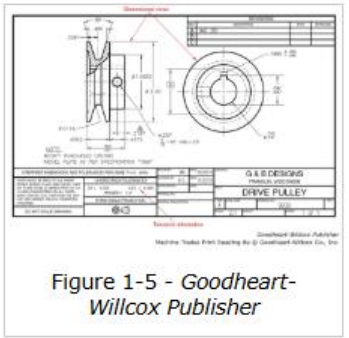

Figure 1-5 - *Goodheart-Willcox Publisher*

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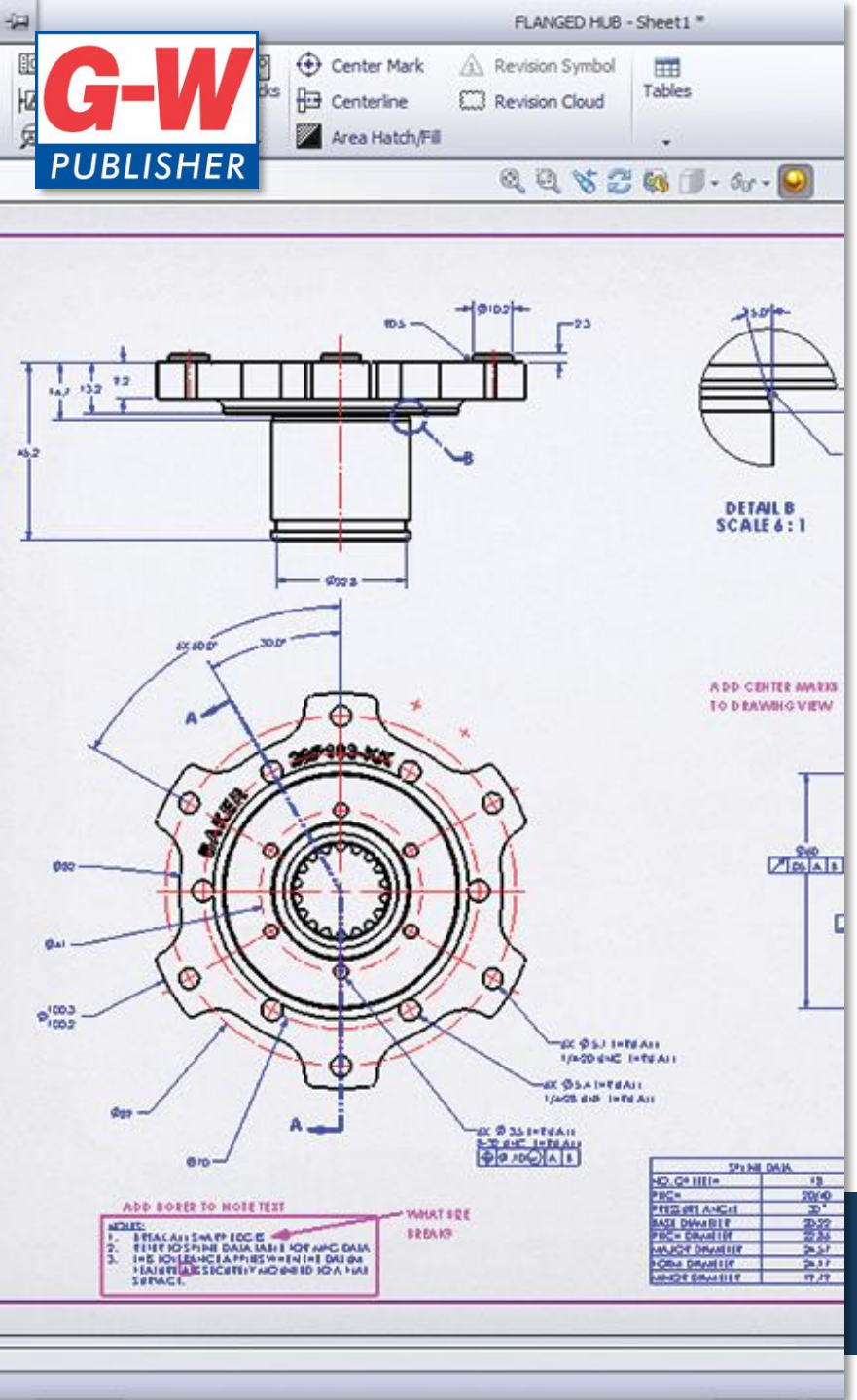
Image Library



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