Inspection and Assessment of Refractory Linings

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Should: As used in a standard, "should" denotes a recommendation or that which is advised but not required to conform to the standard.

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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Important Information Concerning Use of Asbestos or Alternative Materials

Asbestos is specified or referenced for certain components of the equipment described in some API standards. It has been of extreme usefulness in minimizing fire hazards associated with petroleum processing. It has also been a universal sealing material, compatible with most refining fluid services.

Certain serious adverse health effects are associated with asbestos, among them the serious and often fatal diseases of lung cancer, asbestosis, and mesothelioma (a cancer of the chest and abdominal linings). The degree of exposure to asbestos varies with the product and the work practices involved.

Consult the most recent edition of the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Occupational Safety and Health Standard for Asbestos, Tremolite, Anthophyllite, and Actinolite, 29 *Code of Federal Regulations* Section 1910.1001; the U.S. Environmental Protection Agency, National Emission Standard for Asbestos, 40 *Code of Federal Regulations* Sections 61.140 through 61.156; and the U.S. Environmental Protection Agency (EPA) rule on labeling requirements and phased banning of asbestos products (Sections 763.160–179).

There are currently in use and under development several substitute materials to replace asbestos in certain applications. Manufacturers and users are encouraged to develop and use effective substitute materials that can meet the specifications for, and operating requirements of, the equipment to which they would apply.

SAFETY AND HEALTH INFORMATION WITH RESPECT TO PARTICULAR PRODUCTS OR MATERIALS CAN BE OBTAINED FROM THE EMPLOYER, THE MANUFACTURER OR SUPPLIER OF THAT PRODUCT OR MATERIAL, OR THE MATERIAL SAFETY DATASHEET.

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Inspection and assessment of refractory linings requires specific skills, knowledge, and experience. As refractory repair work progresses, additional deterioration of the refractory in equipment may be discovered which necessitates a reassessment of the repair scope.

Safety of the refractory inspection team member(s) shall always be considered a priority. Hazardous scenarios may exist with refractory linings that have not been thoroughly assessed for safety and security.

There is no substitute for field experience in the inspection and assessment of refractory linings. Literature, such as this document, provides information that needs to be applied to real inspection and assessment situations to develop the skills of a Refractory Inspector.

Users of this recommended practice should be aware that further or differing requirements may be needed for individual applications. This practice is not intended to inhibit a Manufacturer from offering, or the owner from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the Manufacturer should identify any variations to this standard and provide details.

In API Standards, the SI system of units is used. In this standard, where practical, U.S. customary (USC) units are included in parenthesis for information.

Inspection and Assessment of Refractory Linings

1 Scope

This recommended practice (RP) provides recognized industry practices, requirements, and guidance for the installation, in-service inspection, and repair assessment of refractory lining installed into equipment that is used in general refinery services. Refinery equipment included in the scope of this standard includes, but may not be limited to, Fluid Solids Units—including Fluid Catalytic Cracker Units (FCCUs), Reforming Units, Fired Heaters, Incinerators, Sulfur Recovery Units, Flue Gas Ducts, Calciners, Steam-Methane Reformers (SMRs), Cracke Furnaces, Boilers, Hydrogen plant and transfer lines, and Flue Gas Stacks.

Inspection and quality control for design and installation of new, patch repair or replacement lining systems are covered in separate API documents, including:

— API Standard 936, *Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials*

— API Standard 975, *Refractory Installation Quality Control—Inspection and Testing of Refractory Brick Systems and Materials*

— API Standard 976, *Refractory Installation Quality Control—Inspection and Testing of Fiber Linings and Material*

Proper inspection and assessment of the refractory linings is essential to maintain equipment reliability, operating efficiency, personnel safety, and operational process safety. Observations are based on internal visual inspection. Refractory may be installed into refinery equipment for one, or a combination of, several reasons:

a) Thermal protection of equipment—Refractory can protect the structural components of the process equipment from a variety of thermal degradation mechanisms, such as, high temperature oxidation, thermal fatigue, carburization, creep, sulfidation, high temperature hydrogen attack, graphitization, and others.

b) Process efficiency and energy retention—Refractory can retain heat inside the equipment which improves the efficient operation of the refinery unit and reduces thermal energy losses to the atmosphere.

c) Resistance to abrasive process—Severe erosion can occur in some refinery equipment, and refractory linings can help reduce abrasive damage to the equipment.

d) Resistance to corrosion—Refractory linings can, in some cases, reduce the rate of damaging reactions by corrosive compounds in the process on the containment vessel, duct, firebox or pit.

e) Personnel safety—The internal temperature of equipment can be very high, and refractory can be used to reduce the external equipment temperature to a lower level to help prevent personnel injury.

2 References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Standard 936, *Refractory Installation Quality Control—Inspection and Testing Monolithic Refractory Linings and Materials.*

API Standard 560, *Fired Heaters for General Refinery Service*

API Standard 975, *Refractory Installation Quality Control—Inspection and Testing, Brick Systems and Materials*