

Double Pipe and Multitube Hairpin Heat Exchangers

(This practice is appropriate for attachment to Inquiry or Purchase Document)

IP 6-2-1

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Rev. 1

March 1998

Changes shown by ↗

SECTION 1 - GENERAL

- I 1.1 This practice covers the design, materials, fabrication, inspection, testing and preparation for shipment of double pipe and multitube hairpin heat exchangers.
- I 1.2 **An asterisk (*)** indicates that additional information is furnished by the Purchaser in **Attachment 1** or in the Job Specification.
- I 1.3 Vendor shall comply with all local rules and regulations.
- I * 1.4 Registration requirements are as specified by the Purchaser.
- I 1.5 **Table 1** lists the practices, codes, and standards which shall be used with this practice.

TABLE 1

PRACTICES	
IP 5-1-1	Pressure Vessels
IP 18-12-1	Positive Materials Identification
IP 19-1-1	Paint and Protective Coatings
CODES AND STANDARDS	
ASME Codes	
Section V	Nondestructive Examinations
Section VIII	Pressure Vessels, Division I
ASME Standards	
B2.1	Pipe Threads (Except Dryseal)
B16.5	Steel Pipe Flanges
B16.11	Forged Steel Fittings, Socket-Welding and Threaded Fittings
TEMA	Standards of Tubular Exchanger Manufacturers Association
API	
660	Shell-and-Tube Heat Exchangers for General Refinery Services

- I * 1.6 **Table 2** lists the practices which shall be used with this practice if specified by the Purchaser.

TABLE 2

PRACTICES	
IP 3-8-1	Expansion Joints
IP 3-18-1	Piping Fabrication
IP 5-1-2	Additional Requirements for Heavy Wall Pressure Vessels, Thickness Over 2 Inches
IP 6-1-1	Shell and Tube Heat Exchangers
IP 18-4-1	Postweld Heat Treatment of Equipment Handling Alkaline Solutions
IP 19-2-1	Weld Overlay and Integrally Bonded Cladding
IP 20-1-2	Administrative Procedures for Obtaining ER&E Inspection

- I 1.7 In the case of conflict between specified documents, the following order of precedence shall govern:
 - a. Purchaser's Requisition
 - b. This practice
 - c. Purchaser's other practices
 - d. Industry Standards, Codes, etc.

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SECTION 2 - VENDOR'S PROPOSAL

- I 2.1 With the Proposal, Vendor shall submit the following information:
- a. Completed Specification Sheet (**Attachment 2** or equivalent).
 - b. Vendor's Drawings and Documentation Delivery Schedule.
 - c. A drawing showing major dimensions, in plan and elevation, and the location and orientation of the nozzles.
 - d. Hydrotest procedure for shellside and for tubeside of the given exchanger.
 - e. For multitube bundles of 12 in. (300 mm) and larger, a sketch showing the procedures for bundle removal, handling, and insertion.
 - f. A detailed description of any exception to Purchaser's Inquiry.

SECTION 3 - VENDOR'S INFORMATION FOR PURCHASER'S REVIEW

- I 3.1 The drawings submitted for review shall include all details, dimensions, and materials, sufficient for stress calculations for each part. In addition, the drawings shall include all information as described in Section 3.1 of API-660, "Outline Drawings."

SECTION 4 - FINAL RECORDS

- I 4.1 All **As-built** stamped drawings shall be furnished for each individual exchanger. These shall include, but not be limited to, the technical information outlined in Sections 2 and 3 of this practice. In addition, **As-built** drawings shall show the gaskets, the details of shell assembly, the details of tube assembly, and the recommended procedure/scheme for bundle removal, transportation, and "outside-the-shell" testing.

SECTION 5 - DESIGN

GENERAL

- R 5.1 The baffles and tubeside faces of tubesheets for **multitube hairpins** shall be of the same material as the tubes unless otherwise specified by the Purchaser.
- R *5.2 Corrosion allowance of at least 1/8 in. (3 mm) shall be provided for carbon and low-alloy steel components (except tubes), unless otherwise specified by the Purchaser. Corrosion allowance is not required on gasket contact surfaces.
- S 5.3 **Design for differential pressure is not permitted.** All components of hairpin exchanger shall be designed for the full specified shellside or tubeside pressure, with atmospheric pressure on the other side.
- S 5.4 Vendor shall check all multitube hairpin exchangers for flow induced or sonic vibration.
- R 5.5 The minimum permissible pipe schedule for shell construction shall be Schedule 40 for carbon steel and low alloy steel, and Schedule 10 for high alloy and non-ferrous material.
- R 5.6 Two or more supports shall be designed for each shell.
- R 5.7 The vendor shall so design support elements of stacked shells that no distortion would occur to the tube bundles due to thermal expansion/contraction of the shells.
- C *5.8 Unless otherwise specified by the Purchaser, the Vendor shall supply tube connectors for series flow and manifolds for parallel flow so that each side of the multiple shell hairpin exchanger will have only one inlet and one outlet connection to Purchaser's piping.
- M 5.9 All elements of a hairpin exchanger shall be removable through the use of bolted closure joints.

FRONT CLOSURE

- S 5.10 For exchangers with tubeside design pressure over 400 psig (2800 kPa) or with design temperature below minus 20°F (-30°C) or with the design temperature difference between shellside and tubeside greater than 600°F (330°C), the front closure shall be a separated head thru-bolted, double joint, double mechanism type design. Double mechanism type design is defined as a type wherein the shell and tube side gaskets are seated by individual sets of bolts.

- M * 5.11 For exchangers with tubeside design pressures of 400 psig (2800 kPa) and lower, the front closure shall be **EITHER** separated head, thru-bolted, double mechanism design **OR** of the single head, single mechanism type design. Single mechanism type design is defined as a type wherein the shell and tube gaskets are seated by a single (common) set of bolts.

- S 5.12 The use of packed closures, screwed closures, or unihead type closures is prohibited. The unihead type closure is defined as a type wherein a single gasket seals against both the tubeside and shellside fluids.

REAR CLOSURE

- R,M 5.13 The return bend housing of the rear closure shall be a removable cover with the bolted-through flange joint, which shall have the confined gasket type construction per **TEMA Class R**.

SHELLS

- R 5.14 For hairpins with shell size 12 in. (300 mm) and less, the shell shall be seamless pipe.

TUBE BUNDLES FOR MULTITUBE HAIRPINS

- R * 5.15 Unless otherwise specified by the Purchaser, the tube bundle design shall meet the requirements of **API-660**, and the requirements of **IP 6-1-1**.

- R 5.16 Tubes shall be bent from a single straight tube (one piece construction).

- S * 5.17 If specified by the Purchaser, all carbon steel, low alloy steel, copper alloy and Monel U-bends shall be stress relieved.

NOZZLES AND CONNECTIONS

- M * 5.18 All nozzles shall be flanged except that connections between stacked exchangers may be welded rather than flanged, if specified by the Purchaser.

- R * 5.19 Flanges shall be in accordance with **ASME B16.5** or **ASME B16.47, Series B**. Flanges outside the scope of **ASME B16.5** or **ASME 16.47** shall be designed in conformance with the procedures outlined in **Appendix 2** of **Section VIII, Division 1**, of the **ASME Code**.

- O 5.20 **Pressure gauge and thermowell connections** shall be per Section 5 of TEMA.

- O,M * 5.21 **Chemical cleaning connections.** If chemical cleaning is specified, NPS 2 in. (50 mm) horizontal pipe connections shall be installed in flanged nozzles NPS 4 in. (100 mm) and larger. For exchangers in series or series-parallel arrangement, only one chemical cleaning connection need be provided in the inlet nozzle and one in the outlet nozzle of each series group.

- S 5.22 **Couplings** shall be used for threaded connections.

- S 5.23 Connections shall be designed for full penetration welds.

BOLTING

- R * 5.24 All bolting shall be **SA-193, Gr B7**, unless otherwise specified by the Purchaser.

SECTION 6 - FABRICATION

- S 6.1 All welded joints shall be full penetration.

- R 6.2 Gasket contact surfaces other than nozzle flange facing shall meet the requirements of **API-660**.

- R 6.3 Base Metal Weld Repairs - If the vessel is to be postweld heat treated (PWHT), any welding on the base metal (including such items as repairs to base metal) shall be completed and approved by the Inspector prior to such heat treatment.

- R 6.4 When manifold piping or external tubeside return bends are supplied by the Vendor, they shall be fabricated per **IP 3-18-1**.