ALPEMA Responses to Requirements in API 668 (1st Edition, Nov. 2018)

August 2021

The following Exceptions and Clarifications are provided as ALPEMA Responses to Requirements in the 1st Edition of API 668 (November 2018). They were developed collectively by the ALPEMA members.

ALPEMA responses refer to the 3rd Edition of the ALPEMA Standards.

Exceptions

API 668 para.	API 668 Requirement	ALPEMA Response
6.1.1	The vendor shall submit, for review by the purchaser, outline drawings for each plate-fin heat exchanger. The drawings shall include at least the following information: e) type and geometric details of fins used;	ALPEMA considers the type and geometric details of fins as proprietary.
6.2.1	Upon receipt of the purchaser's review comments on the outline drawings, the vendor shall furnish detail drawings for the purchaser's review, including header fabrication and connection details, piping fabrication details, and separator vessel details (when provided by the vendor for two-phase distribution purposes).	ALPEMA members consider details like mercury tolerant features and two-phase devices as proprietary and therefore will not provide full disclosure. All materials will be defined in ASME U1 or equivalent.
11.2	Each stream of the plate-fin heat exchanger shall be dried to a dew point less than –30 °C.	ALPEMA members will use nitrogen/air at a dew point of –30 °C or colder. ALPEMA members confirm that this level of moisture has no corrosion effect and that this quality of drying is suitable.

Clarifications

API 668 para.	API 668 Requirement	ALPEMA Response
4.5	The purchaser shall specify the quantity of mercury, organo-mercuric compounds, and heavy metals that will be present in the fluids in contact with the plate-fin heat exchanger. If water is present, the purchaser shall also specify the quantity of H2S, NH3, CO2, SO2, NOX, CO, Cl, the presence of halides, and the pH value. The purchaser shall identify any streams for which a mercury-tolerant design is required. See Annex A.2 for additional guidance.	In general, ALPEMA members may offer an opinion on the suitability of a fluid with aluminum but no member warrants the heat exchanger against corrosion. ALPEMA members do have mercury tolerant features that can address the topic of mercury corrosion but do not warrant against corrosion.

5.1	NOTE 2. The static head (gravitational) losses or gains shall be considered in the performance design of the heat exchanger and shall be reported for information. The allowable and calculated pressure drop, however, shall consider only the frictional and acceleration losses.	The gravity loss (static head) will be reported when requested by customer.
5.2	When specified by the purchaser, the vendor shall provide detailed information on PFHE design	In order to fully protect ALPEMA members rights on Confidentiality and Intellectual Property, and to maintain a competitive market place, the complete description of the fins and their dimensions are not required to be provided. In their place, the heat transfer surface area and the free flow cross-sectional area are indicated for each stream in corresponding data sheets that may also provide general information on two-phase distributors. Types of two-phase system are indicated but dimensional details are not provided. The calculation details are proprietary and will not be disclosed.
5.3	The vendor shall specify in the proposal the operating limitations (e.g. pressure and temperature limits, flow conditions, variations/frequencies/rates of change in flow rate, pressure, and temperature) for normal operating and startup/shutdown/warm-up/cool-down cases.	The specification sheet lists temperature and pressure limits. Section 4.9 (OPERATION) of the ALPEMA Standards covers the operating limitations (e.g. pressure and temperature limits, flow conditions, variations/frequencies/rates of change in flow rate, pressure, and temperature) for normal operating and startup/shutdown/warm-up/cool-down cases.
5.4	When dissimilar metal flanged connections are to be used, the vendor shall specify the type to be provided and the method to be used to prove the adequacy of the design of the joint.	Flanges are either per ASME B31.3 App. L or per manufacturer's own standard, unless specified otherwise. Gasket and torque recommendations are provided by each ALPEMA member.
5.6	The vendor shall provide recommended strainer (size of mesh) requirements for each stream. See Annex A.4 for additional guidance.	Section 8.2.2.1 of the ALPEMA Standards covers filter recommendations. Briefly, it recommends 80 Tyler mesh (177 micron) filters.
5.8	If a mercury-tolerant design is specified by the purchaser, the vendor shall provide a general description of the special design, manufacturing techniques, and operating procedures that are to be provided.	Mercury tolerant features include, for example, drain ability to reduce liquid mercury pooling and selection of materials more tolerant to liquid mercury.
6.1.2	Torque or bolt tensioning requirements for connection bolting shall be provided for review.	This requirement is applied to non-standard flanges, such as an aluminum flange, but is not applied to standard flanges, such as stainless steel ASME B16.9 or B16.47.

6.2.2	If specified by the purchaser, the vendor shall furnish the information necessary to allow the performance of the plate-fin heat exchanger to be modeled using commercially available software. The information provided shall include a stacking sequence or arrangement; dimensional details for each layer, including distributor type and dimensions; identification of fin(s) used; and fin geometry data, including type height, thickness, fin pitch, fin perforation percentage/serration, length/crest distance (as applicable), and parting sheet thickness.	If requested by the purchaser, each ALPEMA member provides the results of the calculations, but not the calculation details.
6.3.1	After the plate-fin heat exchanger is completed, the vendor shall furnish the purchaser with the following documents in the format and quantities specified by the purchaser:	After the BAHX is completed, the ALPEMA member informs the vendor about any dimensions that exceed tolerances. This is 'as-built' information.
6.3.1 f)	f) third-party verification and certification;	ALPEMA believes the API 668 Section 6.3.1(f) third-party verification and certification statement includes the meaning "when applicable".
7.2	All plate-fin heat exchangers shall have two design temperatures for each stream—a maximum design temperature and a minimum design metal temperature (MDMT)—as specified by the purchaser.	BAHX's have the upper and lower design temperatures specified per BAHX unit, not per stream. In some cases, however, the Maximum Design Temperature per stream is used on data sheets.
7.4.5	7.4.5 and A.6.3 :When operating conditions exist that can subject a plate-fin heat exchanger to thermal transients, thermal gradients, and cyclic conditions in excess of those described above, a rigorous stress analysis and cumulative fatigue damage study may be necessary in order to estimate the impact of these events on the design life of the heat exchanger. The need for such analysis, the method of analysis, and the operating conditions to be considered shall be a matter of agreement between the purchaser and the vendor. See Annex A.6 for additional guidance.	Unless agreed between the purchaser and the Supplier, fatigue analysis is not considered in Suppliers offer. As a general rule, BAHX's do not require fatigue calculations, provided that ALPEMA's recommended good practice during operational conditions are followed, as described in Sections 8.1.3 and 8.1.4 of the ALPEMA Standards.

7.9.3.a	7.9.3.a (for transition joints), a thermal cycle test shall be performed prior to any other applied tests. Three thermal cycles shall be applied, unless additional cycles are specified by the purchaser. A single thermal cycle shall consist of the following steps: 1) Immerse the component in water and bring to a temperature of no less than 80 °C. 2) Immerse the component in liquid nitrogen and bring to the temperature of the nitrogen. 3) Re-immerse the component in water and bring to a temperature of no less than 80 °C.	Transition joints suppliers should be in agreement with API 668 Section 7.9.3.a for diameters lower or equal to DN600. Above DN600, testing per 7.9.3.a should be confirmed with the transition joint suppliers.
8.2	When the presence of mercury, organo-mercuric compounds, heavy metals, or water has been identified, the vendor shall consider this in the selection of materials.	BAHX's shall not be used where the mercury content in a process fluid is more than 0.1µg/Nm³, regardless of implementing so-called "Hg tolerant" measures or not.
10.1.4	When specified by the purchaser, completed transition joints shall be subjected to thermal cycle testing prior to any other required tests. Unless otherwise specified, the definition of and number of cycles to be applied shall be as required by 7.9.3.a.	As a general practice, ALPEMA members do not recommend testing on the installed equipment as that would reduce the lifetime of the transition joints. The ALPEMA members may quote for testing on sacrificial transition joints.
10.3.7	If the plate-fin heat exchanger is supplied with blocked layer(s), the vendor shall supply calculations that confirm the adequacy of the unit for the originally specified service, including the required thermal and hydraulic performance and mechanical integrity.	ALPEMA members provide the results of the calculations, but not the calculation details.
A.12.2	(Thermal Cycling) Aluminum has no endurance limit, which is defined as the mechanical stress below which a material has infinite cycle life. As such, any thermal cycling events will reduce the life span of the plate-fin heat exchanger block and must be minimized. In extreme cases, a single cyclic event may be sufficient to cause heat exchanger failure.	It is extremely unlikely that a single operational event would cause a BAHX failure. As a matter of fact, such a single event may lead to “leak-before-failure”, where the leak can be detected and the problem fixed.