ASNT Level III Study Guide: Magnetic Particle Testing, second edition

Errata – 7th Printing 04/13

The following text correction pertains to the second edition of *ASNT Level III Study Guide: Magnetic Particle Testing*. Subsequent printings of the document will incorporate the corrections into the published text.

The attached corrected page applies to the seventh printing with revision 04/13. In order to verify the print run of your book, refer to the copyright page. Ebooks are updated as corrections are found.

Page	**Correction**
25	In the explanation for Equation 12, replace the word “centimeters” with inches.
52	The answer key should be changed to read 7b.
73	Question 32 should be changed to read: 32. An indication that appears as a very narrow straight line along the root of the weld is:
74	The answer to Question 38 should be changed to c.
82	Question 1, answer d. should be changed to read: d. at least every six months or as otherwise specified.

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Other Symmetrical Shapes

The direction of a magnetic field is quite predictable as long as the item being magnetized is constant and symmetrical in cross section, such as a square, a ring or a disk. When magnetizing shapes other than solid or hollow round objects, configuration and cross section must be considered. For example, a magnetic particle testing inspection on a square bar will require more amperage than the same test on a round bar. The magnetic field in the square bar is greatest along the center of the face and drops to about half that value on the long corner. The field distribution is uniform on the curved surface of the round bar. Because of this, the diameter of the part is taken as the greatest distance between any two points on the outside circumference of the part, as shown in Figure 4.13.

Also, as shapes become more complex, it may be extremely difficult or impossible to predict the field intensity in specific areas. For complex-shaped parts, measuring devices are used to determine the magnetic field intensity in specific areas.

If the square bar in Figure 4.13 is 50 mm (2 in.) per side, the diagonal dimension is 71 mm (2.82 in.). If the square bar is circularly magnetized with direct current, the 1000 A per 25 mm (1 in.) rule would require 2820 A to magnetize a 50 mm (2 in.) square bar with a 71 mm (2.82 in.) diagonal. A 50 mm (2 in.) round bar would require only 2000 A for magnetization because its diagonal is 50 mm (2 in.).

Another approach to determining the current needed for magnetizing irregularly shaped bars requires the comparison of the perimeter of the cross section of the bar with a bar having the same diameter. If the cross-sectional perimeter of the bar in Figure 4.13 is 483 mm (19 in.) the diameter of a round bar with a 483 mm (19 in.) circumference is 483 mm (19 in.)/3.1416 = 154 mm (6 in). This suggests that a 5000 A current is adequate. Using the perimeter approach, the equivalent diameter for a 50 mm (2 in.) square bar would be 200 mm (8 in.)/3.1416 = 64 mm (2.5 in.), which is reasonably close to the 72 mm (2.8 in.) diagonal. A flat bar having the same area of 100 mm^2 (4 in.^{2}) could be 13 mm × 200 mm (0.5 in. × 8 in.). The perimeter of this bar is 432 mm (17 in.). The diameter of a round bar with a 432 mm (17 in.) circumference is 432 mm (17 in.)/ 3.1416 = 137 mm (5.4 in.). Thus, to magnetize a square bar with a 100 mm^2 (4 in.^{2}) cross-sectional area would require about 2500 A, whereas a flat bar with the same cross-sectional area could require more than twice that current. This approach is based on the fact that magnetism is a surface-oriented condition, as Figures 4.4 through 4.12 show; therefore, if the surface for the same cross-sectional area is doubled, the surface magnetic field (and hence the magnetizing current) should be in the same ratio.

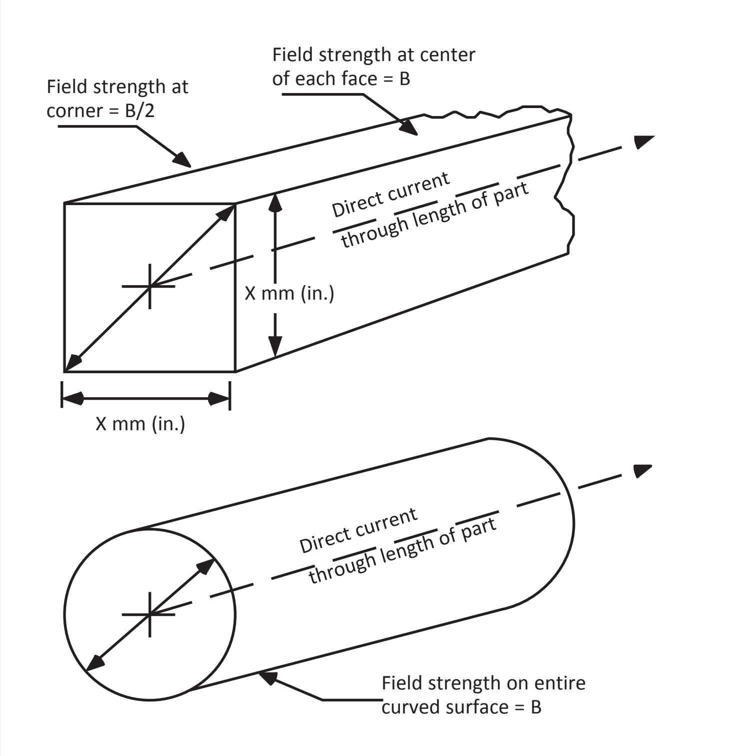

Figure 4.13: Field strength versus current. The diameter of the part is taken as the greatest distance between any two points on the outside circumference of the part.

The study that yielded this approach included surface flux density measurements that closely approximated the expected flux. Using this approach, Equation 12 gives an approximation of the current required for direct contact magnetization of oddly shaped uniform cross sections:

(Eq. 12) $$I = \frac{P}{\pi} \times 1000$$

where:

I = magnetizing current, in amperes direct current,
P = perimeter of cross section, in inches,
π = 3.1416.

A single part with multiple sections of different diameters requires that different magnetizing current levels be selected for each section. The section

9. The primary reason for using water as a suspension is that:

   a. water is cheaper than oil.
   b. a water suspension is easier to remove from the part.
   c. water is not as flammable as oil.
   d. water wets the test surface better.

10. A disadvantage of using water suspensions is that:

   a. water is less evaporative than oil.
   b. particles settle out of water slower than oil.
   c. the tanks of the machine must be treated to reduce rust.
   d. water suspensions do not require wetting agents (surfactants).

11. Concentrates are:

   a. particles that are highly concentrated in slurry.
   b. particles that have been pressed together for shipping purposes.
   c. particles that are coated with a wetting agent.
   d. particles in a wet paste.

12. A property of magnetic particles is that particles are:

   a. less dense than water and oil.
   b. made in various sizes.
   c. made in only one shape.
   d. made to have low contrast with their background.

13. Magnetic particles settle in water ________ than in oil.

   a. faster
   b. slower
   c. about the same
   d. about seven times faster

14. The curing time for magnetic rubber is least affected by the:

   a. temperature of its environment.
   b. percentage of activator used in the mixture.
   c. ambient humidity.
   d. amount of magnetism that is applied.

ANSWERS

1d 2d 3b 4d 5a 6a 7b 8a 9c 10c 11d 12b 13a 14d

27. An extruded seamless tube has a long visible indication along the length of the inside diameter. The possible cause of this indication is:

    a. incomplete penetration in the weld.
    b. an irrelevant indication from the seam weld metallurgical structure.
    c. an irrelevant indication caused by the tendency of the magnetic particles to collect at the bottom of the inside diameter.
    d. a draw mark.

28. A crack is in a critical area of an expensive part. The first plan of action is to save the part. What action should be taken?

    a. Put a weld bead over the crack and polish off the surface.
    b. Grind a notch across the crack to determine if it can be ground out.
    c. Take a radiograph of the cracked area.
    d. Cut a section out of the part for metallurgical evaluation.

29. Magnetic particles bunch in some fillet areas and stand on end on the edge of the part being magnetized. These observations indicate that the:

    a. particle concentration is too low.
    b. flux density is excessive.
    c. flux has the improper orientation.
    d. flux density is too low.

30. To evaluate an indication in the weld, information about:

    a. the welding parameters used and the welder ID number should be known.
    b. the welding procedure qualification date should be readily available.
    c. the strength of the magnetic field used to produce the indication should be known.
    d. the welding procedure and the joint design should be available.

31. Which of the following is typically considered an internal weld discontinuity?

    a. Inadequate penetration.
    b. Incomplete fusion.
    c. Burn through.
    d. Undercut.

32. An indication that appears as a very narrow straight line along the root of the weld is:

    a. slag lines.
    b. inadequate penetration.
    c. a crack.
    d. undercutting.

33. Undercutting is an indication that may appear:

    a. as sharp contours around the edges of grinding marks.
    b. as zigzag or jagged shapes in the middle of the weld bead.
    c. only on one side of the weld or on both sides of the weld.
    d. as rounded indications.

34. Internal stress caused by shrinkage upon cooling of the weld may cause:

    a. porosity
    b. slag inclusions.
    c. incomplete fusion.
    d. a crack.

35. If improper electrodes or long arcs are used and droplets of molten metal stick to the surface of the metal near the weld seam, this is known as:

    a. weld spatter.
    b. grinding marks.
    c. arc strikes.
    d. undercutting.

36. When the welding arc is started or displaced during the weld out onto the base metal surface, it will produce the following indication:

a. grinding mark.
b. arc strike.
c. weld spatter.
d. inadequate penetration.

37. What is the weld discontinuity that occurs as a product of insufficient heat or the presence of scale on the fusion face of a weld bevel?

a. Inadequate penetration.
b. Incomplete fusion.
c. Slag lines.
d. Undercutting.

38. Which of the following discontinuities is NOT formed as a result of improper welding practices?

a. Arc strikes.
b. Weld spatter.
c. Grinding marks.
d. Slag inclusions.

39. Which of the following discontinuities can be easily detected using magnetic particle examination?

a. Incomplete fusion.
b. Lack of cross-centered penetration.
c. Inadequate penetration.
d. Slag inclusions.

ANSWERS

1b	2a	3b	4d	5c	6d	7a	8c	9b	10a	11c	12b	13a
14a	15d	16b	17d	18c	19a	20a	21c	22b	23a	24d	25d	26b
27d	28b	29b	30d	31b	32b	33c	34d	35a	36b	37b	38c	39c

Review Questions

1. The ammeter should be checked against a calibrated shunt/ammeter:

   a. at the start of each shift.
   b. daily.
   c. weekly.
   d. at least every six months or as otherwise specified.

2. The magnetizing current ammeter should be calibrated by:

   a. a field strength meter.
   b. nothing —installed ammeters are considered to be accurate unless damaged by overload or accident.
   c. a calibrated ammeter and master shunt placed between the machine's current contacts.
   d. a calibrated galvanometer and bridge circuit connected across the installed ammeter.

3. The alternating current ammeter should be checked:

   a. with a shunt and a master alternating current ammeter.
   b. with an impedance bridge and an oscilloscope.
   c. with a master current transformer and a calibrated alternating current ammeter.
   d. only if it is damaged.

4. Which of the following is NOT a means of verifying the correct operation of the magnetic particle testing process?

   a. Checking the ultraviolet light intensity.
   b. Checking the water washability of the emulsifier.
   c. Calibrating the ammeter with a master ammeter and shunt.
   d. Checking the magnetic properties of the particles with a Ketos ring.

5. The Ketos ring test will provide a complete functional check of the magnetic particle testing process. It is a quick, simple test that should be used:

   a. daily.
   b. hourly.
   c. each shift.
   d. whenever the manager requires it.

6. The Ketos ring test provides information about the:

   a. hardness of the piece being inspected.
   b. system sensitivity.
   c. intensity and integrity of ultraviolet lights.
   d. concentration of particles in suspension.