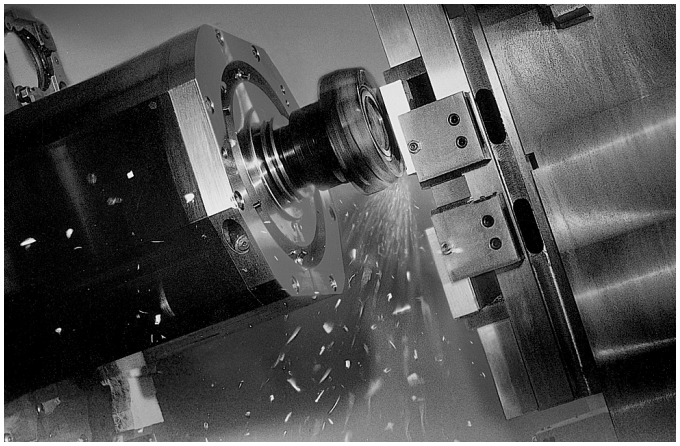


Chapter 19

Precision Grinding

LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- Explain how precision grinders operate.
- Identify the various-types of precision grinding machines.
- Select, dress, and true grinding wheels.
- Safely operate a surface grinder using various work-holding devices.
- Solve common surface grinding problems.
- List safety rules related to precision grinding.

INSTRUCTIONAL MATERIALS

Text: pages 353–382
Test Your Knowledge Questions, page 381
Workbook: pages 107–112
Instructor's Resource: pages 253–268
Guide for Lesson Planning
Research and Development Ideas
Reproducible Masters:
19-1 Planer-Type Surface Grinders
19-2 Rotary-Type Surface Grinders
19-3 Grinding Wheel Marking System
19-4 Grinding Wheel Shapes
19-5 Mounting Grinding Wheels
19-6 Creep Grinding
19-7 Traverse Grinding
19-8 Plunge Grinding
19-9 Centerless Grinding
19-10 Test Your Knowledge Questions
Color Transparencies (Binder/CD only)

GUIDE FOR LESSON PLANNING

Due to the amount of material covered, it would be advisable to divide this chapter into several segments. Although it has been divided into seven parts here, each classroom situation will dictate what division would work best.

Part I—Types of Surface Grinders

Set up a surface grinder to demonstrate its operation. Be sure all of the class can observe and hear the demonstration. They should also be wearing approved eye protection.

Have the students/trainees read and study pages 353–356, paying particular attention to the illustrations. Review the assignment using Reproducible Masters 19-1 and 19-2 as overhead transparencies and/or handouts. Discuss the following:

- The principles of precision grinding and why it is done.
- Types of surface grinders.
- How surface grinders operate.

Part II—Work-Holding Devices

A selection of work-holding devices should be available for demonstration purposes and for the class to examine.

Have class read and study pages 356–358. Review the assignment and discuss the following:

- Types of work-holding devices used for surface grinding.

- The advantages and disadvantages of each type.
- How they operate.
- Why a demagnetizer is used.

Part III—Grinding Wheels and Cutting Fluids

Prepare a surface grinder for the class to examine. A selection of grinding wheels should be available for examination and to demonstrate how to check a grinding wheel for soundness.

Have the class read and study pages 358–363. Review the assignment using Reproducible Masters 19-3, 19-4, and 19-5 as overhead transparencies and/or handouts. Discuss the following:

- The various types and shapes of grinding wheels.
- How to determine whether a grinding wheel requires dressing.
- The grinding wheel marking system.
- The need for so many grinding wheel shapes.
- How to mount grinding wheels.
- Types of cutting fluids.
- Why cutting fluids are required for most grinding operations.
- How cutting fluids are applied.

Part IV—Grinding Applications

Prepare a surface grinder to demonstrate how to prepare the machine for operation, dress the grinding wheel, and check the machine for safe operation.

Have the class read and study pages 364–368. Review the assignment and discuss and demonstrate the following:

- Preparing a surface grinder for operation.
- The procedure for dressing a grinding wheel.
- Why a magnetic chuck is "ground-in."
- Why a piece of oiled paper is placed between the work and the magnetic chuck.
- The sequence for starting a surface grinder.
- How to use a paper strip to position the grinding wheel.
- Grinding edges square and parallel with face sides.
- Proper way to clean the surface grinder.
- Creep grinding. Use Reproducible Master 19-6.
- Grinding problems and how to correct them.
- Grinding safety.

Part V—Tool and Cutter Grinders

Prepare a tool and cutter grinder to demonstrate sharpening milling cutters.

Have the class read and study pages 368–373, paying particular attention to the illustrations. Review the assignment and discuss the following:

- Use of the tool and cutter grinder.
- Selecting the proper wheel for the sharpening operation.
- Using and adjusting tooth rest.
- Sequence for grinding plain milling cutters.
- Sequence for grinding cutters with helical teeth.
- How to grind end mills.
- How to grind form cutters.
- Sharpening taps and reamers.

Part VI—Cylindrical and Internal Grinding

Prepare a cylindrical grinder to demonstrate its operation.

Have the class read and study pages 373–376, paying particular attention to the illustrations. Review the assignment and discuss the following:

- The principle of cylindrical grinding.
- The difference between traverse and plunge grinding. Use Reproducible Masters 19-7 and 19-8.
- Holding and driving the work.
- Machine operation.
- Internal grinding operations.

Part VII—Other Grinding Operations

Have the class read and study pages 377–381, paying particular attention to the illustrations. Review the assignment and discuss the following:

- The principle of centerless grinding. Use Reproducible Master 19-9.
- The types and variations of centerless grinding.
- The principle of form grinding.

- The principle of abrasive belt machining.
- The principle of electrolytic grinding.
- Computer (CNC) grinders.

Emphasize grinding safety and the necessity of having grinder "burns" properly treated. Grinder burns are caused when the machinist's fingers or hand comes in contact with a rotating grinding wheel.

A review of the demonstrations will provide an opportunity to answer questions students/trainees may still have.

Technical Terms

Review the terms introduced in the chapter. New terms can be assigned as a quiz, homework, or extra credit. The following list is also given at the beginning of the chapter.

centerless grinding
creep grinding
diamond dressing tool
form grinding
internal grinding
magnetic chuck
planer-type surface grinders
plunge grinding
tooth rest
universal tool and cutter grinder

Review Questions

Assign *Test Your Knowledge* questions. Copy and distribute Reproducible Master 19-10 or have students use the questions on page 381 and write their answers on a separate sheet of paper.

Workbook Assignment

Assign Chapter 19 of the ***Machining Fundamentals Workbook.***

Research and Development

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

1. Secure samples of work produced by precision grinding. Compare them with a surface roughness comparison standard and determine the degree of roughness of each sample.
2. Prepare a specimen board with surfaces finished by the various precision grinding techniques. Use illustrations to indicate the type of machine used to produce each surface.
3. Check all of the grinding wheels in the shop or lab. Discard the ones that would be dangerous to use. Design a storage rack so the good wheels can be stored safely.
4. Inspect the coolant system on the grinders in the shop or lab. Clean and make necessary repairs.
5. Prepare a list of recommendations that will improve precision grinding operations in the shop.
6. Contact grinding wheel manufacturers and request photos that show how grinding wheels are manufactured. Design a bulletin board display around the material.
7. Demonstrate how to sharpen a milling cutter.
8. Demonstrate the correct way to true and dress a grinding wheel.
9. Research the various types of coolants and the material on which they are used. Make a poster on your findings and mount it near the grinding machines.
10. Prepare a poster that lists the problems encountered with precision grinding and how they can be corrected. Mount the poster near the grinding machines.
11. Prepare a handbook on how to safely operate precision grinding machines. Duplicate it for each member in the class.

TEST YOUR KNOWLEDGE ANSWERS, Page 381

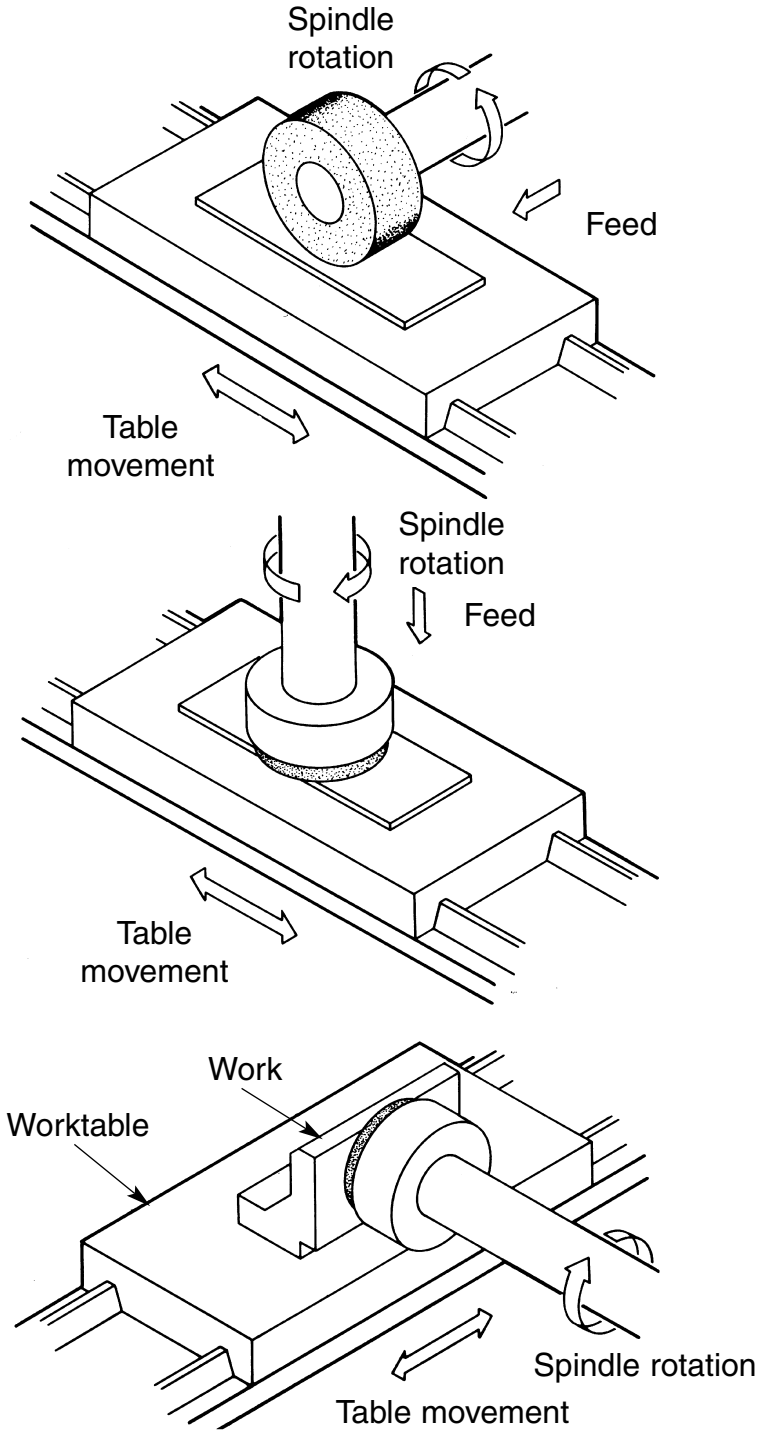
1. flat
2. Planer type and rotary type.
3. Any three of the following: magnetic chuck, universal vise, indexing head with centers, clamps, precision vise, double-faced masking tape.
4. Abrasive type, grain size, structure, grade, and bond.
5. a. Wear away as the abrasive particles become dull.
6. metallic ring
7. Loaded and glazed.
8. Cutting fluids lessen wear on the grinding wheel, help maintain accurate dimensions, affect the quality of the surface finish, and remove heat generated during the grinding operation.
9. Water-soluble chemical fluids and water-soluble-oil fluids. Polymers are also used.
10. diamond

11. glazed, loaded
12. redressing, grinding wheel
13. dirty coolant; Clean coolant system and replace coolant.
14. Conventional grinding removes the material a small amount at a time. Creep grinding does it in a single pass.
15. universal tool, cutter grinder
16. Traverse grinding and plunge grinding.
17. centerless
18. Evaluate individually. Refer to Figure 19-23.
19. abrasive belt machining
20. Electrolytic, electrochemical; Evaluate descriptions individually. Refer to Section 19.14.2.

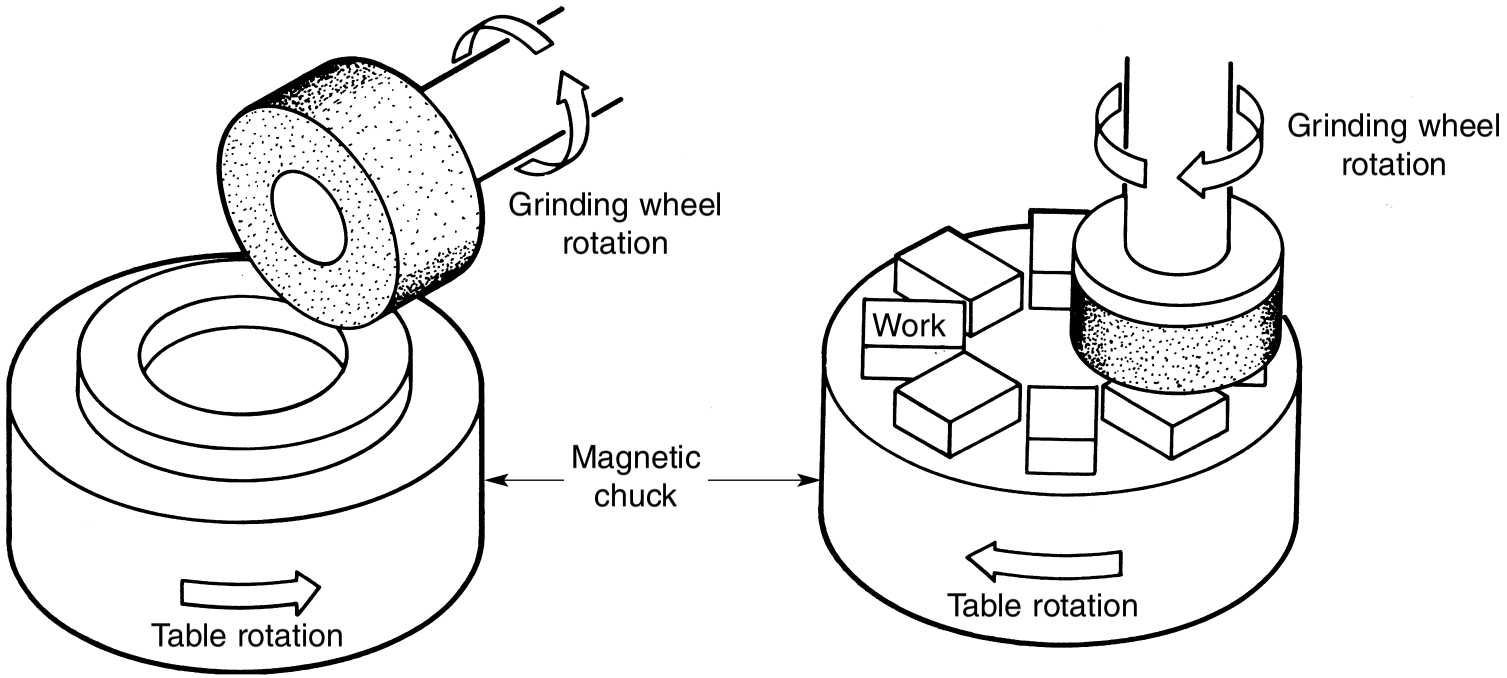
WORKBOOK ANSWERS, Pages 107–112

1. many-tooth milling cutter as each of the abrasive particles is a separate cutting edge
2. smooth, accurate
3. c. downfeed
4. a. traverse
5. b. cross-feed
6. d. All of the above.
7. magnetic chuck
8. coolant
9. Tap it lightly with a metal rod. A solid wheel will give off a clear metallic ring.
10. Unbalanced wheels will cause irregularities on the finished ground surface.
11. Student answers will vary but may include the following: by flooding the grinding area; using a mist system; manually applying with a pressure-type oil pump can.
12. It can cause surface waviness.
13. Evaluate individually. Refer to Section 19.5.2.
14. Any of the following: clogged hydraulic lines; insufficient hydraulic fluid; hydraulic pump not functioning properly; inadequate table lubrication; cold hydraulic system; air in the system.
15. The wheel being out-of-round. It can be corrected by truing the wheel.
16. d. All of the above.
17. a. nicked or dirty chuck
18. Evaluate individually. Refer to Section 19.7.
19. Crowding
20. a. dirty coolant
21. Any or all of the following: grinding wheel may be too soft and wearing down too rapidly; tooth rest may not be mounted solidly; the arbor may not be running true on the centers.
22. workhead
23. twisting
24. radially
25. Work is mounted between centers or in a chuck and rotates while in contact with the grinding wheel.
26. b. one-third
27. d. All of the above.
28. The work is rotated against the grinding wheel. It does not have to be supported between centers. The piece is positioned on a work support blade and fed automatically between a regulating or feed wheel and a grinding wheel. The regulating wheel causes the piece to rotate and the grinding wheel does the cutting. Feed through the wheels is obtained by setting the regulating wheel at a slight angle.
29. Through feed, infeed, end feed, and internal centerless grinding.
30. shaped, contour
31. Any two of the following: removes material at a high rate; run cool and require light contact pressure; versatility; belts may be used dry or with a coolant; reduce possibility of metal distortion caused by heat; soft contact wheels and flexible belt conform to irregular shapes.
32. e. Both a and c.
33. d. All of the above.
34. d. All of the above.
35. e. None of the above.

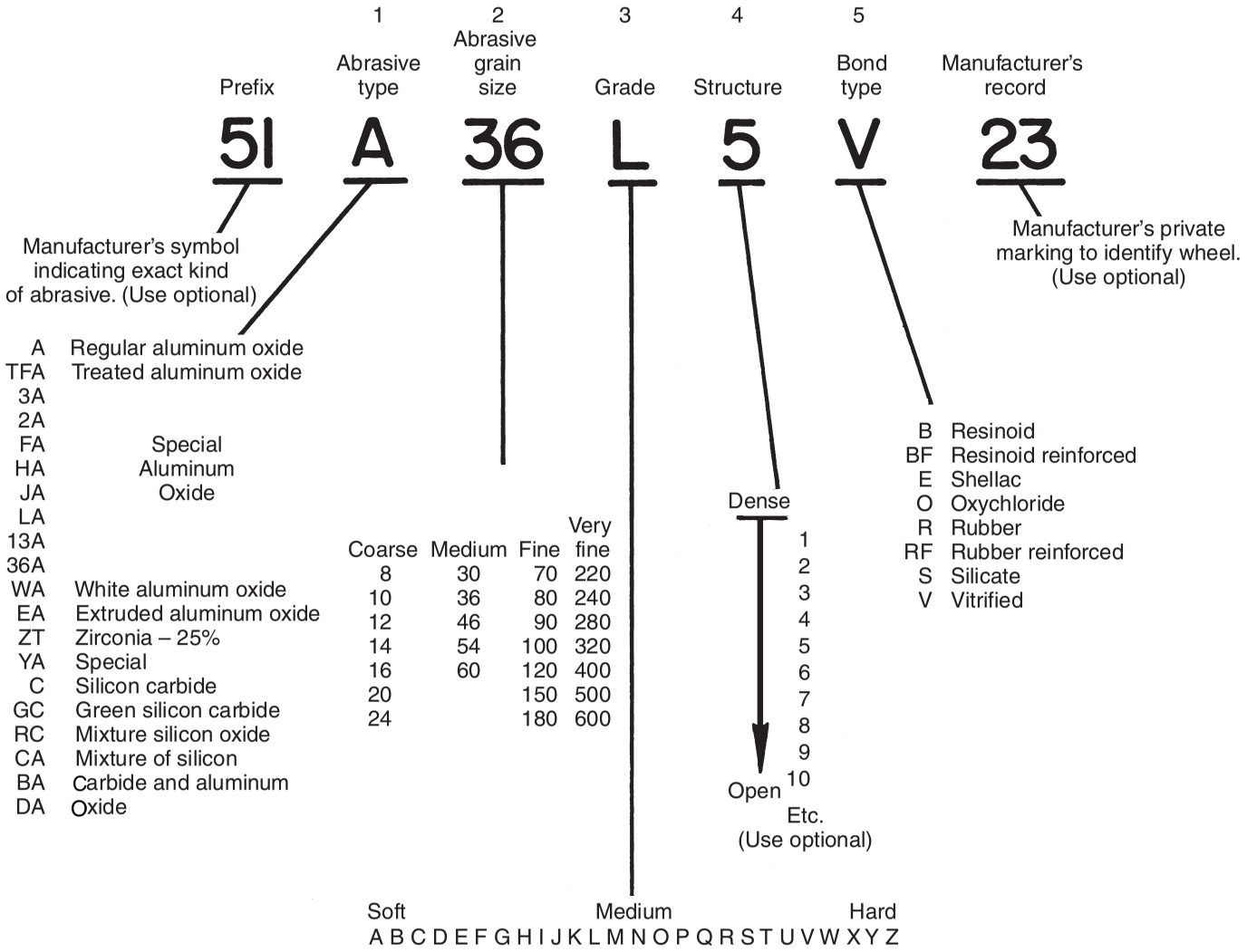
Planer-Type Surface Grinders



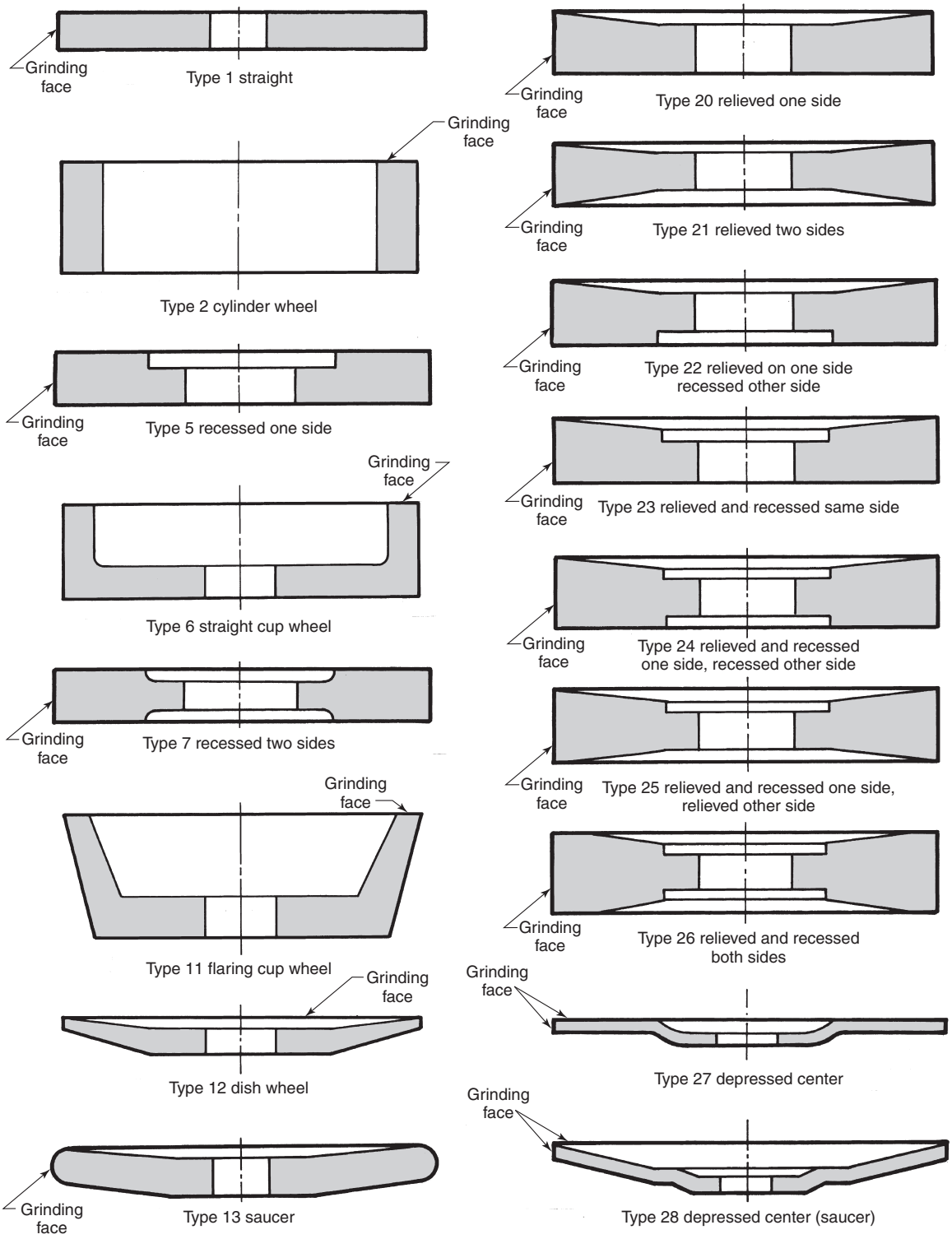
Rotary-Type Surface Grinders



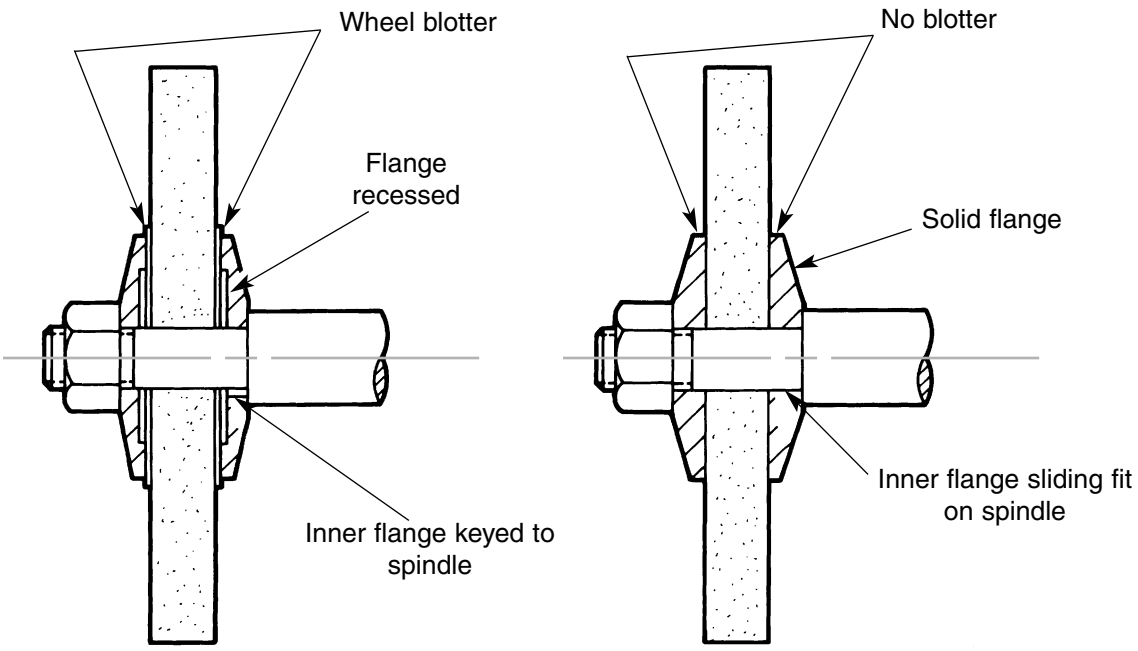
Grinding Wheel Marking System



Grinding Wheel Shapes



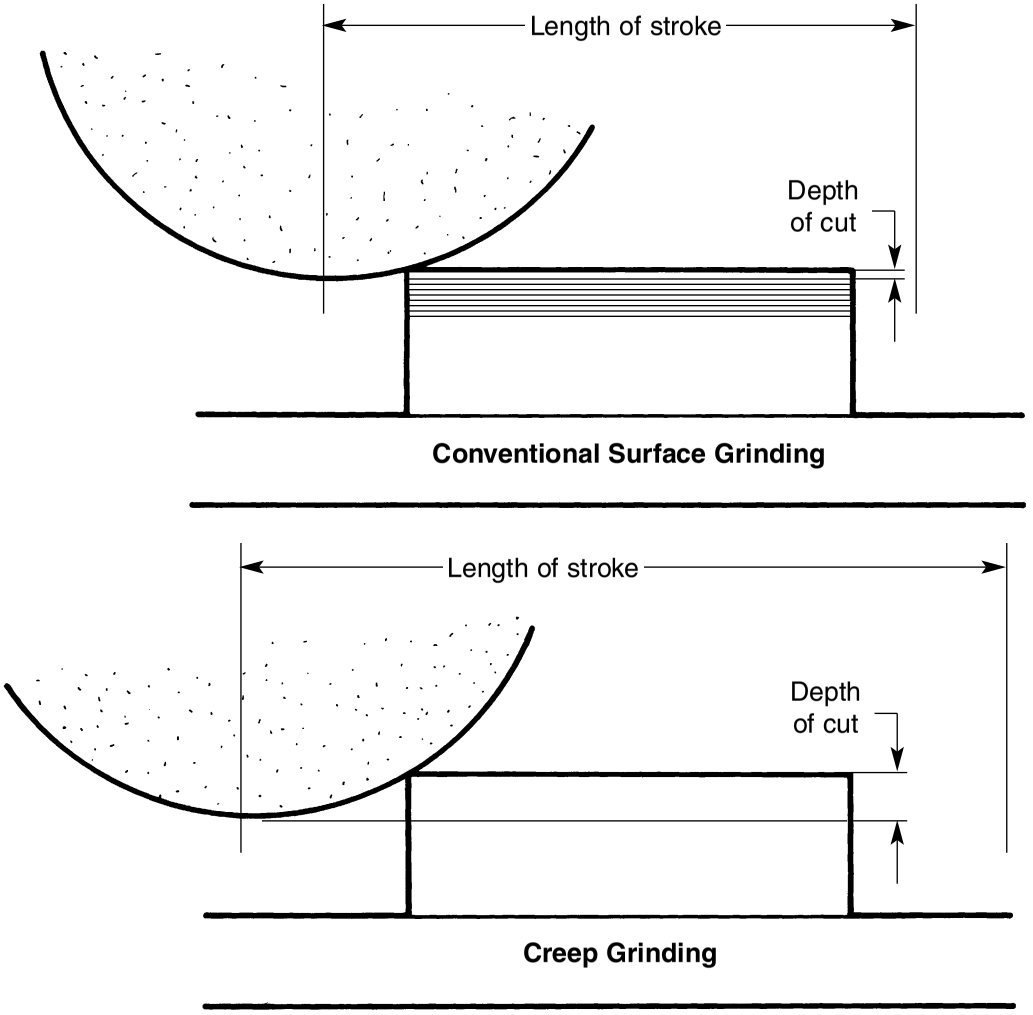
Mounting Grinding Wheels



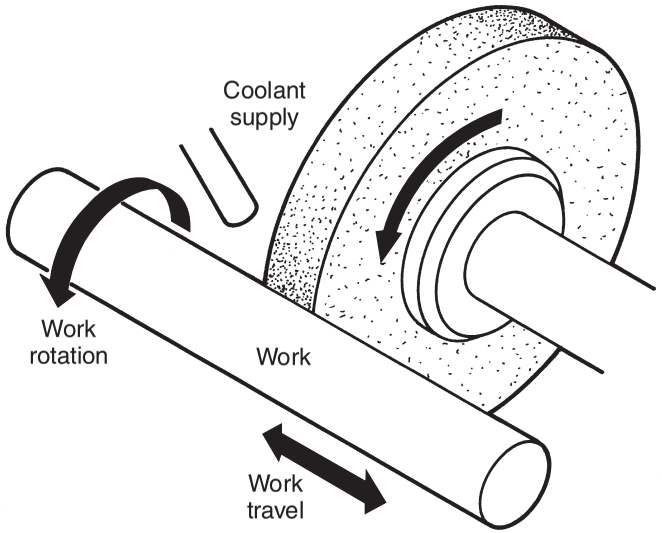
Correctly mounted wheel

Wheel incorrectly and dangerously mounted

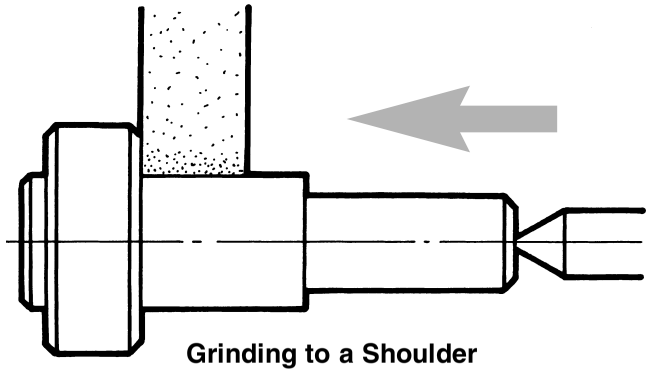
Creep Grinding



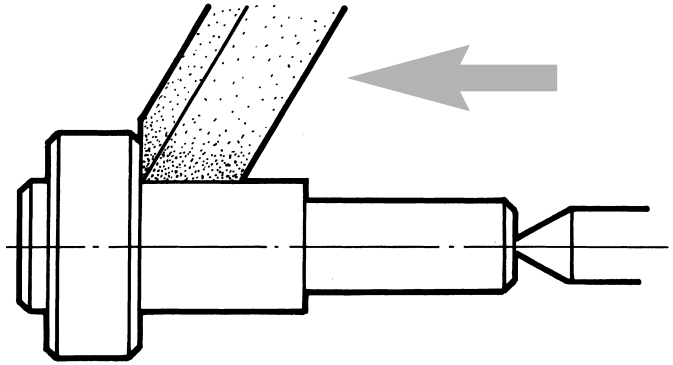
Traverse Grinding



The rotating work moves past the rotating grinding wheel.

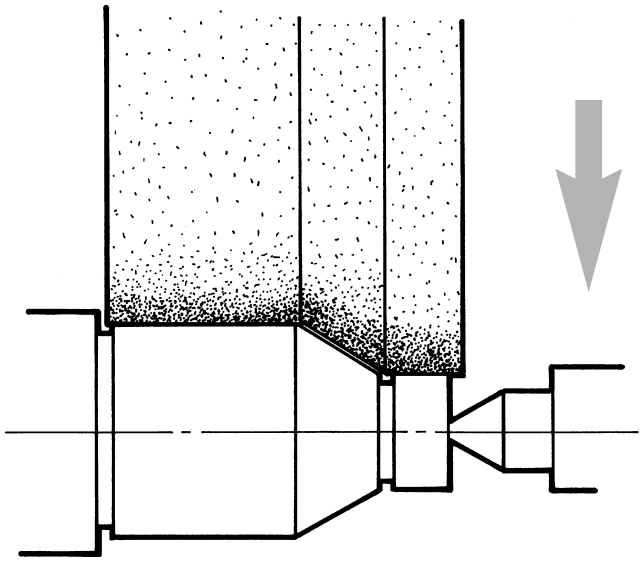


Grinding to a Shoulder

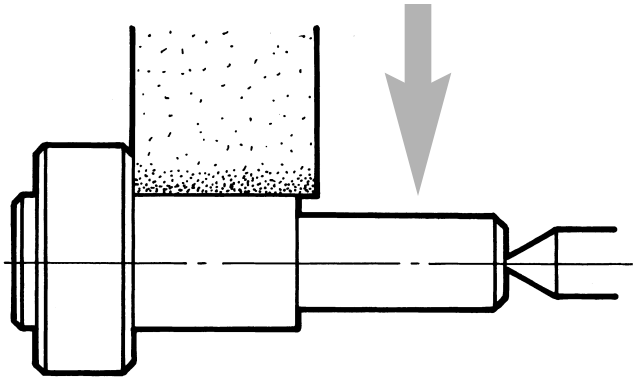


Grinding to a Shoulder with Angular Wheel

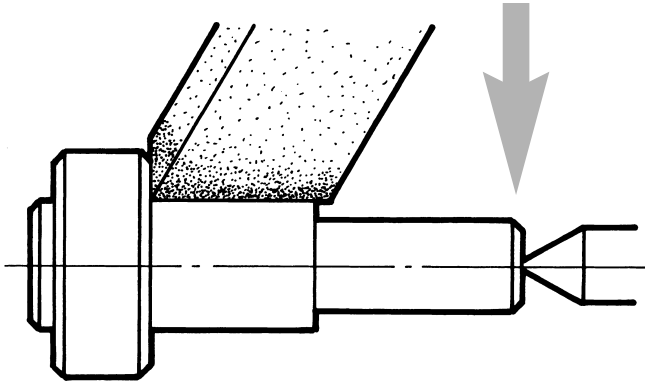
Plunge Grinding



With plunge grinding, grinding wheel is fed into rotating work. Since work is no wider than grinding wheel, reciprocating motion is not needed.

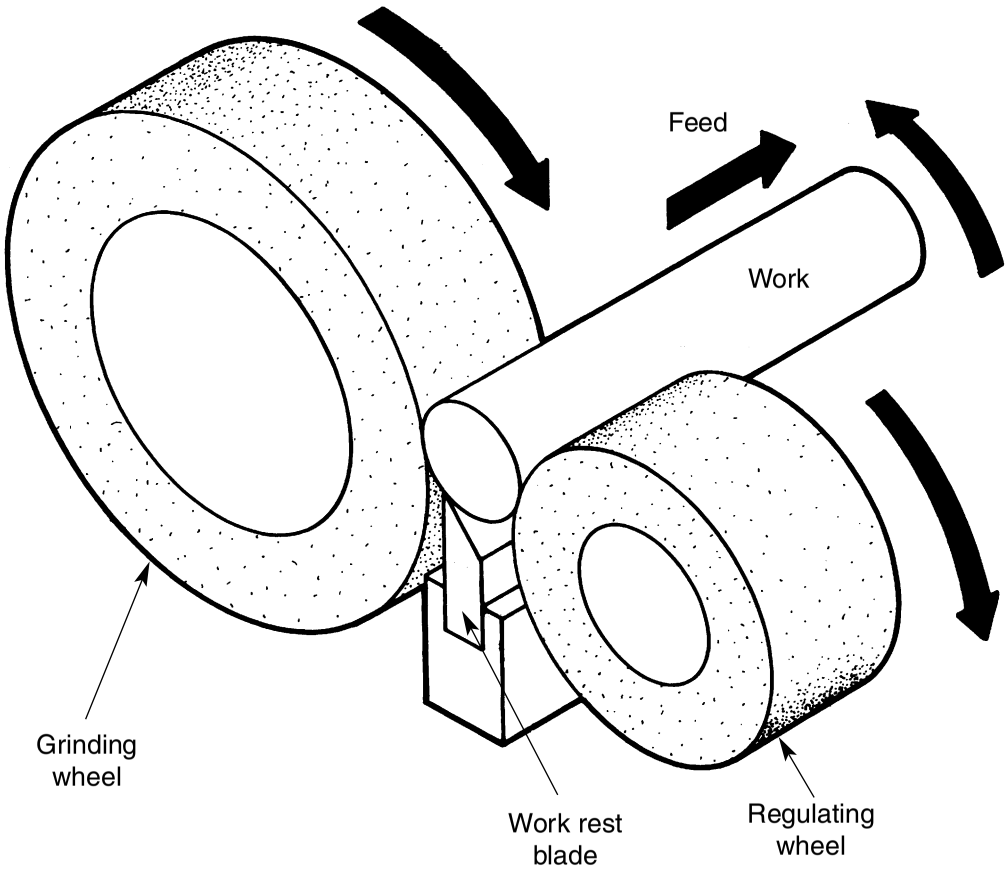


Grinding to a Shoulder



Grinding to a Shoulder with Angular Wheel

Centerless Grinding



Precision Grinding

Name: _____ Date: _____ Score: _____

1. Industry classifies surface grinding as the grinding of _____ surfaces. 1. _____
2. Surface grinding operations fall into two categories. List them. _____
3. Various work-holding devices are used to hold work for surface grinding. Name three of them.
4. List five (5) factors that are distinguishing characteristics of a grinding wheel. _____
5. The ideal grinding wheel will: 5. _____
   a. wear away as the abrasive particles become dull.
   b. wear away at a predetermined rate.
   c. wear away slowly to save money.
   d. All of the above.
   e. None of the above.
6. A solid grinding wheel will give off a _____ when struck lightly with a metal rod. 6. _____
7. List the two conditions that commonly prevent a grinding wheel from cutting efficiently.
8. Why are cutting fluids or coolants necessary for grinding operations? _____
9. List the basic types of cutting fluids. _____
10. A _____ wheel dressing tool is usually used to true and dress wheels for precision grinding. 10. _____
11. Chatter and vibration marks are caused on the work when the grinding wheel is _____ or _____. 11. _____
12. The problems in Question 11 can be corrected by _____ the _____. 12. _____
13. Irregular scratches on the work are usually caused by a _____ system. How can this problem be corrected?_____

Name: _____

14. What is the difference between conventional grinding and creep grinding? _____

15. A _____ and _____ is a grinding machine designed to support cutters (usually milling cutters) while they are being sharpened. 15. _____

16. List the two variations of cylindrical grinding. _____

17. With _____ grinding, it is not necessary to support work between centers or mount work in a chuck while it is being rotated against the grinding wheel. 17. _____

18. Make sketches of nine standard grinding wheel shapes.

19. The grinding technique that employs a belt on which abrasive particles are bonded for stock removal, finishing, and polishing operations is known as _____. 19. _____

20. _____ or _____ grinding is actually an electrochemical machining process. Describe how it is done. 20. _____