

# Fired Heaters for General Refinery Service

ANSI/API STANDARD 560  
FOURTH EDITION, AUGUST 2007

**ISO 13705:2006 (Identical), Petroleum, petrochemical and natural gas industries—Fired heaters for general refinery service**





## Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

*Copyright © 2007 American Petroleum Institute*

## **API Foreword**

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

Suggested revisions are invited and should be submitted to the Standards and Publications Department, API, 1220 L Street, NW, Washington, DC 20005, [standards@api.org](mailto:standards@api.org).

# Contents

Page

API Foreword .....	ii
Foreword .....	v
Introduction.....	vi
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	4
4 General .....	11
4.1 Pressure design code .....	11
4.2 Regulations .....	11
4.3 Heater nomenclature.....	11
5 Proposals .....	15
5.1 Purchaser's responsibilities.....	15
5.2 Vendor's responsibilities.....	15
5.3 Documentation.....	15
5.4 Final records .....	17
6 Design considerations .....	17
6.1 Process design .....	17
6.2 Combustion design .....	18
6.3 Mechanical design.....	18
7 Tubes .....	19
7.1 General .....	19
7.2 Extended surface.....	20
7.3 Materials .....	21
8 Headers.....	21
8.1 General .....	21
8.2 Plug headers .....	22
8.3 Return bends.....	23
8.4 Materials .....	23
9 Piping, terminals and manifolds .....	24
9.1 General .....	24
9.2 Allowable movement and loads.....	25
9.3 Materials .....	27
10 Tube supports.....	27
10.1 General .....	27
10.2 Loads and allowable stress.....	28
10.3 Materials .....	29
11 Refractories and insulation .....	30
11.1 General .....	30
11.2 Brick and tile construction .....	31
11.3 Castable construction.....	32
11.4 Ceramic-fibre construction.....	32
11.5 Multi-component lining construction .....	34
11.6 Materials .....	34

<b>12</b>	<b>Structures and appurtenances .....</b>	<b>35</b>
12.1	General.....	35
12.2	Structures .....	35
12.3	Header boxes, doors and ports.....	36
12.4	Ladders, platforms and stairways.....	36
12.5	Materials .....	37
<b>13</b>	<b>Stacks, ducts and breeching .....</b>	<b>38</b>
13.1	General.....	38
13.2	Design considerations .....	38
13.3	Design methods .....	39
13.4	Static design.....	40
13.5	Wind-induced vibration design .....	41
13.6	Materials .....	42
<b>14</b>	<b>Burners and auxiliary equipment.....</b>	<b>42</b>
14.1	Burners .....	42
14.2	Sootblowers .....	47
14.3	Fans and drivers .....	47
14.4	Dampers and damper controls for stacks and ducts.....	47
<b>15</b>	<b>Instrument and auxiliary connections .....</b>	<b>48</b>
15.1	Flue gas and air.....	48
15.2	Process fluid temperature .....	49
15.3	Auxiliary connections.....	49
15.4	Tube-skin thermocouples .....	50
15.5	Access to connections.....	50
<b>16</b>	<b>Shop fabrication and field erection.....</b>	<b>50</b>
16.1	General.....	50
16.2	Structural-steel fabrication .....	51
16.3	Coil fabrication .....	52
16.4	Painting and galvanizing.....	53
16.5	Refractories and insulation .....	53
16.6	Preparation for shipment .....	54
16.7	Field erection.....	55
<b>17</b>	<b>Inspection, examination and testing.....</b>	<b>55</b>
17.1	General.....	55
17.2	Weld examination .....	55
17.3	Castings examination.....	56
17.4	Examination of other components.....	57
17.5	Testing .....	58
<b>Annex A</b>	<b>(informative) Equipment data sheets.....</b>	<b>60</b>
<b>Annex B</b>	<b>(informative) Purchaser's checklist .....</b>	<b>89</b>
<b>Annex C</b>	<b>(informative) Proposed shop-assembly conditions .....</b>	<b>93</b>
<b>Annex D</b>	<b>(normative) Stress curves for use in the design of tube-support elements .....</b>	<b>95</b>
<b>Annex E</b>	<b>(normative) Centrifugal fans for fired-heater systems.....</b>	<b>111</b>
<b>Annex F</b>	<b>(normative) Air preheat systems for fired-process heaters .....</b>	<b>128</b>
<b>Annex G</b>	<b>(informative) Measurement of efficiency of fired-process heaters .....</b>	<b>186</b>
<b>Annex H</b>	<b>(informative) Stack design .....</b>	<b>253</b>
<b>Bibliography</b>	<b>.....</b>	<b>263</b>

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13705 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

This second edition cancels and replaces the first edition (ISO 13705:2001), which has been technically revised.

## Introduction

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit a vendor 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 vendor should identify any variations from this International Standard and provide details.

In International Standards, the SI system of units is used. Where practical in this International Standard, US Customary (USC) units are included in brackets for information.

A bullet (●) at the beginning of a clause or subclause indicates that either a decision is required or further information is to be provided by the purchaser. This information should be indicated on data sheets (see examples in Annex A) or stated in the enquiry or purchase order. Decisions should be indicated on a check list (see example in Annex B).



# Petroleum, petrochemical and natural gas industries — Fired heaters for general refinery service

## 1 Scope

This International Standard specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing, preparation for shipment, and erection of fired heaters, air preheaters, fans and burners for general refinery service.

This International Standard is not intended to apply to the design of steam reformers or pyrolysis furnaces.

## 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.

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 1940-1:2003, *Mechanical vibration — Balance quality requirements for rotors in a constant (rigid) state — Part 1: Specification and verification of balance tolerances*

ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 10684, *Fasteners — Hot dip galvanized coatings*

ISO 13704, *Petroleum, petrochemical and natural gas industries — Calculation of heater-tube thickness in petroleum refineries*

ISO 15649, *Petroleum and natural gas industries — Piping*

IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

EN 10025-2:2004<sup>1)</sup>, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

ABMA Standard 9<sup>2)</sup>, *Load Ratings and Fatigue Life for Ball Bearings*

AMCA 210<sup>3)</sup>, *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating*

AMCA 801:2001, *Industrial Process/Power Generation Fans — Specifications and Guidelines*

API 673<sup>4)</sup>, *Centrifugal Fans for Petroleum, Chemical and Gas Industry Services*

---

1) European Committee for Standardization (CEN), Rue de Stassart 36, B-1050 Brussels, Belgium.

2) American Bearing Manufacturers Association, 2025 M. Street, NW, Suite 800, Washington, DC 20036, USA.

3) Air Movement and Control Association, 30 West University Drive, Arlington Heights, IL 60004, USA.

4) American Petroleum Institute, 1220 L Street NW, Washington, DC 20005-4070, USA.