PV Newsletter

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[*This article has been provided by Mr. Purav Desai.*]

API 660 vs TEMA

For Shell & Tube heat exchangers employed in refineries & petrochemical complexes, the applicability of API 660 (ISO 16812) in addition to TEMA has becoming mandatory by most end users and consultants. API 660 lays down most requirements based on practical considerations & past experience. At the same time, incorporating such requirements does have an impact on cost and efforts during fabrication of S&T Heat exchangers. The table below compares critical requirements of API 660 with relative TEMA requirements and mostly includes design and drawing requirements. It does not include API 660 Supplementary Requirements and Recommended Practices.

Sr.	Subject	API 660 Requirement	TEMA Requirement
1	Tubesheet Cladding Thickness (7.2.2)	• Minimum 10 mm for expanded tube to tubesheet joints. • Minimum 5 mm for welded tube to tubesheet joints.	• For TEMA Class R & B, minimum 7.8 mm for expanded tube to tubesheet joints and 3.2 mm for welded tube to tubesheet joints. • For TEMA Class, minimum 4.8 mm for expanded tube to tubesheet joints and 3.2 mm for welded tube to tubesheet joints.
2	Anchor bolt Slot Hole Dimensions for Sliding saddle base plate (7.3.5)	• The width of the slot shall be equal to the anchor bolt diameter + 8 mm (5/16”). • The length of the slot shall be equal to the anchor bolt diameter + allowance for longitudinal movement + 8 mm (5/16”).	• No specific guidelines (numbers) are given in TEMA to decide the slot dimension. • Slot dimensions given in API 660 may increase the width of sliding side base plate and accordingly the size of foundation or supporting structure.
3	Type of Exchangers (7.5.3)	• TEMA types “P” (Outside packed floating head) and “W” (Externally sealed floating tubesheet) are not allowed.	• As per TEMA RCB-5.2, Type “P” exchangers are allowed for all classes R, C & B. • Type “W” (Externally sealed floating tubesheet) exchangers shall be used only for water, steam, air, lubricating oil, or similar service. For other limitations refer TEMA.
4	Backing Device Corrosion Allowance (7.5.5)	Shell side corrosion allowance shall be included on the back side of the floating-head backing device.	As per TEMA floating head backing devices are not required to have corrosion allowance.
5	Minimum Tube OD (7.6.1.1)	The minimum outside diameter of the tubes shall be 19.05 mm (3/4”).	As per TEMA minimum tube outside diameter can be 6.4 mm also.
6	Tube Thickness (7.6.1.2)	Minimum tube thicknesses are defined with reference to tube material of construction.	No specific guidelines (numbers) are given in TEMA for minimum tube thickness with reference to tube material of construction.

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7	Tubesheet Extension (7.6.2.4)	A full-diameter stationary tubesheet shall be provided for removable bundle exchangers with Bonnets (TEMA “B”).	No specific guideline is given in TEMA for consideration of tubesheet extension.
8	Baffle Thickness (7.6.3.1)	The thickness of carbon steel or low-alloy steel (max. 9 % chromium) transverse baffles and support plates shall be not less than twice the specified shell side corrosion allowance.	Thickness of baffles and support plates for all materials is given with reference to various shell diameters and plate spacing. Also as per TEMA, baffles and support plates does not require corrosion allowance.
9	Impingement Plate Thickness (7.6.4.4)	Minimum thickness of the impingement plate shall 6 mm (1/4”).	No specific guidelines (numbers) are given in TEMA for minimum thickness of impingement plates.
10	Impingement Plate (7.6.4.6)	Perforated impingement plate baffles shall not be used.	Use of perforated distribution device is allowed as per TEMA recommended good practice.
11	Bypass Sealing Devices (7.6.5)	Specific requirements for the provision of bypass sealing devices such as seal strips, tie rods and dummy tubes. This is important during thermal design of exchangers and tube layout development.	No specific guideline is given in TEMA for the requirements of bypass sealing devices.
12	Seal Strips Thickness (7.6.5.5)	Minimum thickness of seal strips shall be the nominal thickness of the transverse baffles or 6 mm (1/4”), whichever is less.	No specific guideline is given in TEMA for the thickness of seal strips.
13	Washer Requirement for Studs (7.8.6)	Hardened washers shall be provided under nuts for all bolts having diameters of 38 mm (1½”) or larger. The washers shall be at least 6 mm (1/4”) thick.	No specific guideline is given in TEMA.
15	Allowable stress for flange design (7.8.9)	Allowable stresses that have been established on the basis of short-time tensile strength shall not be used for the design of girth flanges, gasketed tubesheets and gasketed flat covers.	No specific guideline is given in TEMA.
16	Thin walled expansion joints (7.9.2)	There are many specific requirements Expansion joints given in API 660 like life cycle, liner requirement etc.	TEMA does not cover thin walled expansion joints.
17	Gasket Construction (7.10.3)	Gasket construction (Welded or Non-welded) is defined with respect to size and type of gaskets. Requirements for serrated gasket, jacketed gasket, corrugated gasket, and Spiral wound gasket are specified separately.	No specific guideline is given in TEMA.
18	Integrally Finned Copper Alloy Tubes (8.3.1)	Integrally finned tubes of copper alloy shall be in annealed-temper condition as described in ASTM B 359/B 359M.	No specific guideline is given in TEMA.
19	Shell Ovality Checking (9.1.2)	For removable bundle exchangers, shell ovality shall be checked using metal template made from minimum two disks (same as baffle diameter)	As per TEMA, fabricated shell ID shall not exceed the design ID by 3.2 mm as determined by circumferential measurement. There is no requirement for metal template.

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		and spaced at minimum 300 mm distance.	
20	Pass Partition Plate Weld (9.2)	First 50 mm from gasket face shall be full penetration weld if pass partition plate is welded on both sides.	No specific guideline is given in TEMA for full penetration weld requirement for pass partition plate.
21	PWHT requirement of Channel (9.6.4)	• CS and LAS Channels with 6 or more pass • Nozzle to channel ID ratio > 0.5.	No specific guideline is given in TEMA.
22	PWHT of floating head (9.6.6)	CS and LAS floating head covers fabricated from dish and ring welding.	No specific guideline is given in TEMA.
23	Tolerances (9.7.3)	Tolerances for mating nozzle flanges of stacked exchangers are stringent then TEMA.	Refer TEMA Figure F-1 & F-2 for tolerances.
24	Tube Holes (9.9.2)	Tube holes in tubesheet shall be "Special Close Fit" type for austenitic stainless steel, duplex stainless steel, titanium, cupro-nickel or nickel-alloy tubes.	No specific guideline is given in TEMA for the selection of standard fit or special close fit.
25	Maximum tube wall reduction (9.10.1)	Maximum allowable tube wall thickness reduction for roller-expanded tube-to-tubesheet joints is given for different tube materials.	No specific guideline is given in TEMA.
26	Expansion Length of Tube inside tubesheet (9.10.2/9.10.3)	For welded and expanded tube to tubesheet joint, tubes expansion shell begin 6 mm away from weld and ends at to 3 mm away from shell side face of tubesheet.	Tubes shall be expanded in the tubesheet for the length smaller of {50.8 mm (2") or Tubesheet thickness – 3.2 mm}.
27	Pneumatic Test for welded tube to tubesheet joints (10.3.1)	Additional pneumatic test shall be performed for welded-and-expanded tube-to-tubesheet joints to check tube-weld integrity before final expansion of the tubes, using a soap-water solution to reveal leaks.	No specific guideline is given in TEMA.

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Sources:

1. TEMA 1988, *Standards of the Tubular Exchangers Manufacturers Association*
2. API 660, *Shell-and-Tube Heat Exchangers for General Refinery Service*

***** E N D O F T H E A R T I C L E *****

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