

DIN EN ISO 12212

ICS 71.120.30

**Erdöl-, petrochemische und Erdgasindustrie –
Haarnadel-Wärmetauscher (ISO 12212:2012);
Englische Fassung EN ISO 12212:2012**

Petroleum, petrochemical and natural gas industries –
Hairpin-type heat exchangers (ISO 12212:2012);
English version EN ISO 12212:2012

Industries du pétrole et du gaz naturel –
Échangeurs thermiques en épingle à cheveux (ISO 12212:2012);
Version anglaise EN ISO 12212:2012

Gesamtumfang 56 Seiten

Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Dieses Dokument (EN ISO 12212:2012) wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“, Subkomitee SC 6 „Processing equipment and systems“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat AFNOR, Frankreich) erarbeitet.

Für Deutschland hat hieran der Arbeitsausschuss NA 109-00-01 AA „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie — Spiegelausschuss zu CEN/TC 12“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) des DIN Deutsches Institut für Normung e. V. mitgearbeitet.

Diese Europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung der ISO Norm.

Diese Norm enthält neben den gesetzlichen Einheiten auch die Einheiten „°F“, „BTU/h“, „ft“, „in (inch)“, „lb (pound)“, „lb/ft³“, „lbf“, „NPS“ und „psi“ die im Deutschen Normenwerk nicht zugelassen sind. Es wird ausdrücklich darauf hingewiesen, dass die Anwendung dieser Einheiten im nationalen amtlichen und geschäftlichen Verkehr aufgrund des Gesetzes über Einheiten im Messwesen nicht zulässig ist.

Umrechnung:

Nicht-SI-Einheit	SI-Einheit	Umrechnung	
°F	°C	°C	= (5/9) (°F – 32)
BTU/h	kJ/h	1 BTU/h	= 1,055 kJ/h
ft	m	1 ft	= 0,304 8 m
in (inch)	mm	1 inch	= 25,4 mm
lb (pound)	kg	1 lb	= 0,453 592 37 kg
lb/ft ³	kg/m ³	1 lb/ft ³	= 4,882 kg/m ³
lbf	N	1 lbf	= 4,448 222 N
NPS	DN	1 NPS	= DN 25
psi (psig)	kPa	1 psi	= 6,894 757 kPa

Für die in diesem Dokument zitierten Internationalen Normen wird im Folgenden auf die entsprechenden Deutschen Normen hingewiesen:

ISO 15156 (all parts)	siehe	DIN EN ISO 15156 (alle Teile)
ISO 23251	siehe	DIN EN ISO 23251

Nationaler Anhang NA (informativ)

Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

Die Benummerung der folgenden Begriffe ist identisch mit der Benummerung in der englischen Fassung.

3.1

zyklischer Betrieb

Arbeitsgang mit periodischer Änderung der Temperatur, des Drucks und/oder der Durchflussrate

3.2

Doppelrohr

Einzelrohr innerhalb eines Rohrmantels

3.3

effektive Wärmeübertragungsfläche

Bereich der äußeren Rohroberfläche, der für die Wärmeübertragung vorgesehen ist, einschließlich gerippter Rohroberflächen (wenn vorhanden)

3.4

vollständige Durchschweißung

Schweißung, bei der sich das Schweißgut über den gesamten Wandquerschnitt der zusammengefügt Teile ausdehnt

3.5

stirnseitiger Abschluss

Abschluss, der die Rohrseite des Wärmetauschers mit der rohrseitigen Verrohrung des Bestellers verbindet und zur Befestigung des Rohrbündels oder des Teils am Mantel dient

3.6

Haarnadel-Wärmetauscher

Doppelrohr- (Rohr-in-Rohr) oder Rohrbündelwärmetauscher mit einem zweischenkligen Rohrbündel, wobei jede Schenkelseite in ihrem eigenen separaten Mantelgehäuse geführt wird

ANMERKUNG In Bild 1 sind die üblichen Teile eines Haarnadel-Wärmetauschers dargestellt.

3.7

Wärmetauschereinheit

ein oder mehrere, für einen festgelegten Einsatz parallel oder in Reihe angeordnete Wärmetauscher, die zur Erfüllung einer geplanten Aufgabe zusammenwirken

3.8

Wasserstoffbetrieb

Betrieb, bei dem Wasserstoff mit einem absoluten Partialdruck von mehr als 700 kPa (100 psi) vorkommt

3.9

Artikelnummer

Kennnummer des Bestellers für einen Haarnadel-Wärmetauscher

3.10

niedrigste Auslegungswandtemperatur

niedrigste Wandtemperatur, bei der drucktragende Teile dem Auslegungsdruck ausgesetzt werden können

BEISPIELE Umgebungstemperatur oder Temperatur des Prozessmediums.

3.11

Mehrfachrohr

mehrere Rohre innerhalb eines Rohrmantels

3.12

Berechnungsvorschrift für Druckbehälter

anerkannte, vom Besteller festgelegte oder in Absprache mit ihm ausgewählte Druckbehälternorm

BEISPIELE ASME BPVC Abschnitt VIII, EN 13445 (alle Teile).

3.13

rückseitiger Abschluss

Abschluss am Rücklaufende des Wärmetauschers zur Abdeckung der U-Rohrbögen

3.14

Dichtungsring

spezieller Dichtring, der zur Abdichtung des Außendurchmessers des Rohrbodens und des mantel-/rohrseitigen Flansches dient

3.15

Haarnadelabschnitt

ein U-Rohrelement, bei dem die beiden Schenkelseiten jeweils in einem Mantelgehäuse geführt werden

3.16

dichtgeschweißt

Aufbringen einer Verbindungsschweißnaht zwischen Rohr und Rohboden, die eine nicht festgelegte Festigkeit aufweist und ausschließlich zur Verringerung der Möglichkeit von Undichtigkeiten dient

3.17

tragend verschweißt

Aufbringen einer Verbindungsschweißnaht zwischen Rohr und Rohboden, deren Bemessungsfestigkeit gleich oder größer ist als die in der Berechnungsvorschrift für Druckbehälter festgelegte axiale Festigkeit der Rohre

3.18

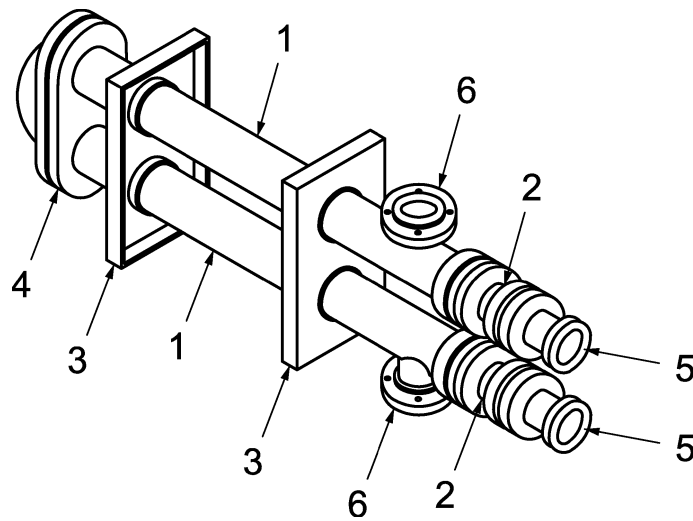
Schweißtechnik-Vorschrift

en: structural welding code

anerkannte, vom Besteller festgelegte oder in Absprache mit ihm ausgewählte Schweißtechnik-Vorschrift

3.19**Rohrbündel**

Anordnung von U-Rohren, Rohrboden und Umlenkblechen, wobei die Rohre glatt oder gerippt sein können

**Legende**

- 1 Mantel
- 2 stirnseitiger Abschluss
- 3 Abstützvorrichtung
- 4 rückseitiger Abschluss
- 5 rohrseitige Anbindung
- 6 mantelrohrseitige Anbindung

Bild 1 — Typische Bauteile eines Haarnadel-Wärmetauschers

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN EN ISO 15156 (alle Teile), *Erdöl- und Erdgasindustrie — Werkstoffe für den Einsatz in H₂S-haltiger Umgebung bei der Öl- und Gasgewinnung*

DIN EN ISO 23251, *Erdöl-, petrochemische und Erdgasindustrie — Druckentlastungs- und Druckausgleichssysteme*

English Version

Petroleum, petrochemical and natural gas industries —
Hairpin-type heat exchangers
(ISO 12212:2012)

Industries du pétrole et du gaz naturel —
Échangeurs thermiques en épingle à cheveux
(ISO 12212:2012)

Erdöl-, petrochemische und Erdgasindustrie —
Haarnadel-Wärmetauscher
(ISO 12212:2012)

This European Standard was approved by CEN on 27 April 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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Foreword

This document (EN ISO 12212:2012) has been prepared by Technical Committee ISO/TC 67 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries” in collaboration with Technical Committee CEN/TC 12 “Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2013, and conflicting national standards shall be withdrawn at the latest by February 2013.

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

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 12212:2012 has been approved by CEN as a EN ISO 12212:2012 without any modification.

Introduction

It is necessary that users of this International Standard be aware that further or differing requirements can 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 can be particularly applicable where there is an innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor to identify any variations from this International Standard and provide details.

This International Standard requires the purchaser to specify certain details and features.

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

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

1 Scope

This International Standard specifies requirements and gives recommendations for the mechanical design, materials selection, fabrication, inspection, testing and preparation for shipment of hairpin heat exchangers for use in the petroleum, petrochemical and natural gas industries.

Hairpin heat exchangers include double-pipe and multi-tube type heat exchangers.

2 Normative reference

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*

ISO 23251, *Petroleum, petrochemical and natural gas industries — Pressure-relieving and depressuring systems*

ASME B16.5¹⁾, *Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard*

NACE MR0103²⁾, *Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments*

NACE SP0472, *Methods and Controls to Prevent In-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments*

TEMA³⁾, *Standards of the Tubular Exchanger Manufacturers Association*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 cyclic service

process operation with periodic variation in temperature, pressure and/or flowrate

3.2 double-pipe

single pipe within a shell

3.3 effective heat transfer area

outside surface area of the tubes that contributes to heat transfer including finned surface area (if any)

3.4 full-penetration weld

welded joint that results in weld metal through the entire thickness of the components being joined

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

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

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

3.5

front closure

closure that connects the tube side to purchaser's tube side piping and fixes the tube bundle or element to the shell

3.6

hairpin heat exchanger

double-pipe (pipe-in-pipe) or multi-tube heat exchanger of two-leg bundle where each leg has its own separate shell

NOTE Figure 1 shows typical components of a hairpin heat exchanger.

3.7

heat exchanger unit

one or more heat exchangers arranged in series or parallel for a specified service that work together to perform the intended duty

3.8

hydrogen service

service that contains hydrogen at a partial pressure exceeding 700 kPa (100 psi) absolute

3.9

item number

purchaser's identification number for a hairpin heat exchanger

3.10

minimum design metal temperature

lowest metal temperature at which pressure-containing elements can be subjected to design pressure

EXAMPLES Ambient temperature or process fluid temperature.

3.11

multi-tube

multiple tubes within a shell

3.12

pressure design code

recognized pressure vessel standard specified or agreed by the purchaser

EXAMPLES ASME BPVC, Section VIII; EN 13445 (all parts).

3.13

rear closure

closure used at the return end of the heat exchanger which covers the u-bends

3.14

sealing ring

special gasket that provides a seal on the OD of tubesheet and the shell/tube side flange

3.15

hairpin section

one U-tube element with two shell legs

3.16

seal-welded

tube-to-tubesheet joint weld of unspecified strength applied between the tubes and tubesheets for the sole purpose of reducing the potential for leakage

3.17

strength-welded

tube-to-tubesheet joint welded so that the design strength is equal to, or greater than, the axial tube strength specified by the pressure design code

3.18

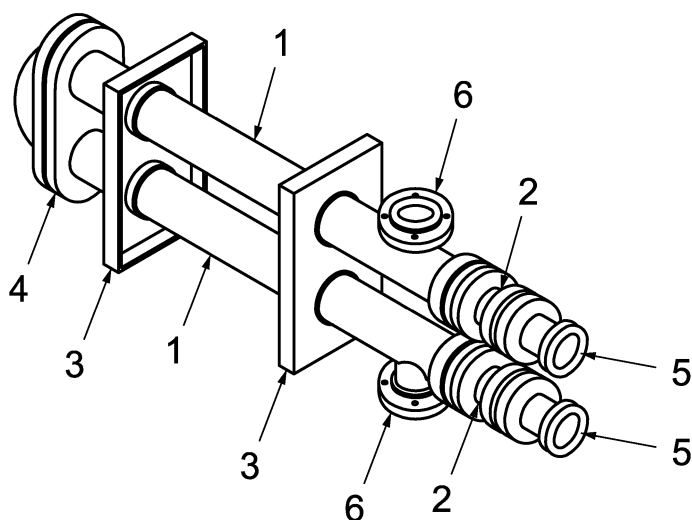
structural welding code

recognized structural welding code specified or agreed by the purchaser

3.19

tube bundle

assembly of U-tubes, tube sheet and baffles where the tubes can be plain or finned



Key

1 shell	4 rear closure
2 front closure	5 tube side connection
3 support	6 shell side connection

Figure 1 — Typical components of a hairpin heat exchanger

4 General

- **4.1** The pressure design code shall be specified or agreed by the purchaser. Pressure components shall comply with the pressure design code and the supplemental requirements in this International Standard.
- 4.2** Where the use of TEMA is specified within this International Standard, the heat-exchanger construction shall conform to TEMA, Class R, unless another TEMA class is specified.
- 4.3** Hairpin exchangers typically do not require expansion joints. However, it can be necessary to evaluate some units to assess the requirement for an expansion joint. For such cases, the purchaser and vendor shall agree to all relevant design, fabrication, inspection and testing requirements.
- **4.4** The vendor shall comply with the applicable local regulations specified by the purchaser.
- 4.5** Annex A includes recommended mechanical and design details for information.
- 4.6** Annex B provides a checklist that can be used by the purchaser to ensure that bulleted items in this International Standard are addressed.

- **4.7** The purchaser shall specify whether the service is designated as sour in accordance with ISO 15156 (all parts) for oil and gas production facilities and natural gas sweetening plants, or designated as wet hydrogen sulfide service in accordance with NACE MR0103 for other applications (e.g. petroleum refineries, LNG plants and chemical plants), in which case all materials in contact with the process fluid shall meet the requirements of the applicable standard to mitigate potential for sulfide stress cracking (SSC). Identification of the complete set of materials, qualification, fabrication and testing specifications to prevent in-service environmental cracking is the responsibility of the user (purchaser).

NOTE For the purpose of this provision, NACE MR0175 is equivalent to ISO 15156 (all parts).

5 Proposal information required

5.1 The vendor's proposal shall include, for each heat exchanger unit, completed data sheets such as those given in Annex C.

5.2 For components that are not fully identified by Clause 3, the vendor shall describe the details of construction and assembly.

5.3 The proposal shall include a detailed description of all exceptions to the requirements of the purchaser's inquiry.

5.4 For stacked heat exchangers, the vendor shall supply the following components unless otherwise specified by the purchaser:

- a) bolts, nuts and gaskets for interconnecting nozzles;
- b) shims and bolting for interconnecting supports;
- c) external, interconnecting tube side piping.

5.5 The vendor shall supply a recommended spare parts list for each hairpin heat exchanger.

6 Drawings and other required data

6.1 Outline drawings and other supporting data

6.1.1 The vendor shall submit, for review by the purchaser, outline drawings for each heat exchanger unit. The drawings shall include the following information:

- a) service, item number, project name and location, purchaser's order number, vendor's shop order number and other special identification numbers;
- b) design pressure, test pressure, maximum design temperature, minimum design metal temperature and any restriction on testing or operation of the heat exchanger;
- c) maximum allowable working pressure (MAWP) in the corroded condition and at the design temperature for the shell side and tube side;
- d) connection sizes, location, orientation, projection, direction of flow and, if flanged, the rating and facing;
- e) coupling sizes, rating and orientation;
- f) dimensions, orientation and location of supports, including bolt holes and slots, and the stacking arrangement;
- g) overall dimensions of the heat exchanger;

- h) tube bundle removal clearance;
- i) mass of the heat exchanger, empty and full of water, and of removable components with a mass greater than 25 kg (60 lb), (e.g. removable tube bundle, individual front closure and rear closure);
- j) specified corrosion allowance for each side of the heat exchanger;
- k) references to the applicable code and the purchaser's specification;
- l) requirements for post-weld heat treatment;
- m) requirements for NDE examination;
- n) requirements for material impact testing;
- o) requirements for surface preparation and painting;
- p) gasket materials;
- q) insulation thickness;
- r) location and orientation of nameplates, lifting lugs, grounding clips or other attachments;
- s) location of the centre of gravity of the exchanger for empty and full of water;
- t) material specifications and grades for all components;
- u) forces and moments on connections as specified by the purchaser;
- v) tube-to-tubesheet joint welding and testing procedures.

6.1.2 The vendor shall recommend the tools required for the assembly and maintenance of the hairpin heat exchanger. If torquing of bolts is required, the vendor shall provide torquing procedures.

6.1.3 The review of engineering documents by the purchaser shall not relieve the vendor of the responsibility of meeting the requirements of the purchase order.

6.2 Information required after outline drawings are reviewed

6.2.1 Generic gasket information, including type and material, shall be provided.

6.2.2 Upon receipt of the purchaser's review comments on the outline drawings, the vendor shall submit copies of all detailed (non-proprietary) drawings. These shall fully describe the heat exchanger and shall include at least the following information:

- a) full views and cross-sectional views including tube bundle details with dimensions and materials;
- b) bundle details, including the following:
 - tube layout,
 - number of baffles, type and description (for segmental baffles include cross-baffle cut, layout and orientation in a view that shows the cut),
 - details and locations of all sealing and sliding strips;
- c) details of each pressure-retaining weld, including weld material, weld nominal thickness, weld location and applicable non-destructive examination method;

- d) details of each weld and weld nominal thickness for non-pressure attachments welded to pressure parts and for all load bearing attachments;
 - e) complete bills of materials, including the material specifications and part numbers for all proprietary components;
 - f) details of cladding and weld overlay;
 - g) details of tube-to-tubesheet joints, including procedures for installation, welding, expansion, inspection and testing;
 - h) flange-face finish.
- **6.2.3** If specified by the purchaser, the vendor shall furnish copies of applicable welding procedure specifications, procedure qualifications and weld map for review or record.
 - **6.2.4** The purchaser shall specify whether the vendor shall furnish for the purchaser's review or record the following documentation:
 - a) mechanical design calculations for shell thickness, tube thickness, nozzle reinforcement and other non-proprietary pressure-retaining components. If calculations are made using computer software, all input and output data shall be detailed so as to facilitate an understanding of the calculation procedures. The equations in the applicable sections of the pressure design code and TEMA shall be referenced;
 - b) minimum required thicknesses for all pressure-retaining components, whether they are proprietary or non-proprietary;
 - c) maximum allowable working pressure calculations (MAWP);
 - d) design calculations based on seismic, wind, transportation and/or piping loads, if these loads are provided by the purchaser;
 - e) proposed procedures for assembly of flanged joints. Any required lubricants shall be stated;
 - f) design calculations for thermal loads imposed on nozzles of stacked heat exchangers;
 - g) flow-induced vibration analysis;
 - h) where sour or wet hydrogen sulfide service is specified, a Certified Material Test Report (CMTR) shall be supplied for all carbon steel materials in contact with the process fluid.

6.3 Reports and records

- After the heat exchanger is completed, the vendor shall furnish the purchaser with the following documents in the format and quantities specified by the purchaser:
 - a) "as-built" data sheet;
 - b) all outline and non-proprietary detail drawings, marked "CERTIFIED AS-BUILT";
 - c) certified record of all impact tests performed;
 - d) certified mill test reports for all pressure-retaining parts, including tubes (each material test report shall be identified by a part number);
 - e) complete certified bill of materials suitable for obtaining all replacement parts, including quantity, description, material specification and identification of each part;