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PROCESS DESIGN OF DOUBLE PIPE HEAT EXCHANGERS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standards and Specifications covers the minimum process design requirements, field of application and selection of types, design consideration for double pipe heat exchangers.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. ASME (American Society of Mechanical Engineers)

   ASME Code

2. TEMA (Tubular Exchangers Manufacturers Association)

SYMBOLS AND ABBREVIATIONS

SYMBOL/ABBREVIATION	DESCRIPTION
A	Total Exchanger area, (m^2)
ASME	American Society of Mechanical Engineers
BWG	Birmingham Wire Gage
DN	Diameter Nominal, (mm)
K	Temperature in Kelvin, (K)
OGP	Oil, Gas and Petrochemical
TEMA	Tubular Exchangers Manufacturers As
U	Overall duty heat transfer coefficient, W/m2. °C (W/m^2.K).

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

GENERAL

1. Double pipe heat exchangers are normally designed in a hairpin shape and are fabricated in accordance with ASME Code.

   The principal parts are two sets of concentric pipes, two connecting tees, and a return head and a return bend as shown in Fig. 1

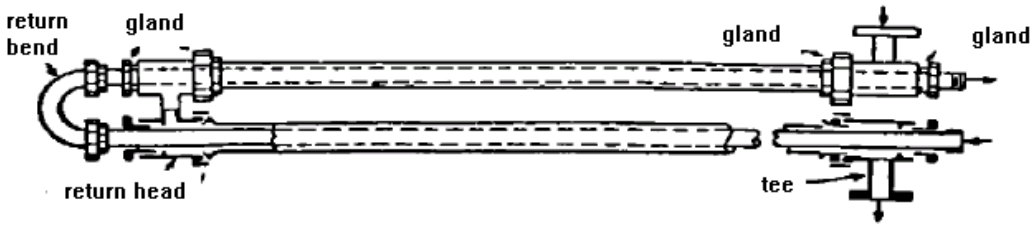

Fig. 1 Typical Double Pipe Exchanger

   Double pipe exchangers are divided into two major types:

   Single-tube and Multi-tube. The Single-tube type consists of a single tube or pipe, either finned or bare, inside a shell.

   The Multi-tube type consists of several tubes, either finned or bare, inside a shell (see Fig. 2).

2. Double-pipe sections permit true counter-current or true co-current flow, which may be of particular advantage when very close temperature approaches or very long temperature ranges are required.

3. Double-pipe units are well suited for high pressure applications because of their relatively small diameters. This allows the use of small flanges and thin wall sections, as compared to conventional shell and tube equipment. Doublepipe sections have been designed for up to 165 bar (ga) (2, 400 psig) on the shell side and up to 1033 bar (ga) (15,000 psig) on the tube side, Metal-to metal ground joints, ring joints or confined Orings are used in the front end closures at lower pressures.

4. Commercially available single tube double-pipe sections range from 50.8 through 101.6 mm (2 through 4-inch) pipe size shells with inner tubes varying from 19 to 63.5 mm (¾ to 2½ inch) pipe size. These can be justified economically if the equivalent shell and surface required is less than 27.8 m2 (300 ft2).

5. In some cases where the thermal resistances of the two fluid film are essentially the same, it will be found for small heat loads that the installation

of double pipe finned tube units are more economical than shell and tube units.

6. The use of fin tubes in double pipe sections are normally economical if the annular heat transfer coefficient is less than 75% of the tube side coefficient.

   The fin efficiency increases with decreasing annular coefficient and increasing fin thermal conductivity. In addition, shorter fins have higher fin efficiencies.

7. Commercially available single tube double-pipe section range from 50.8 through 101.6 mm (2 through 4 inch) pipe size shells with inner tubes varying from 19 mm 63.5 mm (¾ to 2½ inch) pipe size. The inner pipe which may be bare or longitudinally finned.

   The fins 16 to 48 per tube are 12.7 to 25.4 mm (½ to 1 inch) high 0.9 to 1.3 mm (35 to 50 mils) thick.

8. Multiple tube double pipe sections contain from 7 to 64 tubes, bare or longitudinally finned, within the outer pipe shell. Normally, only bare tubes are used in sections containing more than 19 tubes. Section shells normally range from 101.6-406.4 mm (4 through 16 inch) pipe sizes. The inner tubes are available with outside diameters of 15.9-25.4 mm (5/8 inch to 1 inch). The fins, 12 to 20 per tube, are nominally 6.3 mm (¼ inch) high and 0.9 mm (35 mils) thick.

9. Sections containing 7 tubes are the most common. However, the economics of these sections are difficult to define due to the high surface area per section. One or two sections are normally more economical than the equivalent surface area in single tube sections. But, if the particular service requires fractional portions or short tube lengths of a multitube section, single tube sections are more economical.

10. Section containing more than 7 tubes per section are rarely used since they have limited, if any, economic advantage for most services.