Reforming Furnaces for Hydrogen and Synthesis Gas Production in General Refinery and Petrochemical Services

API STANDARD 561
FIRST EDITION, FEBRUARY 2026



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Introduction

Steam reforming for the production of hydrogen and synthesis gas is a process where steam and a hydrocarbon (most commonly methane) are heated in a high-temperature furnace in the presence of catalyst. The reformer furnace differs from general fired process heaters for refinery services due to the presence of catalyst and the chemical reactions inside the tubes. The reforming reaction is endothermic, which requires high process operating temperatures, higher firebox temperatures, and correspondingly higher furnace flue gas outlet temperatures than typically experienced in fired process heaters for general refinery service. The residual heat in the flue gas is recovered in a convection section typically preheating the feed/process fluid, providing steam generation and steam superheating and/or heating combustion air. The specification of a steam reformer furnace addresses both the production of the synthesis gas and the heat integration and recovery of available residual heat.

In most cases, steam reforming is associated with a technology licensed process and associated with many proprietary designs and materials. This standard is not intended to supersede any requirements of licensor-supplied information. This standard is not intended to promote or restrict the use of any specific licensed design or material. This standard covers several firing configurations such as, but not limited to, multilevel up-fired, top-fired, bottom-fired, and side-fired designs. This standard does not include upstream or downstream reforming equipment (pre-reformers, post-reformers, secondary reformers, or autothermal reformers) nor process gas boilers.

API Standard 560, *Fired Heaters for General Refinery Service*, is considered integral to the use and technical requirements of this standard with reference and amending requirements as noted. Auxiliary equipment, such as air-preheat systems, fans, stacks, post combustion selective catalytic reduction, etc. is addressed in other API documents and referenced accordingly in this standard.

Several annexes to this standard provide information and guidance to an owner for integrity management of new and existing reformer equipment and components over the life of the equipment. These annexes include Annex E—Pre-commissioning Inspection, Annex F—Onstream Inspection and Testing, Annex G—Turnaround Reformer Inspections, and Annex H—Fitness-For-Service and Remaining Life Assessment.

Users of this standard should be aware that further or differing requirements may be needed for individual applications. This standard is not intended to inhibit a supplier from offering or the purchaser 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 supplier shall identify any variations from 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 parentheses for information.

A bullet [●] at the beginning of a section or subsection indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on datasheets (see Annex B), on the purchaser's checklist (see Annex C), or stated in the inquiry or purchase order.

Reforming Furnaces for Hydrogen and Synthesis Gas Production in General Refinery and Petrochemical Services

1 Scope

This standard specifies the requirements and recommendations for the design, materials, fabrication, inspection, testing, preparation for shipment, and erection unique to direct-fired steam-reforming furnaces for hydrogen and synthesis gas production (steam hydrocarbon reformers) in refining and chemical plant applications.

2 Normative 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 530, *Calculation of Heater-tube Thickness in Petroleum Refineries*

API Standard 535, *Burners for Fired Heaters for General Refinery Services*

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

API Standard 582, *Welding Guidelines for the Chemical, Oil, and Gas Industries*

API Standard 673, *Centrifugal Fans for Petroleum, Chemical, and Gas Industry Services*

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 AES/RCF Fiber Linings and Materials*

AISC [1], *Steel Construction Manual*

ANSI [2]/ISA-5.1 [3], *Instrumentation and Control—Symbols and Identification*

ASME B31.3 [4], *Process Piping*

ASTM A530/A530M [5], *Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe*

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1 American Institute of Steel Construction, 130 East Randolph, Suite 2000, Chicago, IL 60601, www.aisc.org.
2 American National Standards Institute, 1180 Avenue of the Americas 10th Floor, New York, NY 10036, www.ansi.org.
3 The International Society of Automation, PO Box 12277, Research Triangle Park, NC, 22709, www.isa.org.
4 American Society of Mechanical Engineers, Two Park Ave, New York, NY 10016, www.asme.org.
5 ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428, www.astm.org.