

INTRODUCTION

A specification is a detailed set of written instructions. Specifications can: supplement the drawings in a set of plans and identify equipment and materials used in the structure; state the requirements that a material, product, system, or service must satisfy; and/or identify how to determine whether the requirements are satisfied. Specifications and standards become legally binding (1) when a government body requires them or (2) when bidding documents, contracts, or other documents reference them.

FOCUS ASSIGNMENTS

FOCUS ASSIGNMENTS

1. Visit the web site of the American Society for Testing and Materials (ASTM). The URL is <www.astm.org>. From the link to "frequently asked questions" (FAQ), find out about the types of standards that the ASTM develops.
2. Visit the web site of the American Concrete Institute International (ACI). The URL is <www.aci-int.org>. Click on the link about the different ACI certification programs.



Reading



Employability



Technology

UNIT OBJECTIVE

After completing this unit, you will show the following competencies by mastering the activities on the Assignment and Job Sheets and by scoring at least 85% on the Written Test.

SPECIFIC OBJECTIVES

1. Describe a specification.
2. List common sources of specifications and standards.
3. Recognize common ASTM sampling and testing procedures for plastic (fresh) concrete.
4. Recognize common ASTM sampling and testing procedures for hardened concrete.
5. Profile a specification that applies to concrete construction. (Assignment Sheet)



6. Obtain representative test samples of fresh concrete. (Job Sheet 1)
7. Perform a slump test. (Job Sheet 2)
8. Make a cylinder-mold test specimen. (Job Sheet 3)
9. Make a beam-mold test specimen. (Job Sheet 4)
10. Perform a volumetric-method air content test. (Job Sheet 5)
11. Perform a pressure-method air content test using a Type B air meter. (Job Sheet 6)
12. Perform a temperature test. (Job Sheet 7)
13. Perform a unit weight, yield, and air content test. (Job Sheet 8)




OBJECTIVE 1

Optional Activities/
Resources in Instructor's
Guide

Describe a specification.

WORDS YOU SHOULD KNOW

tolerance the acceptable variance from a standard

 Look at sample specifications that your instructor provides. Your instructor will also show you examples of how standards and specifications are referenced in other documents, such as bidding documents, contracts, etc.

- A specification is a detailed set of written instructions. Specifications can:
 - supplement the drawings in a set of plans and identify equipment and materials used in the structure;
 - state the requirements that a material, product, system, or service must satisfy; and/or
 - identify how to determine whether the requirements are satisfied.
- Factors related to concrete in specifications can include:
 - type and quality of materials to be used
 - dimensions of concrete components to be constructed
 - dimensions of materials to be used
 - required construction methods
 - allowable tolerances
 - allowable maximum water-cement ratios
 - required percentage of air in concrete
 - required slump
 - required finishes
 - required types and methods of curing
 - required tests
- Specifications and standards become legally binding (1) when they are required by a government body or (2) when they are cited in bidding documents, contracts, or other documents.

✓ **NOTE:** Bidding and contract documents usually cite specifications and standards by reference (to the title and/or number of the specification or standard).



OBJECTIVE 2

Optional Activities/
Resources in Instructor's
Guide

List common sources of specifications and standards.

- **ACI (American Concrete Institute International)** — a source of standards and guides for designs and construction that incorporate concrete and related materials; a source for certification in specific concrete occupations

EXAMPLES: The ACI publishes documents such as *Cement and Concrete Terminology*; *Guide to Durable Concrete*; *Chemical Admixtures for Concrete*; *Standard Practice for Curing Concrete*; and many others.

- **ASTM (American Society for Testing and Materials)** — a not-for-profit source of voluntary, standardized sampling and testing procedures for concrete

OBJECTIVE 3

Optional Activities/
Resources in Instructor's
Guide

Recognize common ASTM sampling and testing procedures for plastic (fresh) concrete.



NOTICE: Standards are subject to change. For example, they may be revised or replaced. You can find the latest standards in the current editions of ASTM publications or from the ASTM web site.

- Sampling — Procedures to obtain representative samples of fresh concrete from stationary, paving, and truck mixers, and from agitating and nonagitating transport equipment (such as a dump truck)

EXAMPLES: Standard Practice for Sampling Freshly Mixed Concrete (Practice C172-99)

- Slump — Procedure for determining slump of hydraulic-cement concrete in the laboratory and in the field

EXAMPLES: Standard Test Method for Slump of Hydraulic Cement Concrete (Test Method C143/C143M-00)

- Cylinder and beam molding — Procedures for making and curing molded samples in the shape of cylinders and beams from representative samples of fresh concrete

EXAMPLES: Standard Practice for Making and Curing Concrete Test Specimens in the Field (Practice C31/C31M-00)



- Air content — Method for determining the air content of freshly mixed concrete that contains any type of aggregate

EXAMPLES: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method (Test Method C173-94ae1); Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method (Test Method C231-97e1)

- Bulk density (“unit weight”) — Method for determining the bulk density (“unit weight”) of compacted or loose aggregate

EXAMPLES: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete (Test Method C138-01); Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate (Test Method C29/C29M-97)

- Temperature — Method for determining the internal temperature of fresh concrete

EXAMPLES: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete (Test Method C1064/C1064M-99)

OBJECTIVE 4

Optional Activities/
Resources in Instructor’s
Guide

Recognize common ASTM sampling and testing procedures for hardened concrete.



NOTICE: Standards are subject to change. For example, they may be revised or replaced. You can find the latest standards in the current editions of ASTM publications or from the ASTM web site.

- Sampling — Procedures for visually examining and sampling hardened concrete, such as in prefabricated building units, precast products, and laboratory samples

EXAMPLES: Standard Practice for Examination and Sampling of Hardened Concrete in Constructions (Practice C823-00); Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete (Test Method C1084-97)

- Core sampling — Method for obtaining a sample of hardened concrete from the job site for use in various strength tests (compression tests, flexural strength, etc.)

EXAMPLES: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete (Test Method C42/C42M-99)

✓ **NOTE:** Core sampling is not regularly required.



- Impact testing — Procedures performed at the job site on hardened, in-place concrete to determine when forms can be removed and when loads can be applied

EXAMPLES: Standard Test Method for Rebound Number of Hardened Concrete (Test Method C805-97)

✓ **NOTE:** A spring-driven rebound or impact hammer (Figure 1) can be used against the surface of the concrete to record a rebound value.

FIGURE 1



OBJECTIVE 5

Complete the Assignment Sheet.

OBJECTIVE 6

Complete Job Sheet 1.

OBJECTIVE 7

Complete Job Sheet 2.

OBJECTIVE 8

Complete Job Sheet 3.

OBJECTIVE 9

Complete Job Sheet 4.



OBJECTIVE 10 **Complete Job Sheet 5.**

OBJECTIVE 11 **Complete Job Sheet 6.**

OBJECTIVE 12 **Complete Job Sheet 7.**

OBJECTIVE 13 **Complete Job Sheet 8.**





Name _____ Score _____

OBJECTIVE 5

Profile a specification that applies to concrete construction.

BASIC SKILLS



Writing



Mathematics



Critical Thinking



Employability

EQUIPMENT AND SUPPLIES

- Pen or pencil
- Access to ASTM and other specifications and standards

INSTRUCTIONS

- Your instructor will provide you with samples of complete specifications and standards. Study the one that your instructor assigns to you.
- Answer the questions below.
- Your instructor may ask you to present your answers to the class.

1. What is the full name of the specification or standard?

2. What is the source of the specification or standard (organization)?

3. Do the methods or procedures take place on the job site, at a laboratory, or both?



4. What types of procedures or tests are covered (the scope of the specification)?

5. Is anything intentionally not covered? Please describe.

6. Are any specific hazards identified? Please list.

7. Is any personal protective equipment (PPE) identified? Please list.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

8. What other documents are referenced or cited? List three (3) references.



Name _____ Score _____

OBJECTIVE 6

Obtain representative test samples of fresh concrete.

BASIC SKILLS



Reading



Science



Employability

EQUIPMENT AND SUPPLIES

- Sampling and mixing containers

✓ **NOTE:** The containers must be suitable heavy-gauge metal pans; wheelbarrows; or flat, clean, nonabsorbent mixing boards.

- Shovels
- Hand scoops
- Trowels
- Concrete
- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Personal protective equipment

✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Sampling from a stationary mixer, revolving-drum truck mixers, or agitators.

Yes No

1. At regularly spaced intervals during discharge of the *middle* third portion of batch, take two or more sample portions, using one of the following methods:



CAUTION: Do *not* obtain samples until all of the water has been added to mixer.

- a. Repeatedly pass the sampling container through the entire discharge stream, *or*
- b. Completely divert the discharge stream into the sampling container.



Yes No

- 2. Collect sample portions into the mixing container to produce a composite sample.
- 3. Transport the composite sample to the test location.
- 4. Using a shovel, combine and remix the composite sample just enough to ensure mix uniformity.
- 5. Begin testing.

SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
Obtained sample from correct part of mix	4	3	2	1

AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

- 4 Skilled** — Can perform job with no additional training
- 3 Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS



Name _____ Score _____

OBJECTIVE 7

Perform a slump test.

BASIC SKILLS



Reading



Science



Employability

EQUIPMENT AND SUPPLIES

- Standard slump cone

✓ **NOTE:** The standard slump cone is 8 inches in diameter at the base, 4 inches in diameter at the top, and 12 inches high. The base and top are open, and the cone has foot pieces and handles. (Figure 1) Some slump cones come with a base that has a folding handle that can be used as a measuring point rather than measuring from the inverted cone.

FIGURE 1



- Tamping rod

✓ **NOTE:** The tamping rod for this test is smooth, $\frac{5}{8}$ -inch-by-24-inch, bullet-nosed (hemispherical-tipped) steel rod.

- Scoop
- Rule
- Clean, firm, level, nonabsorbent test surface

EXAMPLES: Smooth plank, concrete slab



- Container of water
- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Pencil or pen
- Chart for recording test results
- Personal protective equipment

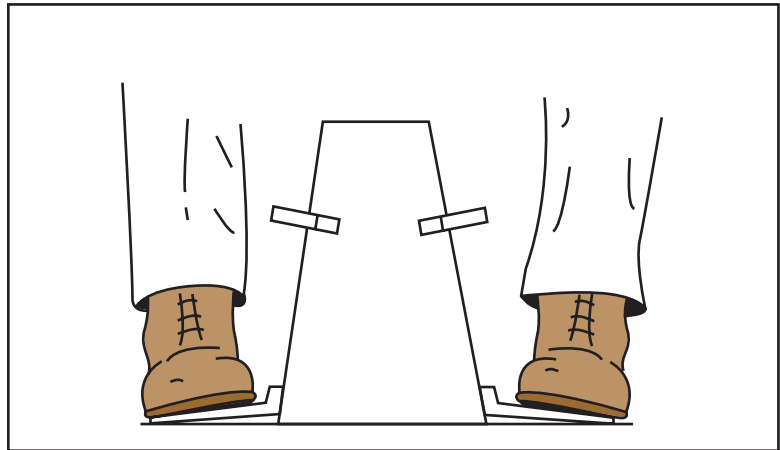
✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Yes No

- 1. Obtain a representative concrete test sample. (See Job Sheet 1)
- 2. Dampen the slump cone and the test surface with water.
- 3. Place the slump cone base down on the test surface, and stand on the cone's foot pieces to hold the cone firmly in place. (Figure 2)

FIGURE 2



CAUTION: Steps 4 through 12 should be completed in about 2½ minutes.

- 4. Fill the slump cone with concrete to about one-third the cone's capacity (about 2⁵/₈ inches), distributing concrete spirally around the inside perimeter of the cone. (Figure 3)



FIGURE 3



Yes No

5. Insert the tamping rod in the cone, and rod the concrete 25 times, using the following procedures: (Figure 4)

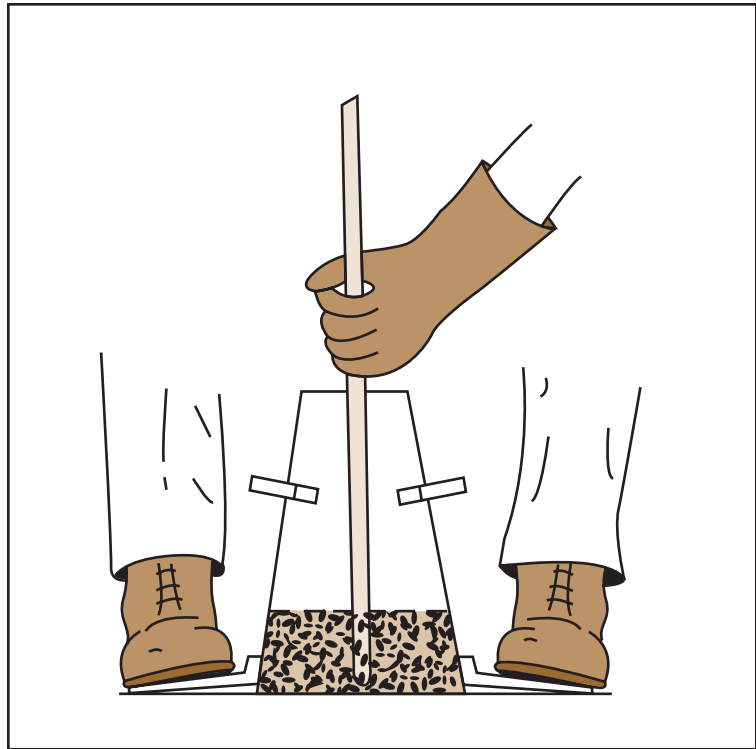
FIGURE 4



- a. Use an up-and-down motion of the rod, rodding the layer throughout its depth.
- b. Distribute the rod strokes evenly by starting at the perimeter of the cone and moving in a spiral toward the center of cone. (Figure 5)



FIGURE 5



Yes No

- 6. Fill the next one-third of the slump cone (to about 6½ inches) with concrete, distributing concrete spirally around the inside perimeter of cone. (Figure 6)
- 7. Rod the concrete 25 times, using the following procedures:
 - a. Use an up-and-down motion, making the rod just penetrate into the underlying layer of concrete.
 - b. Distribute rod strokes evenly by starting at the perimeter of the cone and moving in a spiral toward the center of cone.



FIGURE 6



Yes No

- 8. Fill the slump cone to overflowing with concrete.
- 9. Rod the concrete 25 times, following the procedures in Step 7 and also adding additional concrete as necessary to keep concrete above the top of the cone. (Figure 7)

FIGURE 7



Yes No

10. Using a screeding and rolling motion of the tamping rod, strike off (level) excess concrete from the top of the slump cone. (Figure 8)

FIGURE 8



Yes No

11. Clean excess concrete away from the base of the slump cone.
12. Raise the slump cone from the test sample with a steady, vertical (upward) lift in 5 ± 2 seconds. (Figure 9)



CAUTION: Do *not* move the cone laterally (sideways) or turn the cone anyway that would disturb the test sample.



FIGURE 9



Yes No

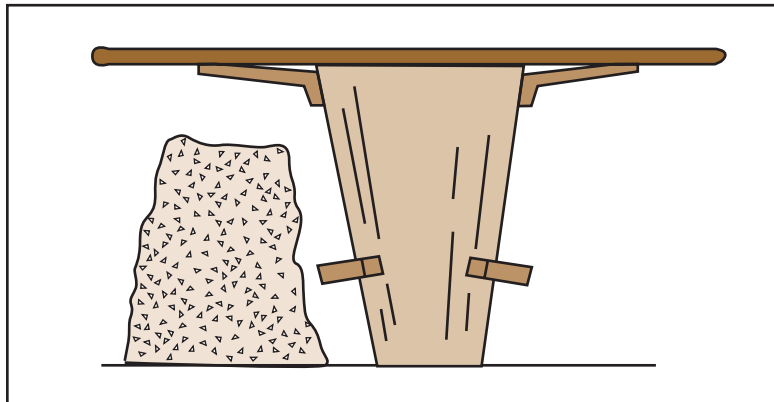
13. Turn the slump cone upside down and gently place it next to the test sample. Or, if using a slump cone with a folding handle, set the slump cone aside.



CAUTION: Do *not* disturb the test sample.

14. Place the tamping rod across the slump cone's base so the rod extends over test sample. (Figure 10) If using the slump cone with the folding handle, carefully raise the handle over the test sample.

FIGURE 10



Yes No

15. Using a rule, measure (to nearest $\frac{1}{4}$ inch) the distance from the bottom of the tamping rod (Figure 11) or the folding handle (Figure 12) to the displaced center to test sample.

✓ **NOTE:** This measurement is called the *slump* of the concrete.

FIGURE 11

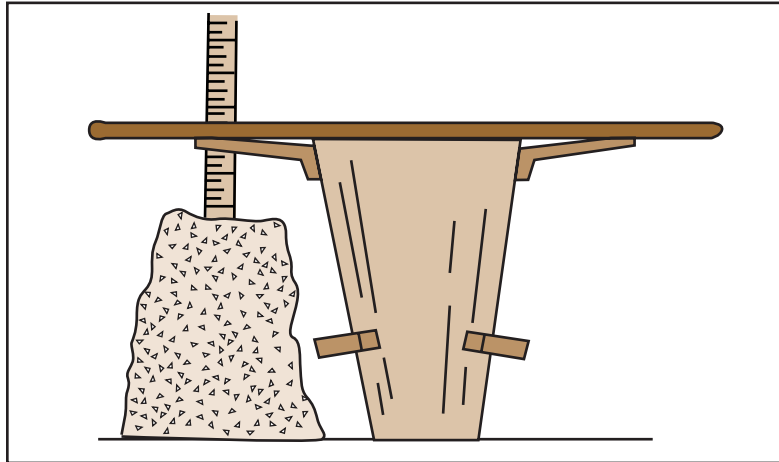


FIGURE 12



16. Record the slump measurement in inches.
17. Notify the contractor and ready mix provider or job engineer of results—modify proportions if necessary.
18. Clean test area and tools, and properly store tools and materials.



SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
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Followed procedures	4	3	2	1
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AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

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- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS





Name _____ Score _____

OBJECTIVE 8

Make a cylinder-mold test specimen.

BASIC SKILLS



EQUIPMENT AND SUPPLIES

- Clean, firm, level, nonabsorbent test surface

EXAMPLES: Smooth plank, concrete slab

- Watertight cylinder mold

✓ **NOTE:** The mold will be selected by your instructor.

- Tamping rod

✓ **NOTE:** The tamping rod for this test is a smooth, $\frac{5}{8}$ -inch-by-24-inch, bullet-nosed (hemispherical-tipped) steel rod.

- Suitable storage area

✓ **NOTE:** For initial curing, cylinder molds must be stored as near as practical to the testing area and in a place where the specimens will be protected from moisture loss and temperatures can be maintained in a range of from 60°F to 80°F. Samples must not be disturbed for 24 hours.

- Scoop
- Shovel
- Container of water
- Rubber or rawhide mallet
- Pen or pencil
- Specimen tag or marker
- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Moisture-proof material for covering mold specimen

EXAMPLES: Nonabsorptive, nonreactive plate; tough, durable, impervious plastic



- Personal protective equipment

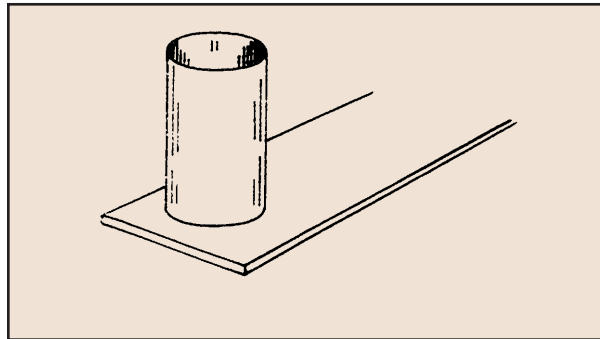
✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Yes No

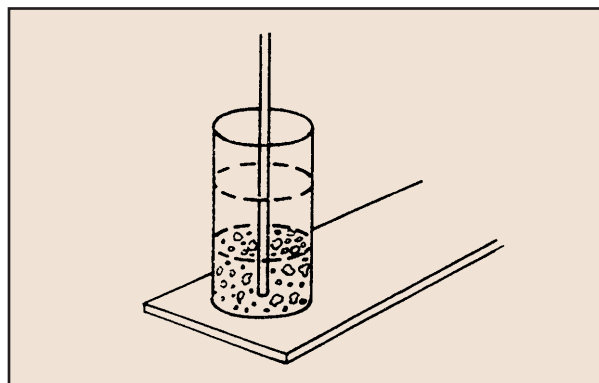
- 1. Obtain a representative concrete test sample. (See Job Sheet 1)
- 2. Place the cylinder mold on the test surface. (Figure 1)

FIGURE 1



- 3. Fill the cylinder mold with concrete to about one-third the mold's capacity, distributing concrete spirally around the inside perimeter of the mold. (Figure 2)
- 4. Insert the tamping rod in the mold, and rod the concrete 25 times, using the following procedures: (Figure 2)
 - a. Use an up-and-down motion of the rod, rodding the layer throughout its depth.
 - b. Distribute rod strokes evenly by starting at the perimeter of mold and moving in a spiral toward the center of cone.

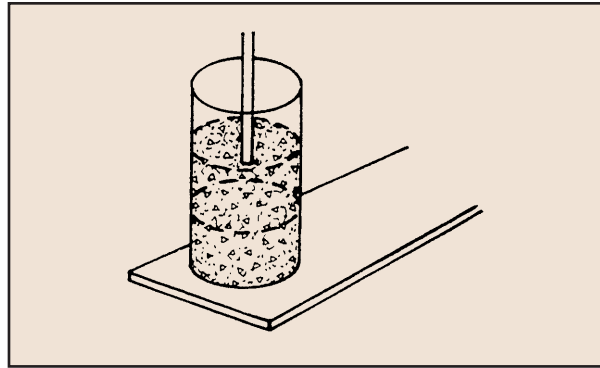
FIGURE 2



Yes No

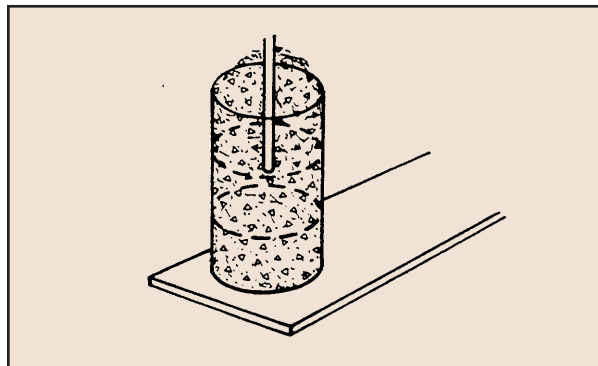
- 5. Tap the sides of the mold with the mallet to close any voids left by the tamping rod.
- 6. Fill the next one-third of the mold with concrete, distributing concrete spirally around the inside perimeter of the mold. (Figure 3)
- 7. Rod the concrete 25 times, using the following procedures: (Figure 3)
 - a. Use an up-and-down motion, making the rod just penetrate into the underlying layer of concrete.
 - b. Distribute rod strokes evenly by starting at the perimeter of mold and moving in a spiral toward the center of cone.

FIGURE 3



- 8. Tap the sides of the mold with the mallet to close any voids left by tamping rod.
- 9. Fill the last one-third of the mold with concrete, attempting to add an amount that will exactly fill the mold after rodding. (Figure 4)
- 10. Rod the concrete 25 times, following procedures in Step 7. (Figure 4)

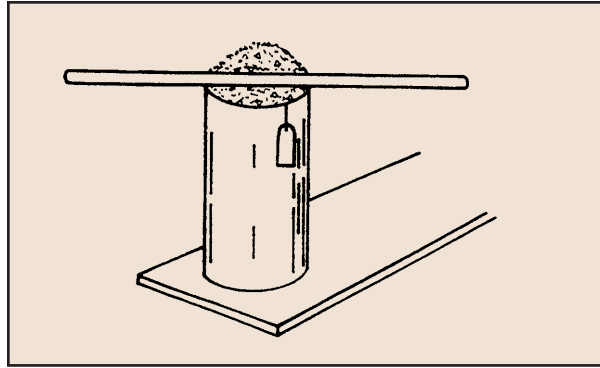
FIGURE 4



Yes No

- 11. Tap the sides of the mold with the mallet to close any voids left by the tamping rod.
- 12. Using a screed and rolling motion of the tamping rod, strike off (level) any excess concrete from the top of the mold to produce a flat even surface. (Figure 5)

FIGURE 5



- 13. Mark or tag the specimen, noting the time, date, location, of test and strength and slump of concrete. (Figure 6)
- 14. Cover the top of the mold with moisture-proof material or a plastic cap.
- 15. Clean excess concrete from the base of the mold.
- 16. Lift and support the specimen from the bottom of the mold with a trowel or other device, and carefully transport the specimen to the storage area.



CAUTION: Leave the mold undisturbed to cure in the storage area for at least twenty-four hours, and even after the initial curing period, handle the mold carefully to avoid damage to the specimen.

- 17. Clean test area and tools, and properly store tools and materials.
- 18. Molds are transported to the testing lab after initial curing period. (Figure 6)
- 19. At specific curing times, the cylinders are stress tested.



FIGURE 6



Yes No

20. Clean test area and tools, and properly store tools and materials.

SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
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Followed procedures	4	3	2	1
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AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.



KEY

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- 2 Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 Unskilled** — Is familiar with process, but is unable to perform job

**EVALUATOR'S
COMMENTS**



Name _____ Score _____

OBJECTIVE 9

Make a beam-mold test specimen.

BASIC SKILLS



EQUIPMENT AND SUPPLIES

- Clean, firm, level, nonabsorbent test surface

EXAMPLES: Smooth plank, concrete slab

- Standard beam mold

✓ **NOTE:** A standard beam mold is 6 inches wide and 6 inches deep; the length must be at least 2 inches greater than three times the depth (20 inches), or 3 times the nominal maximum coarse aggregate for aggregates larger than 2 inches.

- Tamping rod

✓ **NOTE:** The tamping rod for this test is a smooth, $\frac{5}{8}$ -inch-by-24-inch, bullet-nosed (hemispherical-tipped) steel rod.

- Suitable storage area

✓ **NOTE:** For initial curing, beam molds must be stored as near as practical to the testing area and in a place where the specimens will be protected from moisture loss and temperatures can be maintained in a range of from 60°F to 80°F.

- Scoop
- Shovel
- Container of water
- Rubber or rawhide mallet
- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Moisture-proof material for covering mold specimen

EXAMPLES: Nonabsorptive, nonreactive plate; tough, durable, impervious plastic



- Pencil or pen
- Specimen tag or marker
- Wood or metal float
- Form release agent
- Personal protective equipment

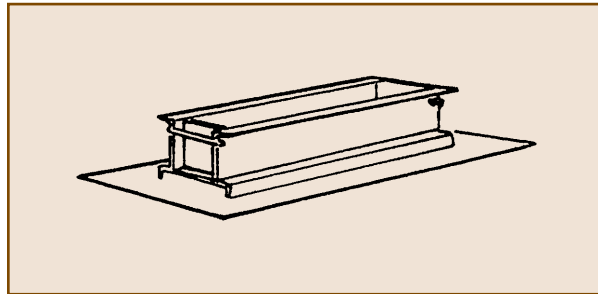
✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Yes No

1. Obtain representative concrete from the test sample. (See Job Sheet 1)
2. Place the beam mold on the test surface. (Figure 1)

FIGURE 1



3. Coat the mold with form release.

✓ **NOTE:** Form release keeps the concrete from sticking to the mold.

4. Fill the beam mold with concrete to about one-half the mold's capacity, distributing concrete around the inside perimeter of the mold.
5. Rod the concrete 60 times, using the following procedures:

✓ **NOTE:** On a 20X6 inch beam mold, use one stroke for each 2 inches of surface area.

$$6 \times 20 = 120 \qquad 120 \div 2 = 60$$

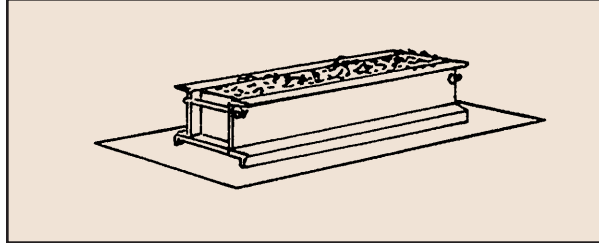
- a. Use an up-and-down motion of the rod, rodding the layer throughout its depth.
- b. Distribute strokes evenly over the cross section of the mold.
6. Tap sides of the mold with the mallet to close any voids left by the tamping rod.



Yes No

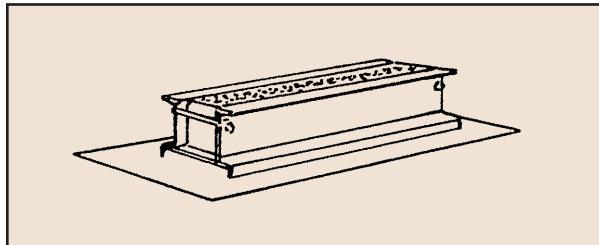
- 7. Spade the sides and ends of the mold with the trowel.
- 8. Fill the beam mold to overflowing with concrete. (Figure 2)

FIGURE 2



- 9. Rod the concrete 60 times, following procedures in Step 5.
- 10. Tap the sides of the mold with the mallet to close any voids left by the tamping rod.
- 11. Spade the sides of the mold with the trowel.
- 12. Level the top of the mold and finish the specimen with a float as required. (Figure 3)

FIGURE 3



- 13. Tag the specimen, noting the time, date, location of test and strength and slump of concrete.
- 14. Cover the top of the specimen with moisture-proof material.
- 15. Clean excess concrete from around the beam mold.
- 16. Lift and support specimen from the bottom of the mold; carefully transport the specimen to storage area.



CAUTION: Leave the mold undisturbed to cure in the storage area for at least twenty-four hours, and even after the initial curing period, handle the mold carefully to avoid damage to the specimen.



Yes No

17. Clean test area and tools, and properly store tools and materials.

PRODUCT EVALUATION

SKILL TEST RECORD

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
Followed procedures	4	3	2	1

AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

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- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS



Name _____ Score _____

OBJECTIVE 10

Perform a volumetric-method air content test.

WORDS YOU SHOULD KNOW

meniscus curved surface at the top of a column of water

BASIC SKILLS



Reading



Science



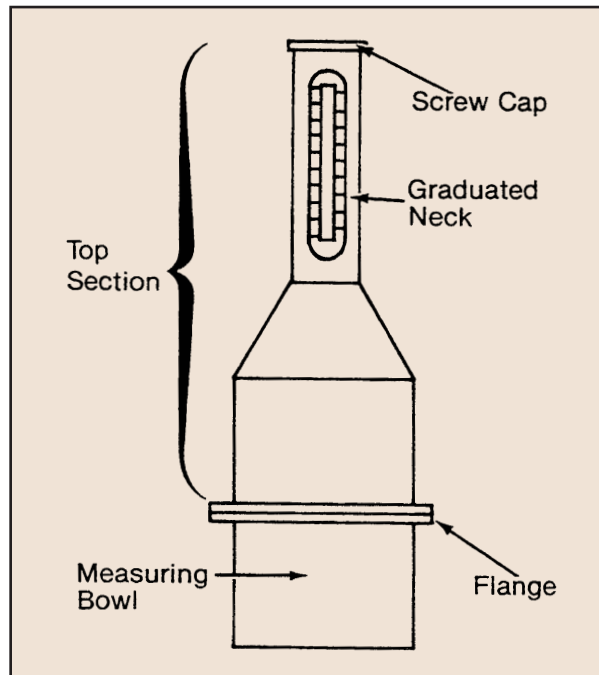
Employability

EQUIPMENT AND SUPPLIES

- Standard volumetric air meter (Figure 1)

✓ **NOTE:** The standard air meter is made of machined metal or plastic and consists of a bottom section (the measuring bowl) and a top section with a glass or transparent-plastic neck graduated from 0 at the top to at least 9 percent of the volume of the measuring bowl. The measuring bowl has a flange at or near the top surface. The upper end of the neck in the top section is threaded and equipped with a screw cap and gasket to make the cap water-tight.

FIGURE 1



- Metal funnel

✓ **NOTE:** The spout of the funnel must be the size that can be inserted into the neck of the top section of the air meter.

- Tamping rod

✓ **NOTE:** The tamping rod for this procedure is smooth, $\frac{5}{8}$ -inch-by-12-inch, bullet-nosed (hemispherical-tipped) steel rod.

- Strike-off bar

✓ **NOTE:** The strike-off bar for this procedure is flat, straight, $\frac{1}{8}$ -inch-by- $\frac{3}{4}$ -inch-by-12-inch steel bar.

- Measuring cup

✓ **NOTE:** The volume of the measuring cup must be 1.0 percent of the volume of the air meter's bowl.

- Pouring vessel

✓ **NOTE:** The metal or glass pouring vessel should have a capacity of at least 1 quart.

- Small rubber-bulb syringe
- Margin trowel
- Small metal scoop
- 70 percent isopropyl alcohol

✓ **NOTE:** Seventy percent isopropyl alcohol is commonly available as rubbing alcohol.

- Container of water
- Rubber or rawhide mallet
- Clean, firm, level test surface

✓ **NOTE:** EXAMPLE: Smooth plank

- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Clean cloth
- Pencil or pen
- Chart for recording test results
- Wood or metal float
- Personal protective equipment

✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.



PROCEDURE

Yes No

1. Obtain a representative concrete test sample. (See Job Sheet 1)
2. Dampen the air-meter measuring bowl.
3. Place the bowl on the test surface.
4. Fill the bowl with concrete to about one-third the bowl's capacity, distributing the concrete spirally around the inside perimeter of the bowl.
5. Insert the tamping rod in the bowl, and rod the concrete 25 times, using the following procedures:
 - a. Use an up-and-down motion of the rod, rodding the layer throughout its depth but making sure the rod does not forcibly strike the bottom of the bowl.
 - b. Distribute the strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the bowl.
6. Tap the sides of bowl smartly 15 times with the mallet.

✓ NOTE: Tapping the sides of the bowl closes any voids left by the tamping rod and releases any large bubbles of air that may have been trapped in the concrete.
7. Fill the next one-third of the bowl with concrete, distributing concrete spirally around the inside perimeter of bowl.
8. Rod the concrete 25 times, using the following procedures:
 - a. Use an up-and-down motion of the rod, making the rod just penetrate into the underlying layer of concrete.
 - b. Distribute strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the bowl.
9. Tap the sides of the bowl smartly 15 times with the mallet.
10. Fill the last one-third of the bowl with concrete, but *do not* overflow the bowl.



Yes No

- 11. Rod the concrete 25 times, following procedures in Step 8.
- 12. Tap the sides of the bowl smartly 15 times with the mallet.
- 13. Strike off the excess concrete with the bar until the surface is flush with the top of the bowl.
- 14. Wipe the bowl flange clean.
- 15. Clamp the top section of the air meter into position on the bowl.
- 16. Insert the funnel into the neck of the top section.
- 17. Add water until you can see water in the neck of the meter.
- 18. Remove the funnel.
- 19. Adjust the water level with a syringe until the bottom of the meniscus is level with the zero mark on the scale.
- 20. Attach and tighten the screw cap.
- 21. Invert and agitate the air meter until the concrete settles free from the base.
- 22. Elevate the neck of the air meter and roll and rock until air appears to have been removed from the concrete.
- 23. Set the air meter upright, shake lightly, and then allow it to stand until air rises to the top.
- 24. Repeat Step 22 until the water level in the column remains constant (until the water level no longer drops).
- 25. Remove the screw cap when all the air has been removed from the concrete.
- 26. Add isopropyl alcohol in 1-cup increments until foam dissipates on the surface of the water.
- 27. Record the number of cups of isopropyl alcohol required to dissipate the foam.
- 28. Reading to the bottom of meniscus, read the level of liquid on the scale to the nearest 0.1 percent.
- 29. Record the reading.



Yes No

- 30. Notify the contractor and ready mix provider or job engineer of results—modify proportions if necessary.
- 31. Clean test area and tools, and properly store tools and materials.

SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
Followed procedures	4	3	2	1

AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

- 4 Skilled** — Can perform job with no additional training
- 3 Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS





Name _____ Score _____

OBJECTIVE 11

Perform a pressure-method air content test using a Type B air meter.

BASIC SKILLS



Reading



Science



Employability

INTRODUCTION

A Type-B air meter is made of steel or some other hard metal and consists of a measuring bowl and pressure-tight cover assembly with a calibrated pressure gauge.

EQUIPMENT AND SUPPLIES

- Standard Type-B air meter (Figures 1 and 2)

FIGURE 1

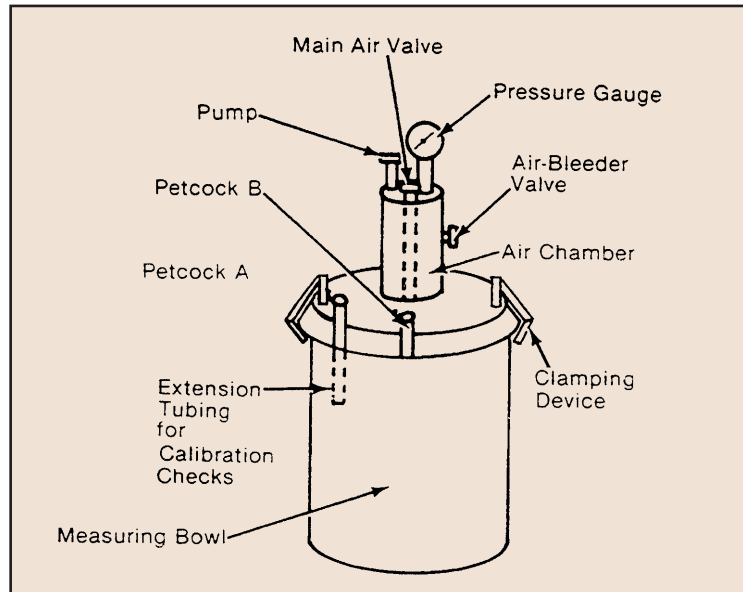


FIGURE 2



- Tamping rod

✓ **NOTE:** The tamping rod for this procedure is smooth, $\frac{5}{8}$ -inch-by-24-inch, bullet-nosed (hemispherical-tipped) steel rod.

- Scoop
- Clean, firm, level test surface

EXAMPLE: Smooth plank

- Rubber or rawhide mallet
- Strike-off bar

✓ **NOTE:** The strike-off bar for this procedure is a flat, straight, $\frac{1}{8}$ -inch-by- $\frac{3}{4}$ -inch-by-12-inch steel bar.

- Container of water
- Clean cloth
- Rubber syringe



- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Pencil or pen
- Chart for recording test results
- Personal protective equipment

✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Yes No

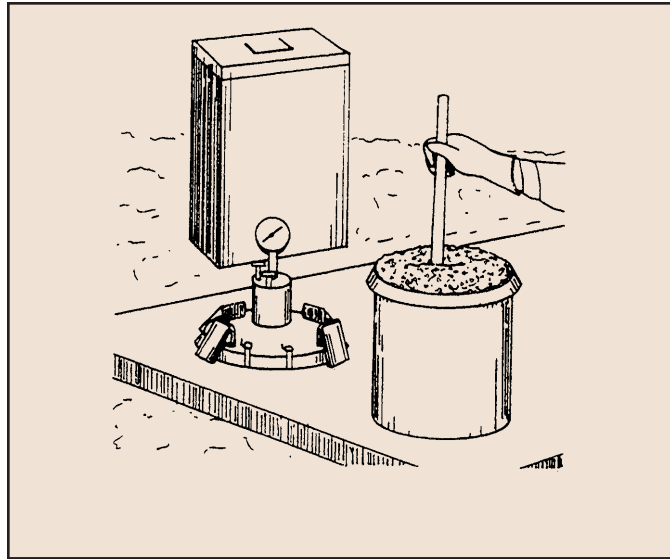
- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | 1. Obtain a representative concrete test sample. (See Job Sheet 1) |
| <input type="checkbox"/> | <input type="checkbox"/> | 2. Place the measuring bowl on the test surface. |
| <input type="checkbox"/> | <input type="checkbox"/> | 3. Dampen the inside of the measuring bowl. |
| <input type="checkbox"/> | <input type="checkbox"/> | 4. Fill the measuring bowl with concrete to about one-third the bowl's capacity, distributing the concrete spirally around the inside perimeter of bowl. |
| <input type="checkbox"/> | <input type="checkbox"/> | 5. Insert the tamping rod in the bowl, and rod the concrete 25 times, using the following procedures: |
| <input type="checkbox"/> | <input type="checkbox"/> | a. Use an up-and-down motion of the rod, rodding the layer throughout its depth but making sure the rod does not forcibly strike the bottom of the bowl. |
| <input type="checkbox"/> | <input type="checkbox"/> | b. Distribute the strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the bowl. |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. Tap the sides of the bowl smartly 10 to 15 times with the mallet to close any voids left by the tamping rod. |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. Fill next one-third of bowl with concrete, distributing concrete spirally around inside perimeter of bowl. |
| <input type="checkbox"/> | <input type="checkbox"/> | 8. Rod the concrete 25 times, using the following procedures: |
| <input type="checkbox"/> | <input type="checkbox"/> | a. Use an up-and-down motion of the rod, making the rod penetrate about 1 inch into the underlying layer of concrete. |
| <input type="checkbox"/> | <input type="checkbox"/> | b. Distribute strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the bowl. |



Yes No

- 9. Tap the sides of the bowl smartly 10 to 15 times with the mallet to close any voids left by the tamping rod.
- 10. Fill the last one-third of the bowl with concrete, but *do not* overflow the bowl.
- 11. Rod the concrete 25 times, following procedures in Step 8. (Figure 3)

FIGURE 3



- 12. Tap the sides of the bowl smartly 10 to 15 times with the mallet to close any voids left by the tamping rod.
- 13. Using a sawing motion of the strike off bar, slide the bar across the rim of the bowl to level the concrete with top of the bowl.
- 14. Thoroughly clean the rim of the bowl and cover the assembly.

✓ **NOTE:** Cleaning the rim assures a pressure-tight seal when the cover assembly is clamped in place.

- 15. Moisten the inside of the cover assembly and its rubber seal.
- 16. Clamp on the cover assembly.
- 17. Close the air valve between the air chamber and the bowl.
- 18. Open petcocks A and B on the holes through the cover.



Yes No

- 19. Holding the syringe in one hand, inject water through petcock A until water comes out petcock B, while using your other hand to gently jar and tap the meter until no air bubbles come from petcock B.
- 20. Close the air-bleeder valve on the air chamber.
- 21. Pump air into the air chamber until the gauge hand reaches the initial pressure line.
- 22. Allow the compressed air to cool for a few seconds.
- 23. Stabilize the gauge hand to initial pressure by pumping or bleeding off air as necessary.
- 24. Close petcocks A and B on the holes through cover.
- 25. Open the air valve between the air chamber and the measuring bowl.
- 26. Tap the sides of the measuring bowl sharply to relieve local restraints.
- 27. Lightly tap the pressure gauge to stabilize the gauge hand.
- 28. Read the percentage of air on the pressure-gauge dial.
- 29. Record the reading.
- 30. Close the main valve, and *then* open both petcocks to release pressure.



CAUTION: Failure to close the main air valve before releasing the pressure from either the container or the air chamber will cause water to be drawn into the air chamber, resulting in an incorrect reading on the next measurement.

- 31. Remove the cover.
- 32. Notify the contractor and ready mix provider or job engineer of results—modify proportions if necessary.
- 33. Clean test area and tools, and properly store tools and materials.



SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
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Followed procedures	4	3	2	1
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AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

- 4 Skilled** — Can perform job with no additional training
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- 2 Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS



Name _____ Score _____

OBJECTIVE 12

Perform a temperature test.

BASIC SKILLS



EQUIPMENT AND SUPPLIES

- ASTM-approved thermometer (Figures 1 and 2)

✓ **NOTE:** An ASTM-approved thermometer is accurate to +1°F, readable to 0.5°F, and has a temperature range from 0.0°F to 120°F.

FIGURE 1

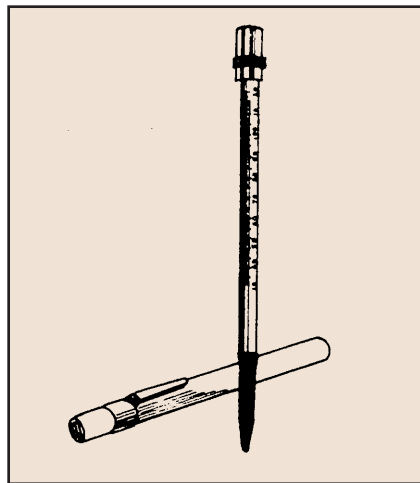
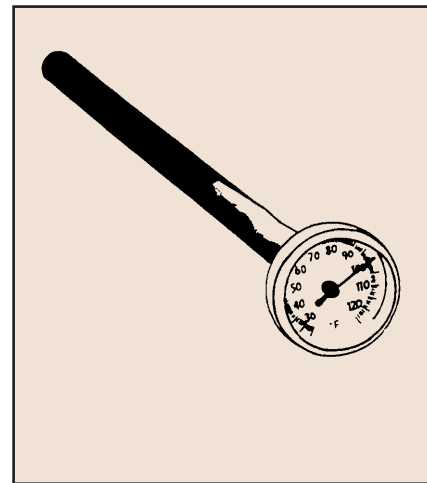


FIGURE 2



- Container of water
- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Pencil or pen
- Chart for recording test results
- Personal protective equipment

✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.



PROCEDURE

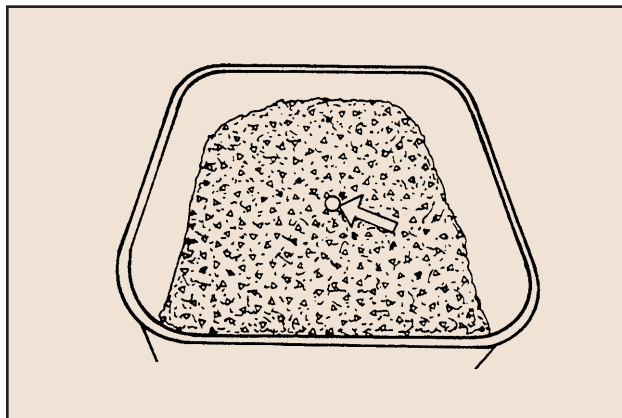
Yes No

1. Obtain a representative concrete test sample. (See Job Sheet 1)

✓ **NOTE:** The sample must be large enough to provide at least a 3-inch cover in all directions around the thermometer's sensor.

2. Insert the thermometer's sensor into the test concrete near the center of the sample. (Figure 3)

FIGURE 3



3. Gently press concrete around the thermometer.
4. Leave the thermometer undisturbed for at least *two minutes*, or until the temperature reading becomes stable.
5. Read the temperature to the nearest degree F.
6. Record the reading.

✓ **NOTE:** It is usually advisable to take more than one temperature reading. Additional sample readings can be taken, or readings can also be taken from placed concrete if they are taken immediately after the concrete has been placed.

7. Remove the thermometer from the test concrete.
8. Notify the contractor and ready mix provider or job engineer of results—modify proportions if necessary.
9. Clean test area and tools, and properly store tools and materials.



SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
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Followed procedures	4	3	2	1
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AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.

KEY

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- 1 Unskilled** — Is familiar with process, but is unable to perform job

EVALUATOR'S COMMENTS





Name _____ Score _____

OBJECTIVE 13

Perform a unit weight, yield, and air content test.

BASIC SKILLS



Reading



Mathematics



Science

EQUIPMENT AND SUPPLIES

- Balance or scale

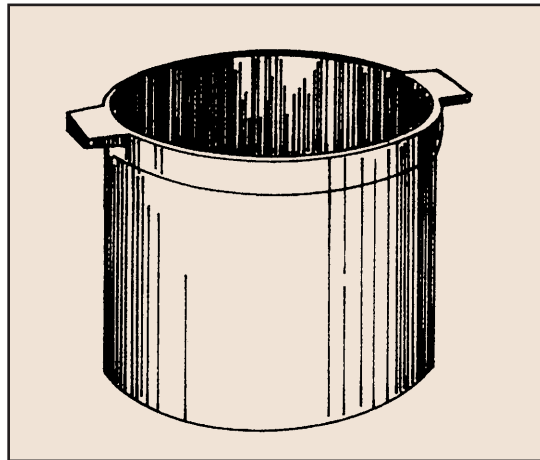
✓ **NOTE:** The balance or scale must be accurate within 0.1 percent of the test load at any point within range of use.

- Tamping rod

✓ **NOTE:** The tamping rod for this procedure is a smooth, 5/8-inch by 24-inch, bullet-nosed (hemispherical-tipped) steel rod.

- 0.5 cubic-foot (1/3 cubic foot for 1" nominal maximum, aggregate size), cylindrical metal measure with handles (Figure 1)

FIGURE 1



- Strike-off plate

✓ **NOTE:** The strike-off plate for this procedure may be metal, glass, or acrylic straightedge.

- Scoop



- Level, rigid, horizontal test surface

EXAMPLE: Smooth plank

- Gloves and protective clothing



CAUTION: Always wear gloves and protective clothing when working with fresh concrete.

- Pencil or pen
- Chart for recording test results
- Personal protective equipment

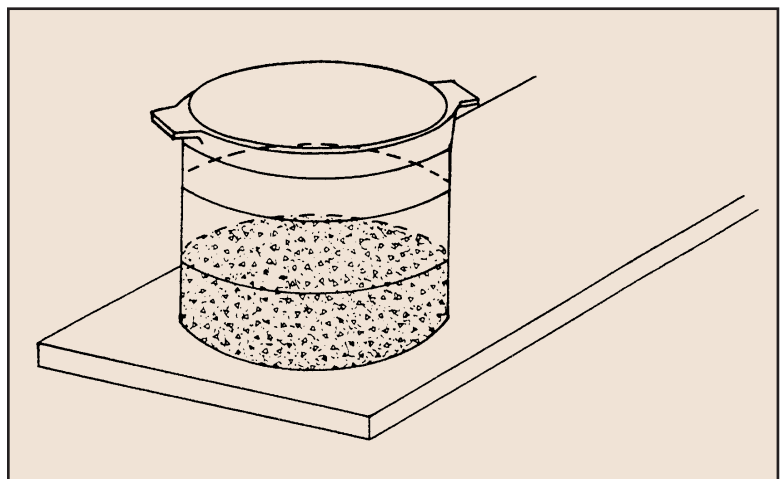
✓ **NOTE:** Refer to C.F.R. 1926.28 Sub Part C in regard to personal protective equipment.

PROCEDURE

Yes No

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | 1. Obtain a representative concrete test sample. (See Job Sheet 1) |
| <input type="checkbox"/> | <input type="checkbox"/> | 2. Place the balance on the test surface. |
| <input type="checkbox"/> | <input type="checkbox"/> | 3. Carefully place the empty measure on the balance. |
| <input type="checkbox"/> | <input type="checkbox"/> | 4. Read the weight of the empty measure. |
| <input type="checkbox"/> | <input type="checkbox"/> | 5. Record the weight of the empty measure. |
| <input type="checkbox"/> | <input type="checkbox"/> | 6. Return the measure to the test surface. |
| <input type="checkbox"/> | <input type="checkbox"/> | 7. Fill the measure with concrete to about one-third the measure's capacity, distributing concrete spirally around inside the perimeter of the measure. (Figure 2) |

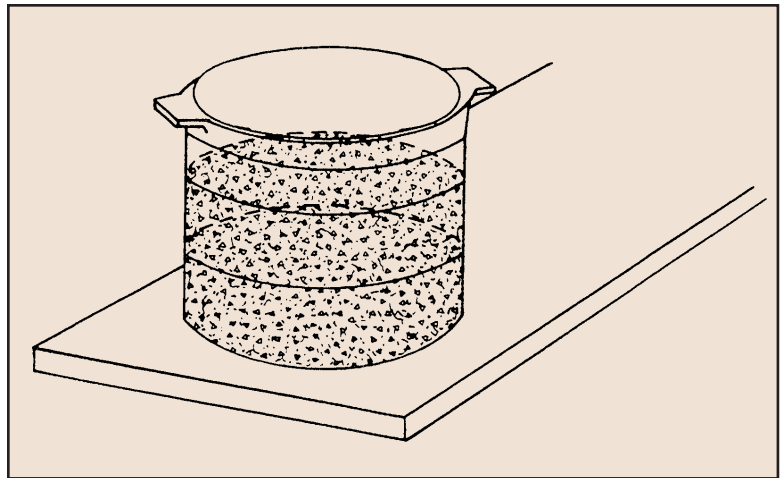
FIGURE 2



Yes No

- 8. Insert the tamping rod in the measure, and rod the concrete 25 times, using the following procedures:
 - a. Use an up-and-down motion of the rod, rodding the layer throughout its depth but making sure the rod does not forcibly strike the bottom of the measure.
 - b. Distribute the strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the measure.
- 9. Fill the next one-third of measure with concrete, distributing concrete spirally around the inside perimeter of the measure. (Figure 3)

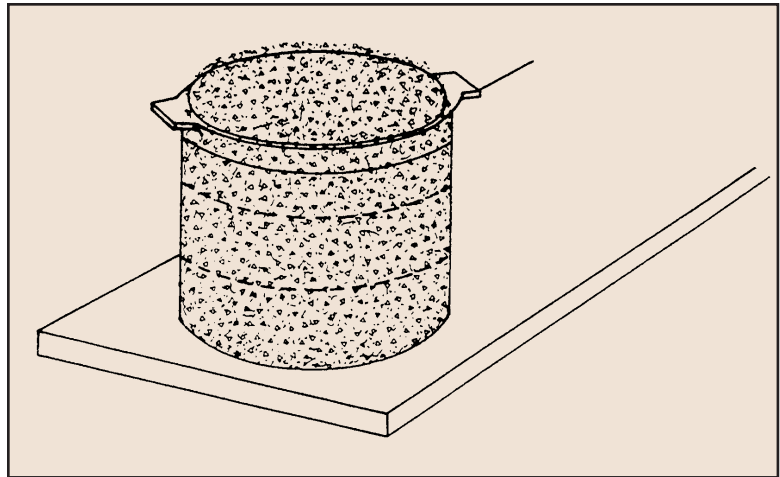
FIGURE 3



- 10. Rod the concrete 25 times, using the following procedures:
 - a. Use an up-and-down motion of the rod, making the rod just penetrate into the underlying layer of concrete.
 - b. Distribute strokes evenly by starting at the perimeter of the bowl and moving in a spiral toward the center of the measure.
- 11. Fill the measure to overflowing with concrete. (Figure 4)



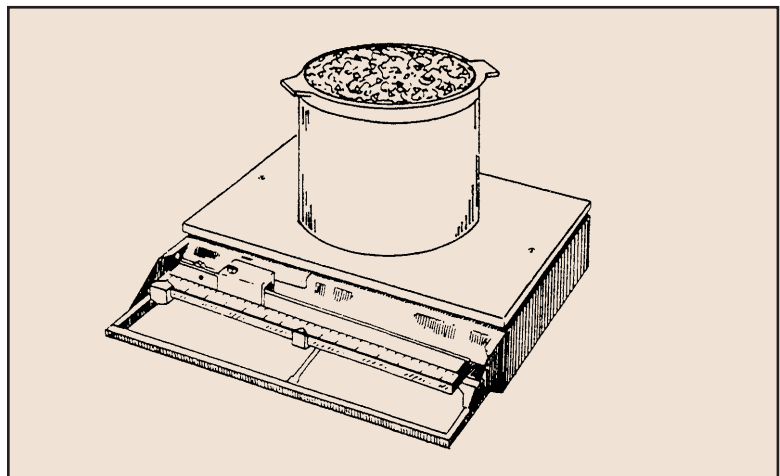
FIGURE 4



Yes No

- 12. Rod the concrete 25 times, following procedures in Step 10.
- 13. Strike off the concrete level with the top of the measure.
- 14. Clean excess test concrete away from the measure.
- 15. Carefully place the filled measure on the balance. (Figure 5)

FIGURE 5



- 16. Read the combined weight of the measure and its contents.
- 17. Record the combined weight to the nearest 0.1 percent.



Yes No

18. Calculate the unit weight of the concrete.
- a. Subtract the weight of the empty measure from the combined weight of the measure and its contents to obtain the weight of the concrete, using the formula:

Combined Weight of Measure and Its Contents —
Weight of Empty Measure = Weight of Concrete

- b. Multiply the weight of the concrete times 2 to obtain the unit weight (cubic-foot weight) of concrete, using the formula:

Weight of Concrete X 2 = Unit Weight of Concrete

✓ **NOTE:** If you are not using a ½ cubic foot container, multiply by the appropriate factor.

19. Record the unit weight of the concrete.
20. Notify the contractor and ready mix provider or job engineer of results—modify proportions if necessary.
21. Clean test area and tools, and properly store tools and materials.

SKILL TEST RECORD

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of “3” or higher to demonstrate student mastery. (See Key below.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Observed safety criteria	4	3	2	1
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Followed procedures	4	3	2	1
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AVERAGE RATING

Evaluator note: To obtain an average rating for the Profile of Training Mastery, total the points in Product Evaluation and divide by the total number of criteria. Circle the rating on the Key.



KEY

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**EVALUATOR'S
COMMENTS**

