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API 936 Refractory Personnel

API API-936

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QUESTION NO: 1

Each sample tested in accordance with ASTM C181 for workability index shall consist of how many specimens?

- A. 1
- B. 2
- C. 3
- D. 5

ANSWER: C

Explanation:

3 is correct. API Standard 936 specifies the quality-control requirements for refractory installation, including workability testing of applicable refractory materials. In its workability-testing requirements, API 936 states that each sample evaluated for workability index in accordance with ASTM C181 must consist of three specimens. Using three specimens provides a representative set of measurements for the sample and supports a more reliable determination of the material's workability index before or during installation. The requirement is therefore not simply a general laboratory preference; it is the defined sample composition required by the API 936 testing provision when ASTM C181 is used. ASTM C181 is the referenced standardized test method for determining the workability index of refractory plastics, while API 936 establishes how that method is applied within the refinery refractory quality-control program. Consult the applicable edition of API 936 and the incorporated ASTM method when verifying project requirements, because contractual documents may identify the governing editions. See the [API 936 standard information](#) and the [ASTM C181 standard page](#).

QUESTION NO: 2

When installing refractory castables in hot weather conditions, which of the following is acceptable? (This may have more than one correct answer; please select all that apply.)

- A. Air conditioning of ambient air
- B. Decreasing mixing time
- C. Shading of equipment and mix area
- D. Spraying water on equipment

ANSWER: A C D

Explanation:

Hot-weather refractory castable installation requires controls that limit heat gain and help keep material temperature and placement conditions within the manufacturer's specified limits. "Air conditioning of ambient air" is an acceptable preventive measure where practical because lowering the surrounding air temperature reduces the heat load on the refractory materials, equipment, and installed lining. "Shading of equipment and mix area" is also appropriate because it reduces direct solar radiation on dry material, forms, mixers, and work surfaces. "Spraying water on equipment" may be used to reduce radiant heat and cool exposed equipment; it should be managed so that unintended water is not introduced into the castable mix or placed lining. These measures align with API TR 980 hot-weather guidance, which identifies shading, cooling, air conditioning where needed, and water spraying of equipment as potential methods for controlling elevated-temperature installation conditions. The applicable project specification and refractory manufacturer's installation instructions remain essential for establishing mixing-water temperature, material temperature, working time, and curing requirements. See [API TR 980](#) and the [API 936 Refractory Personnel Certification](#) program information.

QUESTION NO: 3

A refractory manufacturer has acceptable material qualification data for a low-cement castable. The contractor proposes to install the material with a different crew and a different gunning machine than those used in the previous qualification. What additional demonstration is required before production installation?

- A. Additional material qualification testing only.
- B. Applicator qualification testing using the proposed crew and equipment.
- C. Acceptance based on the manufacturer's published data sheet.
- D. Acceptance after the first production area passes visual inspection.

ANSWER: B

Explanation:

Applicator qualification testing is required because material qualification and applicator qualification establish different capabilities. Material qualification demonstrates that the refractory formulation can meet specified physical-property requirements. Applicator qualification demonstrates that the personnel, equipment, and installation method can produce acceptable installed refractory.

Changing the crew or gunning equipment can affect placement, rebound, density, consolidation, and other installed properties. Existing material qualification data alone do not demonstrate that the revised production installation arrangement is capable of meeting the specified quality standards.

QUESTION NO: 4

Abrasion resistance of a material is reported as loss of:

- A. density.
- B. mass.
- C. volume.
- D. area.

ANSWER: C

Explanation:

The correct answer is **volume**. For refractory materials, abrasion resistance is commonly determined using ASTM C704, "Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperature." The test subjects a prepared refractory specimen to a controlled abrasive stream, typically silicon carbide grit, for a specified time. Abrasion resistance is then expressed as the amount of refractory removed from the specimen, reported as *volume loss*, ordinarily in cubic centimeters (cm³) or cubic inches (in³). This volume-based result provides a consistent measure of material removal even where refractory density differs among formulations. In API 936 work, abrasion testing is especially relevant to refractory linings exposed to erosive service, such as catalyst or particulate-containing process streams. A lower reported volume loss indicates that less material was removed during the standardized exposure and therefore reflects better abrasion resistance under the test conditions. ASTM's current standard listing for this method is available at [ASTM C704](#). API's refractory inspection and quality-control standard is listed at [API Standard 936](#).

QUESTION NO: 5

In accordance with TR 980, when curing a high-purity, low-cement castable for a high-temperature unit, which of the following sequences ensures minimum cracking risk?

- A. Steam curing for 48 hours followed by firing at 1500°F
- B. Air curing for 24 hours, followed by controlled heating ramp of 50°F/h up to 600°F

C. Accelerated drying using forced air at 400°F for 12 hours

D. Dryout using open flame burners after form removal

ANSWER: B

Explanation:

Air curing for 24 hours, followed by controlled heating ramp of 50°F/h up to 600°F is the appropriate sequence because a low-cement castable must first develop sufficient green strength through ambient curing before its retained and chemically bound water are driven off. A 24-hour air cure permits hydration of the cement binder and reduces the chance that the lining will be damaged while it is still mechanically weak. The subsequent controlled heat-up limits internal temperature gradients and, critically, allows water vapor to escape at a manageable rate. This is especially important in dense, high-purity low-cement materials, where restricted permeability can permit steam pressure to build within the lining during initial dryout. Maintaining a ramp no greater than 50°F (28°C) per hour through 600°F (316°C) provides a conservative, controlled transition through the principal moisture-removal range and helps minimize cracking risk. Dryout requirements must also be coordinated with the refractory manufacturer's written installation and heat-up instructions, since the exact holding points and schedule depend on lining thickness, geometry, anchoring, and the specific material formulation. API's refractory personnel program identifies API 936 as the governing inspection and quality-control standard; associated technical guidance supports controlled curing and dryout practices. See [API 936 Refractory Personnel Certification](#) and [API Standards](#).

QUESTION NO: 6

Which two statements correctly distinguish material qualification from applicator qualification for monolithic refractory work?

(Select two.)

A. Material qualification establishes that the refractory formulation can meet specified properties.

B. Material qualification eliminates the need for an installation mock-up.

C. Applicator qualification applies only to the manufacturer's laboratory personnel.

D. Applicator qualification demonstrates the capability of the personnel, equipment, and method.

ANSWER: A D

Explanation:

Material qualification concerns whether the refractory material can meet specified physical-property requirements when prepared and tested under the applicable qualification conditions. Applicator qualification concerns whether the proposed personnel, equipment, and installation method can produce work meeting the specified quality standards.

Neither qualification replaces the other. A satisfactory laboratory result does not establish field installation capability, and a successful applicator demonstration does not eliminate the need to verify that the selected material is qualified for the intended service.

QUESTION NO: 7 - (SIMULATION)

Test results received from cast sample mock-ups will serve to qualify the:

Options

mixing time. quality of the inspection equipment. installation procedures. mix water levels.

fabricator of the mock-up.

ANSWER: Check the explanation for the answer

Explanation:

Select:

Cast sample mock-up trials qualify the proposed material installation variables before production work, including the mixing duration, water addition level, and installation method. Do **not** select *quality of the inspection equipment* or *fabricator of the mock-up*.

QUESTION NO: 8

Hammer testing of a newly installed lining produces a distinctly hollow sound in several localized areas. Which two actions are appropriate for the inspector?

(Select two.)

- A. Identify and document the locations of the hollow indications.
- B. Refer the indications for evaluation and disposition.
- C. Increase hammer force until the sound becomes uniform.
- D. Apply repair material immediately without further evaluation.

ANSWER: A B

Explanation:

A hollow sound is an indication that may be associated with voids, poor bonding, or debonding; it is not, by itself, a final diagnosis. The inspector should identify and document the affected locations and communicate the indication for evaluation and disposition under the project quality procedures.

Increasing the force of hammer blows can damage the lining and does not establish the cause of the indication. Repairing or accepting the area without evaluation bypasses the required nonconformance and disposition process.