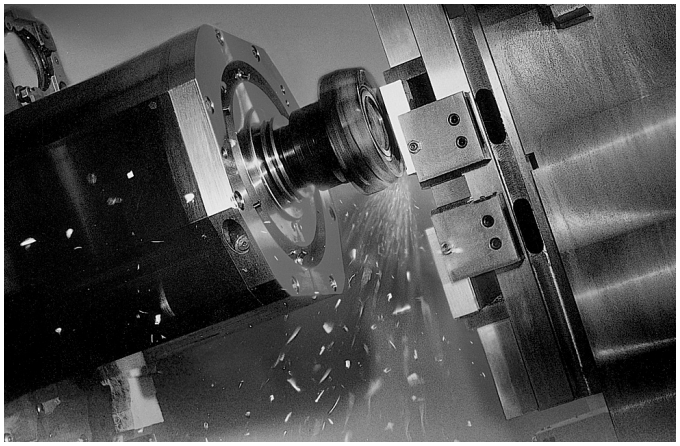


Chapter 23

Quality Control

LEARNING OBJECTIVES

After studying this chapter, students will be able to:

- Explain the need for quality control.
- Point out the difference between the two basic quality control techniques.
- Describe how some nondestructive testing methods operate.
- Explain advanced methods for assuring quality control during and after machining.

INSTRUCTIONAL MATERIALS

Text: pages 435–450
Test Your Knowledge Questions, page 449
Workbook: pages 127–130
Instructor's Resource: pages 303–314
Guide for Lesson Planning
Research and Development Ideas
Reproducible Masters:
23-1 Radiographic (X-ray) Inspection
23-2 Magnetic Particle Inspection
23-3 Ultrasonic Inspection (*basic operation*)
23-4 Ultrasonic Inspection (*liquid coupling/immersion type*)
23-5 Ultrasonic Inspection (*cathode ray tube [CRT]*)
23-6 Test Your Knowledge Questions
Color Transparency (Binder/CD only)

GUIDE FOR LESSON PLANNING

Display a selection of quality control equipment for student/trainee inspection.

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

- The reason for quality control.
- The ultimate goal of quality control.
- History of quality control.
- The two basic types of quality control.
- Why destructive quality control testing may be used.
- Nondestructive quality control techniques.
- Why different types of testing are necessary.
- Measuring techniques.
- The coordinated measuring machine and its capability.
- Radiographic (X-ray) inspection and its advantages and disadvantages. Use Reproducible Master 23-1.
- Magnetic particle inspection and its advantages and disadvantages. Use Reproducible Master 23-2.
- Fluorescent penetrant inspection.
- Ultrasonic inspection. Use Reproducible Masters 23-3, 23-4, and 23-5.
- Inspection using lasers.
- Eddy-current inspection.
- Other quality control techniques.

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.

coordinate measuring machine (CMM)
eddy-current test
fluorescent penetrant inspection
magnetic particle inspection
megahertz (MHz)
optical comparator
profilometer
statistical process control (SPC)
ultrasonic testing
ultraviolet light

Review Questions

Assign *Test Your Knowledge* questions. Copy and distribute Reproducible Master 23-6 or have students use the questions on page 449 and write their answers on a separate sheet of paper.

Workbook Assignment

Assign Chapter 23 of the ***Machining Fundamentals Workbook.***

Research and Development

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

1. Devise a way to use an overhead projector to demonstrate the optical comparator.
2. Develop simple measuring fixtures to check a simple project against its plans.
3. Penetrants described in the text are easy to use. The cost is within reach of most budgets. Carefully analyze the needs of your shop. If needed, present your analysis to request that penetrant materials be purchased.
4. Select a machine part and examine it carefully. What points on the piece come under the quality control program in the plant where it was manufactured? What points must be checked against specifications if the part is to be interchangeable with other components of the assembly?
5. Devise a quality control program for your training area.
6. Arrange a field trip to a manufacturing plant. Request a demonstration of the Magnaflux technique.
7. Check the micrometers and Vernier measuring tools in your instructional area. Make any needed repairs and adjustments.
8. Show a film or video on quality control. Preview it and prepare an outline and quiz on the film's more significant points of interest.

TEST YOUR KNOWLEDGE ANSWERS, Page 449

1. d. All of the above.
2. Destructive testing, the part is destroyed during test.

   Nondestructive testing, the part can be used after test.
3. precision tool calibration
4. X-rays
5. Any order: inspection sensitivity is high; image produced is geometrically accurate; a permanent record is produced; image interpretation is highly accurate.
6. magnafluxing
7. Evaluate individually. Refer to Section 23.3.4.
8. b. It guarantees that the parts being produced meet standards and specifications.
9. optical comparator
10. A magnetic field is set up electrically within the part. Fine iron particles are blown or flowed in liquid suspension on the part. They will outline the flaw.
11. ferrous
12. b. A high-frequency sound beam.
13. Evaluate individually. Refer to Figure 23-29 in the text.
14. Pulse echo. Uses sound waves generated by a transducer that travels through the work. The reflected sound waves (echoes) locate the flaws. One crystal is used to both transmit the sound and receive the echoes.

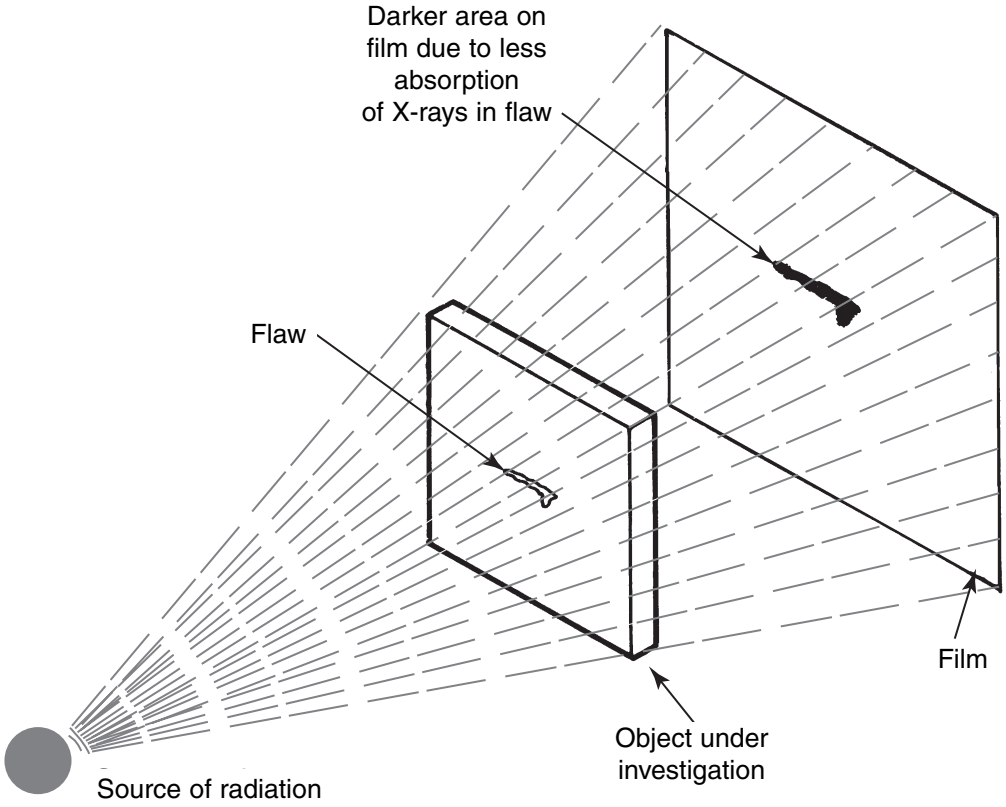
    Through inspection. Has one crystal that transmits the waves through the piece, and another crystal picks up the signal on the opposite end of the piece.
15. Evaluate individually. Refer to Section 23.3.6.

WORKBOOK ANSWERS, Pages 127–130

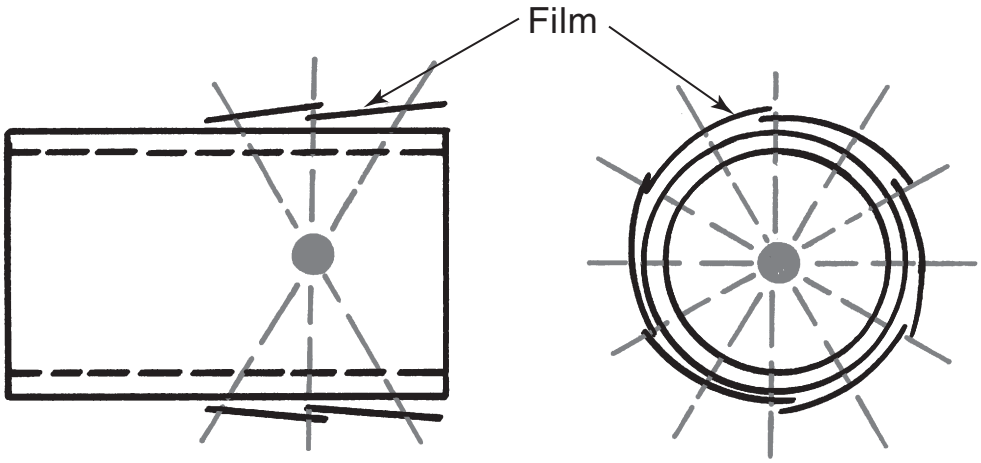
1. prevent
2. d. All of the above.

3. Part is destroyed during testing. Specimen is selected at random and gives no assurance that defective parts could slip by.
4. Evaluate individually.
5. Usefulness of part is not impaired. Each piece is tested individually and as a part of a complete assembly.
6. It guarantees measuring tool accuracy by checking them against known standards.
7. electronically
8. An enlarged image of the part being inspected is projected onto a screen where it is superimposed upon an accurate drawing overlay of the part. Very small size variations can be noted by skilled operator.
9. automates
10. Statistical process control involves measuring a mathematically selected number of parts in a production run.
11. Passing gamma rays through the part and onto light sensitive film to detect flaws. The developed film has an image of the internal structure of the part.
12. d. All of the above.
13. To detect flaws on or near the surface of ferromagnetic (iron-based) metals.
14. Cannot find flaws in nonferrous materials and it only shows serious defects.
15. A penetrant solution is applied to the surface of the part. Capillary action pulls the penetrant into the flaw. The surface is rinsed clean and a developer applied. When inspected under ultraviolet light, flaws will glow with fluorescent brilliance.
16. By coating the part with a red liquid dye which soaks into any flaw. After washing off the dye, a developer is dusted or sprayed on the part. Flaws show up as red against the white of the developer.
17. sound waves
18. d. All of the above.
19. It is based on the fact that flaws in a metal product will cause impedance changes in a coil brought near it. Different eddy-currents will result in test coils placed next to metal parts with and without flaws. This difference determines which parts pass or fail inspection.
20. c. variations in dimension of a metal product

Radiographic (X-ray) Inspection



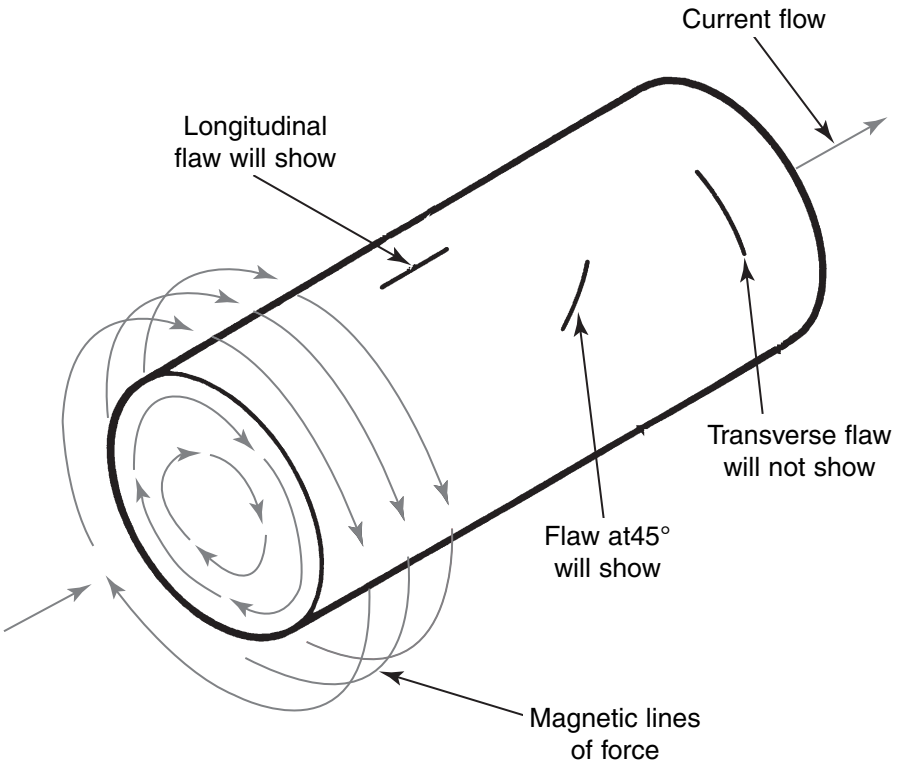
How Radiographic Inspection Works



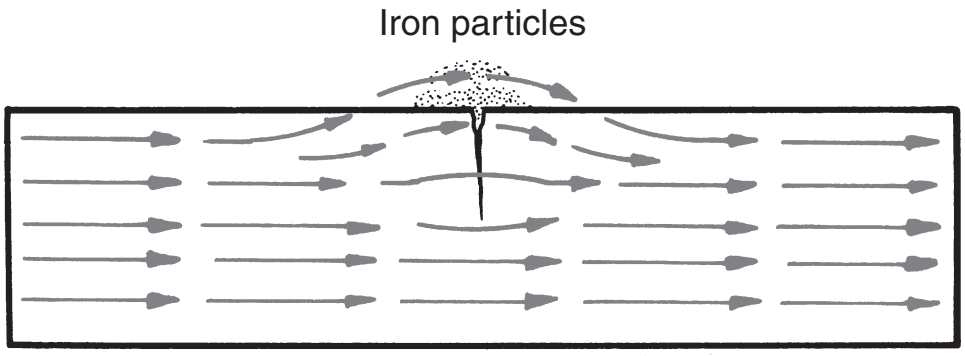
Inspecting Cylindrical Objects

A flaw causes more exposure of the film, so an image of the flaw is shown on the film when it is developed.

Magnetic Particle Inspection

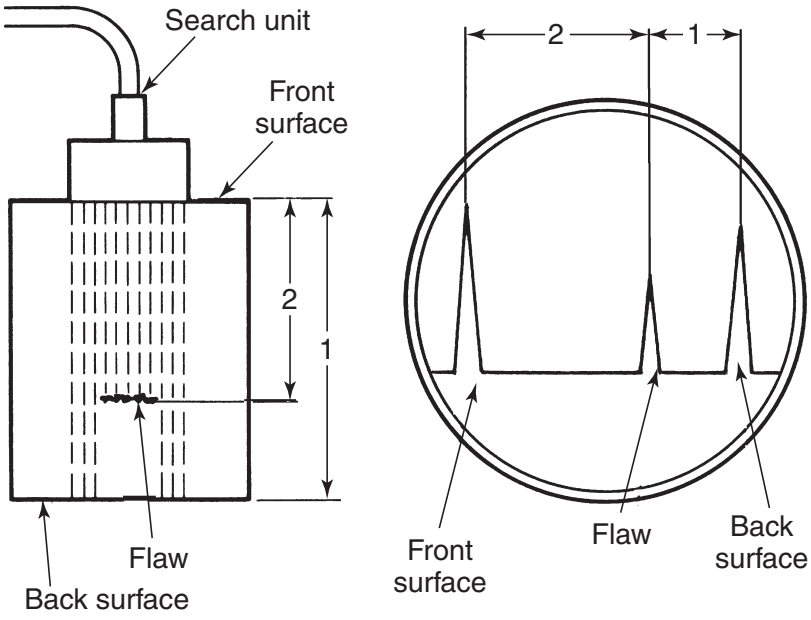


Theory, scope, and limitations of magnetic particle inspection technique.

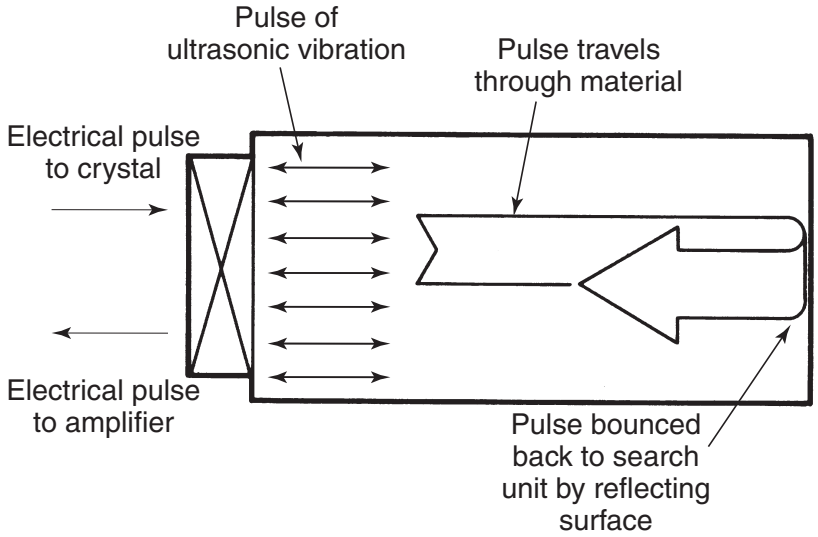


Crack in steel bar generates a magnetic field outside the part to hold on iron particles. Buildup of iron particles makes even tiny flaws visible.

Ultrasonic Inspection

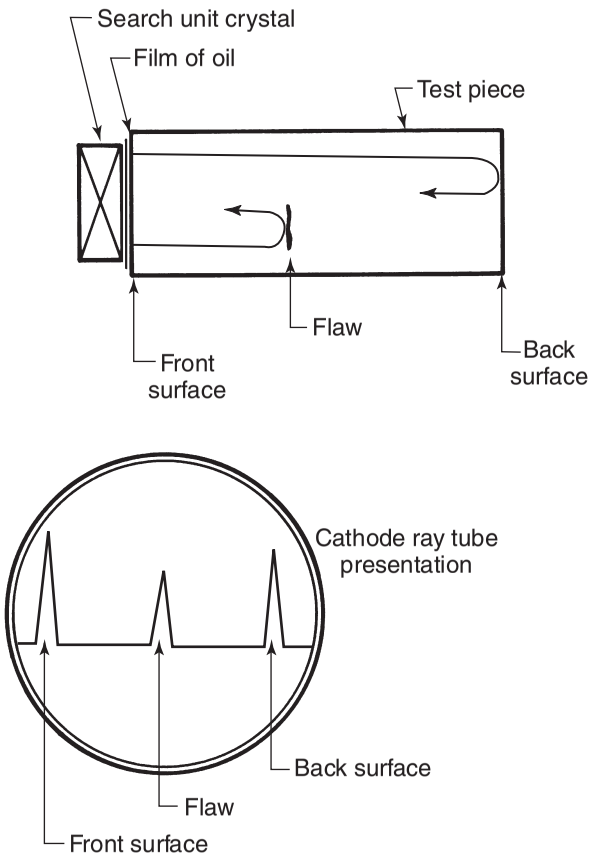


How ultrasonic sound waves are used to detect and locate a flaw in a test piece.



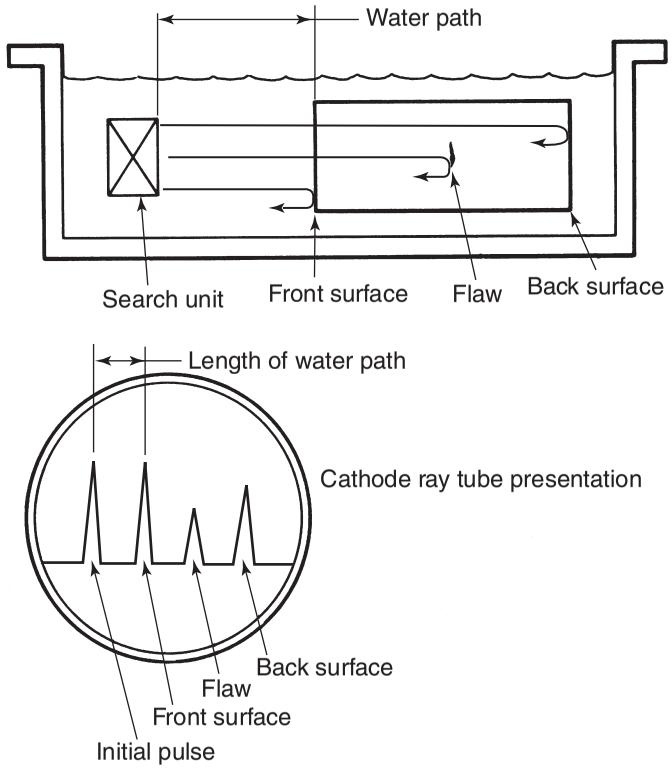
How sound waves travel through a part and bounce back to locate flaws in the material.

Ultrasonic Inspection



Liquid Coupling

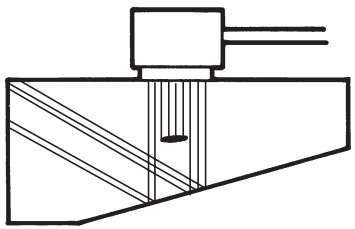
Action of a contact-type ultrasonic inspection device. A film of oil, water, or glycerine is used to make a positive contact between the transducer and the test piece.



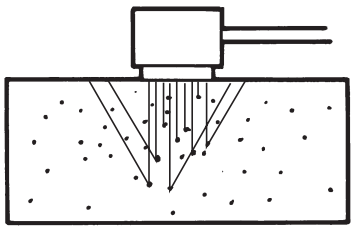
Immersion Type

Note the extra spike on the CRT, indicating the path through water.

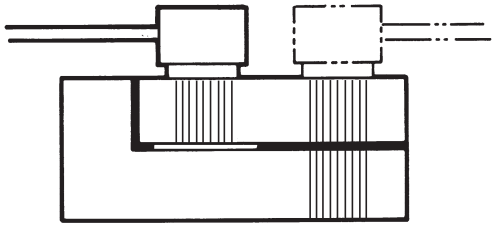
Ultrasonic Inspection



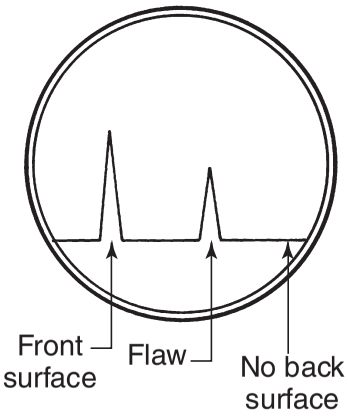
Angular back surface

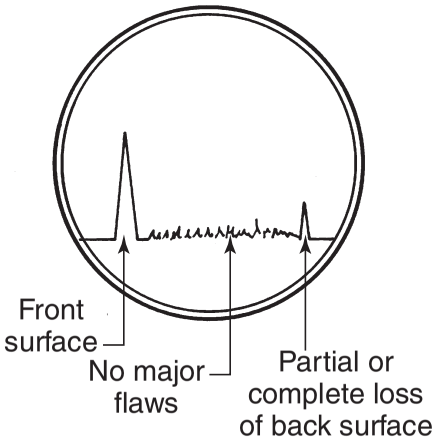


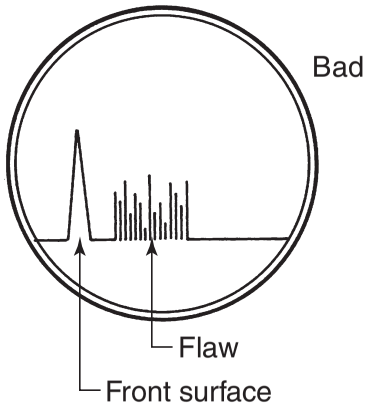
Porous material

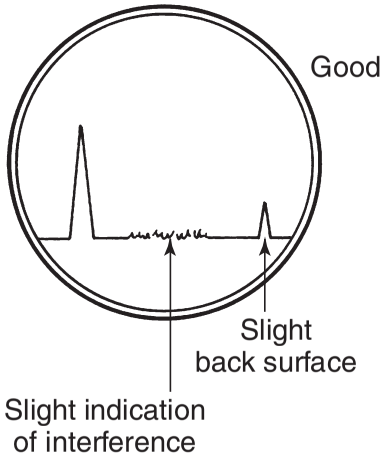


Braze or lamination









Quality Control

Name: _____ Date: _____ Score: _____

1. Quality control is an important segment of industry. Its purpose is to: 1. _____
   a. Improve product quality.
   b. Maintain quality.
   c. Help to reduce costs.
   d. All of the above.
   e. None of the above.
2. Quality control falls into two basic classifications. Name and explain each. _____

   _____

   _____

   _____

   _____
3. Precision measuring tools, such as micrometers, Vernier tools, or dial indicators, are inspected and calibrated in a _____ laboratory. 3. _____
4. Inspection by radiography involves the use of _____ and gamma radiation. 4. _____
5. List four advantages of the radiographic inspection process.

   _____

   _____

   _____

   _____
6. Magnetic particle inspection is commonly known as _____. 6. _____
7. Describe the fluorescent penetrant inspection process. _____

   _____

   _____

   _____
8. Quality control is an important industrial tool because: 8. _____
   a. It can be done easily.
   b. It guarantees that the parts being produced meet standards and specifications.
   c. It can be done by unskilled labor.
   d. All of the above.
   e. None of the above.

Name: _____

9. The _____ is an optical gaging instrument designed for the inspection of small parts and sections of larger parts. 9. _____

10. Explain how the magnetic particle inspection technique operates. _____

_____

_____

_____

_____

11. Only _____ metals can be inspected by the magnetic particle technique. 11. _____

12. Ultrasonic inspection makes use of: 12. _____
    a. Accurately made measuring fixtures.
    b. A high-frequency sound beam.
    c. X-rays.
    d. All of the above.
    e. None of the above.

13. *In the space below or on a separate sheet of paper,* make a sketch showing the two methods of liquid coupling used for ultrasonic testing.

Name: _____

14. List the two basic categories of ultrasonic testing. Briefly describe each._____

_____

_____

_____

_____

15. *In the space below or on a separate sheet of paper,* make a sketch showing how ultrasonic testing is done.