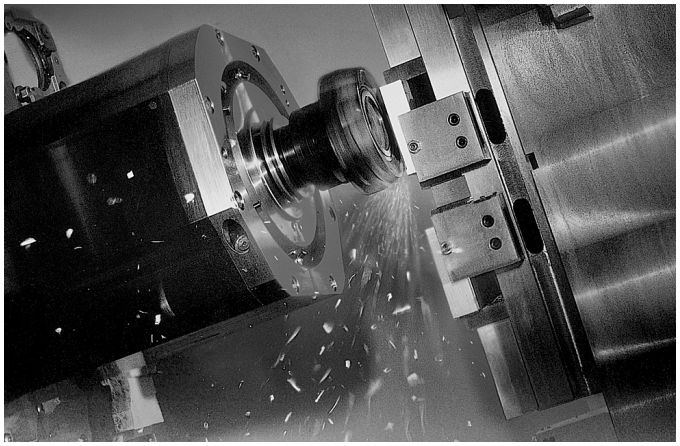


Chapter 26

Metal Finishing

LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- Describe how the quality of a machined surface is determined.
- Explain why the quality of a machined surface has a direct bearing on production costs.
- Describe some metal finishing techniques.

INSTRUCTIONAL MATERIALS

Text: pages 489–502
Test Your Knowledge Questions, page 502
Workbook: pages 139–142
Instructor's Resource: pages 331–340
Guide for Lesson Planning
Research and Development Ideas
Reproducible Masters:
26-1 Surface Condition and Values
26-2 Lay Symbols
26-3 Typical Surface Finishes
26-4 Test Your Knowledge Questions
Color Transparency (Binder/CD only)

GUIDE FOR LESSON PLANNING

A selection of products illustrating the various finishes described in this chapter should be available for class examination.

Have the class read and study the chapter. Review the assignment using the reproducible masters as overhead transparencies and/or handouts. Discuss the following:

- The definition of *surface finish.*
- Why surface roughness standards were devised.
- How to understand the symbols used to specify the finish of a machined surface.
- Degrees of surface roughness.
- How surface finish affects the economics of machined surfaces.
- Other metal finishing techniques and reasons for using them.
- Organic coatings and their application.
- Inorganic coatings and the application processes and materials involved.
- Why the chemical blackening process is used.
- Metal coatings and their application.
- Mechanical finishes and their processes of application.

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.

anodizing
electroplating
lay
metal spraying
microinches
micrometers
roller burnishing

surface roughness standards
vitreous enamel
waviness

Review Questions

Assign *Test Your Knowledge* questions. Copy and distribute Reproducible Master 26-4 or have students use the questions on page 502 and write their answers on a separate sheet of paper.

Workbook Assignment

Assign Chapter 26 of the ***Machining Fundamentals Workbook.***

Research and Development

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

1. Secure a copy of the publication *Surface Texture*–ANSI/ASME B46.1 for the shop technical library. This ANSI publication is on the measurement of surface roughness.
2. Make a collection of brochures advertising the various types of surface roughness/texture checking equipment. Develop a bulletin board display around them.
3. Secure or make samples of machined surfaces that match the various degrees of surface roughness. Mount them on a display panel. Identify each sample with the method employed to machine it and the correct symbol of roughness.
4. Prepare a paper that will explain the techniques used to develop average roughness values. They are explained in many drafting books, machinists' handbooks, and the ANSI/ASME publication. The term RMS is often used in the formulas. What does it mean?
5. Demonstrate electroplating. Secure the necessary equipment from the science department.
6. Prepare a demonstration of the anodizing process.
7. Devise and construct a safe method to clean work made in the shop.
8. Secure samples of work that have been electroplated and anodized.
9. Contact a local machine shop and find out what equipment they use to check for surface quality.
10. Prepare a term paper on flame spraying.

TEST YOUR KNOWLEDGE ANSWERS, Page 502

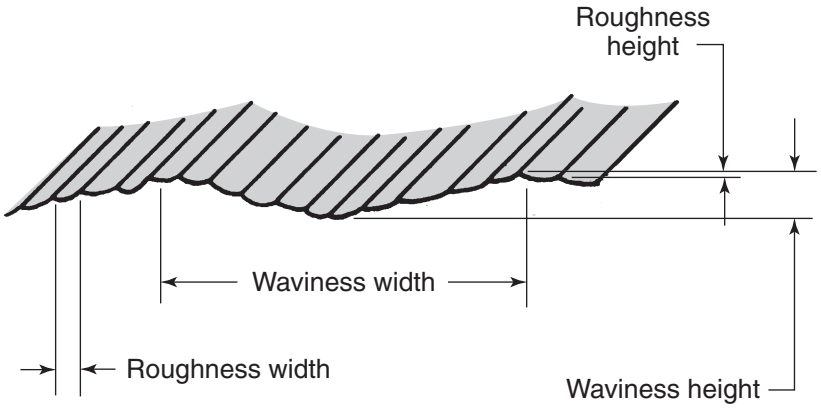
1. *f*
2. Each machinist interpreted it differently because it was not based on a specific set of standards.
3. microinches, micrometers; Microinches equal millionths of an inch. Micrometers equal millionths of a meter.
4. b. Smoothly rounded undulations caused by tool and machine conditions.
5. Term used to describe the direction of the predominate tool marks.
6. rougher
7. Evaluate individually. Refer to Section 26.2.
8. cleaned
9. organic
10. Brushing, spraying, roller coating, dipping, and flow coating.
11. Ordinary anodizing, hardcoat anodizing, and electrobrightening.
12. Metal is deposited electrically on the desired surface.

WORKBOOK ANSWERS, Pages 139–142

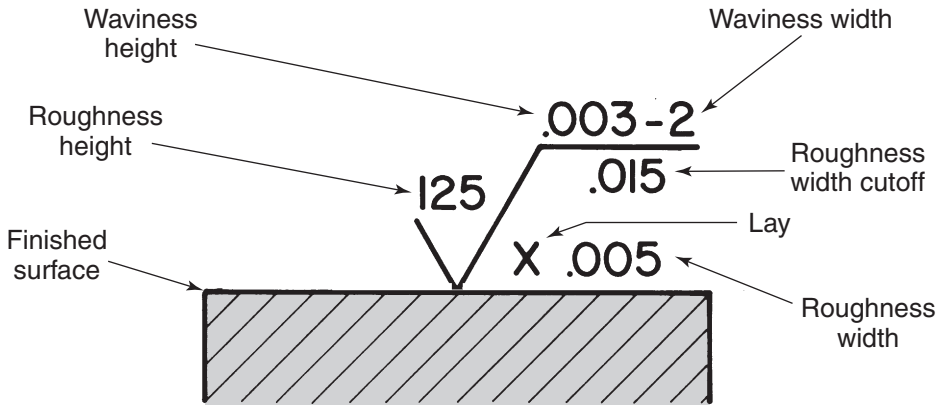
1. Each machinist interpreted specifications differently and pieces were often better finished than necessary, raising costs.
2. d. All of the above.
3. d. All of the above.
4. irregularities
5. roughness gage, profilometer
6. The smoothly rounded peaks and valleys caused by tool vibration and chatter.
7. b. direction of predominate tool marks, grain, or pattern of surface roughness
8. higher
9. Evaluate individually. Refer to Section 26.2.
10. Lapping
11. Paints, varnishes, lacquers, enamels, various plastic-base materials, epoxies.
12. Anodizing forms a protective layer of aluminum oxide on aluminum parts. The three anodizing classes are ordinary anodizing, hard coat anodizing, and electrobrightening.
13. Electrobrightening
14. F. Buffing

15. G. Power brushing
16. A. Anodizing
17. B. Vitreous enamel
18. C. Chemical blackening
19. D. Electroplating
20. E. Metal spraying
21. It is applied as a powder (frit), or as a thin slurry known as slip. After the finish dries, the material is fired at about 1500°F (815°C) until it fuses to the metal surface.
22. Any of the following: enhances appearance of part; protects machined surface against humidity and corrosion; reduces glare; abrasive resistance is improved; adhesion qualities are improved.
23. Builds up worn or scored surfaces so they can be remachined to required size, and superhard coatings can be applied when abrasion-resistant surfaces are needed.
24. A process for depositing a metallic coating on a workpiece. It uses a water-cooled barrel several feet long and about one inch in diameter that is fitted with valving for introducing gases and material to be sprayed.
25. Student answers will vary but may include the following: it can be fully automated; it can be used to apply coatings with high melting points to fully heat-treated parts without danger of changing the metallurgical properties or strength of the part and without danger of thermal distortion; and almost any material that can be melted without decomposing can be sprayed.

Surface Condition and Values

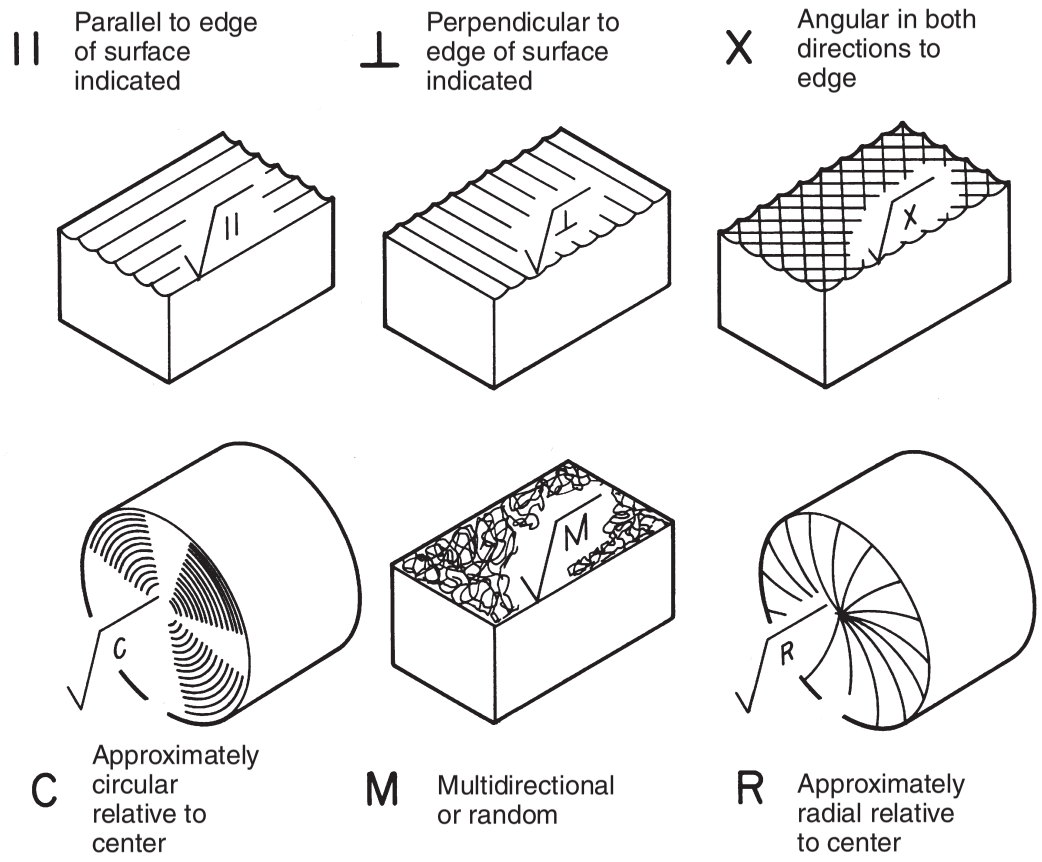


How surface waviness is measured.
Note the difference in magnitude between waviness and roughness.



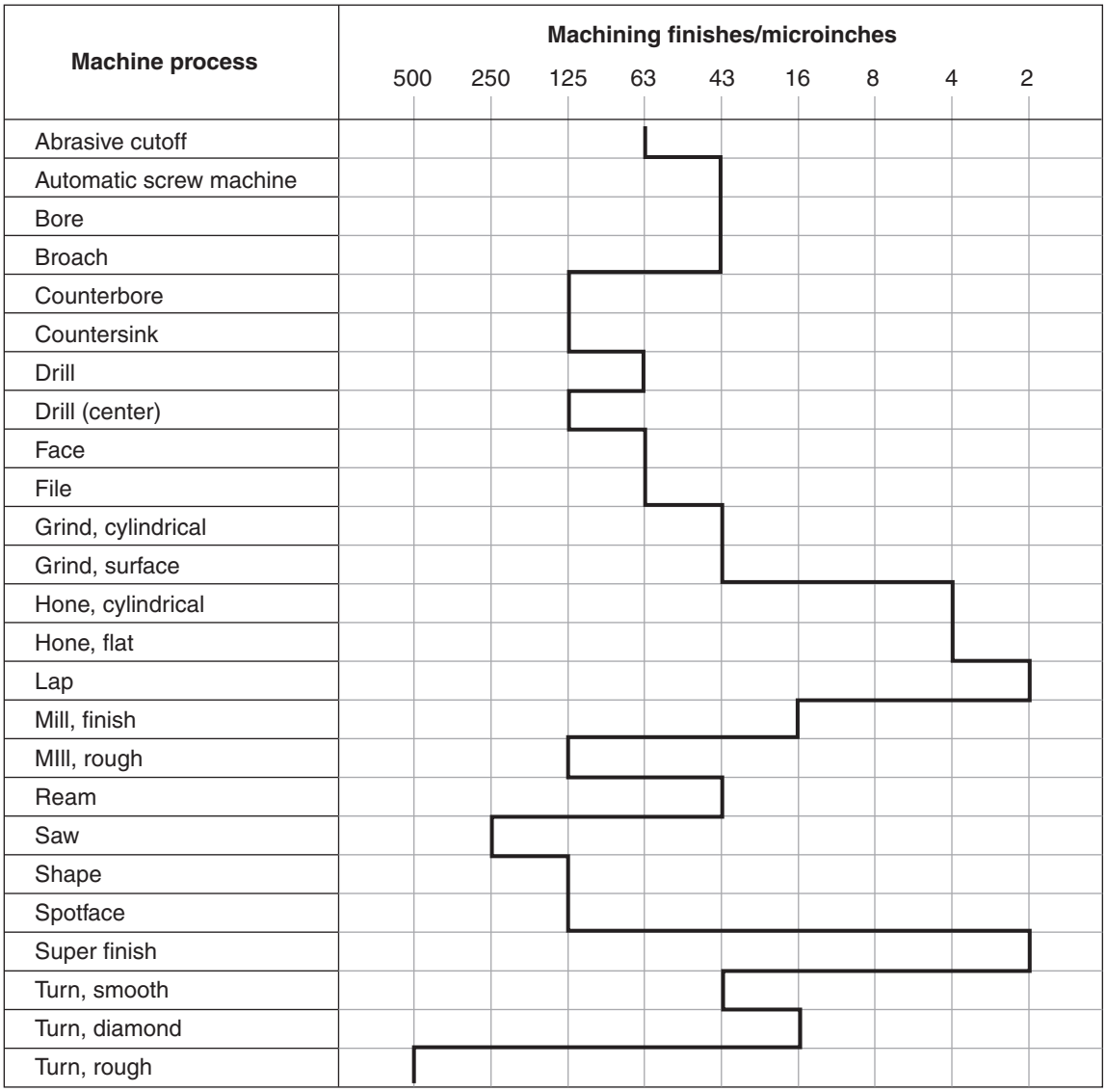
On drawings, symbols and numbers show roughness, waviness, and lay. They specify finishes required on a surface.

Lay Symbols



Lay symbols are located beneath the horizontal bar on a surface texture symbol.

Typical Surface Finishes



The finer the finish (the lower the roughness value in microinches), the higher the cost of obtaining it.

Metal Finishing

Name: _____ Date: _____ Score: _____

1. The symbol _____ was used at one time on drawings to designate a machined surface. 1. _____
2. Why was the above symbol's use discontinued? _____
   _____
   _____
3. Surface roughness is now measured in _____ and _____. What does each equal? _____
   _____
   _____
4. In addition to surface roughness, other surface conditions were given values. Waviness was one such condition. It means: 4. _____
   a. Very rough surfaces.
   b. Smoothly rounded undulations caused by tool and machine conditions.
   c. Scratches on the machined surface.
   d. All of the above.
   e. None of the above.
5. Lay is another surface finish condition. What does it mean? _____
   _____
6. A 500/12.5 surface finish is _____ than a 125/3.2 surface finish. 6. _____
7. While the quality of a machined surface is of paramount importance in the machining of metal, other finishing methods are used in the machine shop. They are employed for one or more of the following reasons. Explain each.
   a. Appearance: _____
   _____
   b. Protection: _____
   _____
   c. Identification: _____
   _____
   d. Cost reduction: _____
   _____
8. Regardless of the finishing method utilized, the surface to be finished must be thoroughly _____ of all contaminants. 8. _____

Name: _____

9. Paints, lacquers, and enamels are in the family of _____ coatings. 9. _____

10. List the five ways employed to apply the finishes in Question 9. _____

_____

11. List three types of anodizing. _____

_____

_____

12. Describe electroplating. _____

_____

_____

_____

_____