

BODY OF KNOWLEDGE FOR API-936 REFRACTORY PERSONNEL CERTIFICATION EXAMINATION

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API certified 936 refractory personnel must have knowledge of installation, inspection, testing and repair of refractory linings. The API 936 Personnel Certification Examination is designed to identify applicants possessing the required knowledge.

The examination consists of 75 multiple-choice questions; and runs for 4 hours; no reference information is permitted on the exam.

The examination focuses on the content of API STD 936 and other referenced publications.

REFERENCE PUBLICATIONS:

A. API Publications:

API Standard 936; 3rd Edition, Nov 2008 – Refractory Installation Quality Control Guidelines – Inspection and Testing Monolithic Refractory Linings and Materials.

B. ACI (American Concrete Institute) Publications:

These two documents are currently available as a .pdf file through the ACI bookstore. To access these two titles go to <http://www.concrete.org/bookstorenet/>. Select "Search for product that is: **Inactive**" and type **547** in the Order Code field.

547R-87 – State of the art report: Refractory Concrete

547.1R-89 – State of the art report: Refractory plastic and Ramming Mixes

C. ASTM (American Society for Testing and Materials) Publications:

C113-02 – Standard Test Method for Reheat Change of Refractory Brick
(Available at <http://www.astm.org/Standards/C113.htm>)

C133-97 – Standard Test Methods for Cold Crushing Strength and Modulus of Rupture of Refractories (Available at <http://www.astm.org/Standards/C133.htm>)

C181-09 – Standard Test Method for Workability Index of Fireclay and High-Alumina Plastic Refractories (Available at <http://www.astm.org/Standards/C181.htm>)

C704-01 - Standard Test Method for Abrasion Resistance of Refractory Materials at Room Temperatures (Available at <http://www.astm.org/Standards/C704.htm>)

Candidates are expected to demonstrate knowledge in the following categories:

1. Laboratory Testing Procedures

The test questions may be based on the following topics:

1. Terms and definitions
2. Test methods (e.g., C704, CCS, PLC, Density) and related calculations
3. Material Qualification
4. Testing equipment, sample preparation techniques, dimensional requirements for test specimens
5. Various materials utilized (for example, plastic, ceramic fiber, anchor, metal fiber, corrosion coatings, etc.)
6. Curing and firing procedures
7. Acceptance/rejection criteria
8. Responsibilities of personnel and documentation requirements.

2. Applicator and Material Qualification

The test questions may be based on the following topics:

1. Installation methods (e.g., gunning, casting, ramming, and hand packing)
2. Sampling and sample preparation procedures
3. Terms and definitions
4. Procedures for determining optimal water content and mixing
5. Applicable formulation and manufacturing information
6. Applicable knowledge of equipment and qualification process
7. Applicable test panel/mock-up requirements
8. Applicable environmental controls
9. Surface preparation requirements
10. Responsibilities of personnel and documentation requirements

3. Installation

The test questions may be based on the following topics:

1. Terms and definitions
2. Responsibilities of personnel and documentation requirements
3. Knowledge of detailed execution plan including design details and quality standards
4. Packaging and storage requirements
5. Surface preparation and cleanliness requirements
6. Anchor: welding, layouts, patterns, materials
7. Frequency and methods of production sampling: gunning, casting, hand packing
8. Water addition: quantity and temperature, mixing procedures
9. Fiber addition: percentage, material, mixing

10. Installation environmental controls (minimum and maximum temperatures)
11. Guniting procedures and equipment, including variables that affect guniting quality (i.e., air pressure, humidity, temperature, aging, water pressure, water purity, additives)
12. Knowledge of flash set
13. Casting procedures and equipment (e.g., air vibrator, vibrator frequency, vibrator sizing, forming, setup)
14. Ramming / Hand packed procedures and equipment

4. Inspection

The test questions may be based on the following topics:

1. Terminology, job specifications, application standards
2. Inspection and data collection procedures
3. Lining design and installation requirements
4. Visual and non-destructive test methods and qualification testing methods
5. Application/limitation for various inspection techniques (for example, hammer testing, sonic testing, radiography, core sampling, portable abrasion testing)
6. Material verification and traceability
7. Acceptance and rejection criteria
8. Repair procedures
9. Curing and dry out procedures
10. Inspectors' and contractors' responsibilities
11. Record keeping systems and requirements

5. Post-Installation

The test questions may be based on the following topics:

1. Terms and definitions
2. Responsibilities of personnel and documentation requirements
3. Knowledge of dryout requirements
4. Sealing requirements (for example, water mist, covering, membrane, curing)
5. Application and time limits for applying membrane curing compounds
6. Environmental conditions required for curing
7. Heating equipment, methods and procedures (e.g., gas fired burner, stress relieving heating elements)
8. Placement of temperature sensing probes
9. Knowledge of manufacturer's recommended heatup and cool down schedules
10. Applicable heating rates for various classes of refractories
11. Lining integrity inspection techniques