

GENERAL SPECIFICATION

PIPING VALVES VESSELS

GS EP PVV 414

Double pipe heat exchangers

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1. Scope

This document applies to the design, thermal and mechanical engineering and fabrication:

- Of heat exchangers consisting of two concentric tubes in which one fluid circulates inside the internal tube, and other fluid in the ring-shaped space between the internal and external tubes, the latter constituting the casing.
- By extension, of heat exchangers designed on the same principle as those above, but having several internal tubes arranged parallel to the external tube. In this case, the outside diameter of the external tube shall not more than 406.4 mm (16").

In case of diameters above this value, **GS EP PVV 411** shall be used in conjunction with this specification for all items pertaining to tubular exchangers (in particular, the tubesheet).

The heat exchangers under this specification may be composed either of plain tubes of finned tubes. In this latter case, the fins shall be either welded or brazed continuously onto the internal tube(s).

No upper pressure limit is specified, it being understood that high pressure exchangers shall be designed, engineered and constructed according to the appropriate techniques given in this specification or proposed by the Manufacturer.

By definition, the heat exchangers or parts of heat exchangers for High Pressure (HP) are those for which the design conditions (pressure and temperature) are corresponding to the selection of a series equal to or greater than 600 lbs as per **ASME B16.5** standard.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

Shell and tube exchangers covered by this specification must be designed and fabricated in accordance with the latest revision issued at the date of the call for tender of the following codes and standards.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
API STD 660	Heat exchanger for general refinery service
ASME B1.1	Unified inch screw threads
ASME B16.5	Steel pipe flanges and flanged fittings
ASME B16.11	Forged steel fittings, socket welding and threaded
ASME B16.20	Ring joints gaskets and grooves for steel pipe flanges
ASME B16.21	Non-metallic gaskets for pipe flanges

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Reference	Title
API STD 660	Heat exchanger for general refinery service
ASME B16.25	Butt-welding ends
ASME B46.1	Surface texture
ASME Section II	Materials specification
ASME Section VIII div. 1	Boiler and Pressure Vessel Code
ASME Section VIII div. 2	Boiler and Pressure Vessel Code
ASME Section IX	Welding and brazing qualifications
ASME Section V	Non-destructive examination
EJMA	Expansion bellows
MSS SP 44	Steel pipe line flanges
MSS SP 6	Standard finishes for contact faces of pipe flanges
NACE MR 0175/ISO 15156	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production
OCMA TEW-1	Recommendations for tube and welding
TEMA	Standards of the Tubular Exchanger Manufacturers Association

Codes

The basic code is [ASME, Section VIII, Division I](#). [Division II](#) may be specified by the Engineering Company in the data of the exchanger, or may be proposed by the Manufacturer.

[TEMA](#) standards shall be taken into account for constitutive elements of exchangers not described in the [ASME](#) code (for example: tubesheets and flat heads with partition grooves).

Particular specifications

The Engineering Company shall establish a particular specification including additions, waivers and precisions dealing with this equipment supply. It will precise codes and norms in accordance with local regulations and the plant location where the equipment shall be installed.

Data sheets

Process data sheet

A process data sheet containing all elements of service required for thermal design shall be given for each exchanger in accordance with Annex 1 pattern.

Mechanical data sheet

The mechanical construction data sheet indicates the design conditions as well as the main geometrical characteristics. The data sheet shall comply with Annex 2 pattern.

Waivers

Waivers to the contractual reference documents may be allowed by the Company on request, in function of their justification.

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These waivers shall be the subject of a specific agreement before the order placement.

If there is a discrepancy between this specification and one of the contractual reference documents, the Manufacturer must so inform the Company, which will decide. It is understood that, in such cases, the more stringent requirement shall apply in the absence of explicit approval by the Company.

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP PVV 402	Standards for exchanger accessories and equipment
GS EP PVV 411	Shell and tube heat exchangers
GS EP PVV 441	Procedure for shop hydraulic tests of shell and tube heat exchangers
GS EP PVV 611	Welding of pressure containing piping and equipment
GS EP PVV 402	Standards for exchanger accessories and equipment SD EP PVV 233 - SD EP PVV 404 - SD EP PVV 405 - SD EP PVV 406 - SD EP PVV 410 - SD EP PVV 414

3. Definition of design data

3.1 Pressures

All pressures are mentioned gauge pressures except in the case of vacuum exchangers.

3.1.1 Service Pressure (SP)

This is the pressure applied to the exchanger during its normal operation.

3.1.2 Maximum Service Pressure (MSP)

This is temporary peak pressure that may have a variety of causes, such as: adjustment during starting up, increase in SP through accidental operation, momentary at a certain stage of operation; it is therefore the maximum pressure anticipated during the complete operating cycle of the exchanger under the most severe conditions.

3.1.3 Design Pressure (DP)

3.1.3.1 Operation above atmospheric pressure

The design pressure shall be taken as the largest of the following values:

- The Maximum Service Pressure (MSP) with a safety margin according to the following table:

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MSP (barg)	Design pressure (barg)
0-10	MSP + 1 bar
10-35	MSP + 10%
35-70	MSP + 3.5 bar
> 70	MSP + 5%

- A minimum of 2 barg
- The maximum discharge pressure at zero flow of the pump or compressor feeding the exchanger (i.e. head at zero flow plus design suction pressure)
- The vapour pressure at design temperature of the fluid contained, except where safety relief valves are designed to take into account the corresponding increase of pressure.

3.1.3.2 Operation under partial vacuum

If the internal pressure is 0.35 bar or less, the exchanger shall be designed for full vacuum.

In all other cases, the exchanger shall be designed for the maximum external pressure plus a margin of 0.15 bar.

3.1.3.3 Shell/Tube differential pressure

Except with the written approval of the Engineering Company, no element subjected to the stresses exerted by both fluids may be designed for the differential pressure.

However, in the case of exchangers, one side of which operates at positive pressure and the other at negative pressure, the elements exposed to both fluids must be designed with allowance for the different DPs.

3.2 Temperatures

3.2.1 Service Temperature (ST)

This is the temperature to which the exchanger is exposed during its normal operation.

3.2.2 Maximum Service Temperature (MST)

This is a temporary peak temperature reached:

- Systematically during an operating cycle
- Occasionally:
 - Due to foreseeable operating error
 - Due to the failure of some safety device
 - Due to unit shutdown.

This temperature shall be taken into account for material selection.

If an operating error or the failure of a safety device should result in a large foreseeable increase in the ST, and if this increase could affect a limited zone of the exchanger, this fact

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should be taken into account and therefore stated. It is therefore possible to specify several MSTs for a given exchanger.

3.2.3 Minimum Service Temperature (mST)

This is the lowest temperature possible during normal operation (this temperature may be caused by internal fluids or by the ambient temperature). This is the temperature taken into account for material selection and mechanical design. The low temperatures reached during occasional operation (such as depressurisation) shall be mentioned on the process data sheets, stating whether they should be taken into account. The basic code indicates to what extent these temperatures shall be taken into account for material selection.

3.2.4 Design Temperature (DT)

This is the temperature taken into account to determine the mechanical characteristics of the materials. It is determined as follows:

- $DT = MST + 15^{\circ}C$ if MST is equal to or greater than ambient temperature
- $DT = mST - 5^{\circ}C$ if mST is below ambient temperature.

However, subject to the Company prior approval on a case by case basis, these rules may be waived for material selection where economics would strongly indicate to stick to $DT = MST$ or $DT = mST$ as applicable.

3.3 Case of several design conditions

An exchanger may be defined against several design parameter ranges (different pressures and temperatures). The exchanger shall then be calculated vs. those various ranges of parameters with the aim of determining the governing conditions.

For the parts in contact with the two fluids (e.g. internal tubes), an intermediate mean design wall temperature may be allowed if doing so leads to a significant saving. This arrangement shall be submitted to the Company with technical and economic justifications for approval.

3.4 Local loads

In certain special cases, the Engineering Company may request the Manufacturer to include, in his study, concentrated loads of external origin, such as the forces and moments transmitted to the nozzles of the exchangers by the piping, the weights of equipment not supplied by Manufacturer, etc.

The local loads specified to the exchanger and those of its accessories included in the supply must be taken into account by the Manufacturer in his calculations, and are therefore excluded from the data to be furnished by the Engineering Company.

4. Thermal design

Double pipe exchangers are more particularly used in case of low flow rates, large temperature differences and when the fluids have appreciable differences in physical characteristics. For each case, several of these parameters can more or less determined the advantage of one type of exchanger over another (tubular or plate type). In most cases, the Engineering Company must carry out a comparison study to show the advantages of using a double tube heat exchangers over other types of exchangers.