

Shell-and-tube Heat Exchangers

ANSI/API STANDARD 660
EIGHTH EDITION, AUGUST 2007

ISO 16812:2007 (Identical), Petroleum, petrochemical
and natural gas industries—Shell-and-tube Heat
Exchangers



Currently in preview, click buy full version

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 substitute 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.

Contents

Page

API Foreword	ii
Foreword	v
Introduction.....	i
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions	2
4 General	3
5 Proposals	3
6 Drawings and other required data.....	4
6.1 Outline drawings and other supporting data.....	4
6.2 Information required after outline drawings are reviewed.....	5
6.3 Reports and records	6
7 Design.....	7
7.1 Design temperature.....	7
7.2 Cladding for corrosion allowance	7
7.3 Shell supports.....	7
7.4 Stationary head.....	8
7.5 Floating head	8
7.6 Tube bundle	9
7.7 Nozzles and other connections	12
7.8 Flanged external girth joints	13
7.9 Expansion joints.....	13
7.10 Gaskets.....	14
7.11 Handling devices.....	15
7.12 Hydrogen service	15
8 Materials	15
8.1 General	15
8.2 Gaskets.....	16
8.3 Tubes	16
9 Fabrication	16
9.1 Shells	16
9.2 Pass-partition plates	16
9.3 Connection junctions.....	16
9.4 Tubes	17
9.5 Welding.....	17
9.6 Heat treatment	17
9.7 Dimensional tolerances	18
9.8 Gasket contact surfaces other than nozzle-flange facings.....	18
9.9 Tube holes.....	19
9.10 Tube-to-tubesheet joints.....	19
9.11 Assembly.....	19

10	Inspection and testing	20
10.1	Quality assurance	20
10.2	Quality control	20
10.3	Pressure testing	21
10.4	Nameplates and stampings	22
11	Preparation for shipment	22
11.1	Protection	22
11.2	Identification	23
12	Supplemental requirements	23
12.1	General	23
12.2	Design	23
12.3	Examination	23
Annex A	(informative) Recommended practices	25
Annex B	(informative) Shell-and-tube heat exchanger checklist	27
Annex C	(informative) Shell-and-tube heat exchanger data sheets	28
Annex D	(informative) Responsibility data sheet	39
Bibliography	41

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 16812 was prepared by Technical Committee ISO/TC 67, *Machinery, 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 16812:2002), 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.

Annex A provides some optional recommended practices.

A bullet (●) at the beginning of a clause or subclause indicates a requirement for the purchaser to make a decision or provide information (see checklist in Annex B).

In this International Standard, where practical, US Customary (USC) units are included in parentheses for information.

Petroleum, petrochemical and natural gas industries — Shell-and-tube heat exchangers

1 Scope

This International Standard specifies requirements and gives recommendations for the mechanical design, material selection, fabrication, inspection, testing and preparation for shipment of shell-and-tube heat exchangers for the petroleum, petrochemical and natural gas industries.

This International Standard is applicable to the following types of shell-and-tube heat exchangers: heaters, condensers, coolers and reboilers.

This International Standard is not applicable to vacuum-operated steam surface condensers and feed-water heaters.

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 15156 (all parts), *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production*

ASME B 16.5¹⁾, *Pipe Flanges and Flanged Fittings*

ASME B 16.11, *Forged Fittings, Socket Welding and Threaded*

ASME B 1.20.1, *Pipe Threads, General Purpose (Inch)*

EJMA²⁾, *Standards of the Expansion Joint Manufacturers Association*

NACE MR0103³⁾, *Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments*

TEMA Standards (Pet⁴⁾, 8th Edition, *Standards of the Tubular Exchanger Manufacturers Association*

1) ASME International, 3 Park Avenue, New York, NY 10016-5990, USA.

2) Expansion Joint Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591, USA.

3) NACE International, P.O. Box 218340, Houston, TX 77218-8340, USA.

4) Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591, USA.