THE STANDARDS OF THE BRAZED ALUMINIUM PLATE-FIN HEAT EXCHANGER MANUFACTURERS' ASSOCIATION

Addendum to 3rd Edition

June 2021

The following notes, provided in the form of Frequently Asked Questions (FAQs), were developed by the ALPEMA members and are published at the following web address.

http://alpema.org/faq.html

These FAQs are updated annually as an Addendum to the current edition of the ALPEMA Standards.

Contents

FAQs

1. What are the standard performance over-design margins?

There are no standard margins for heat transfer (or thermal duty), surface area and pressure drop. Overdesign factors are stream and/or application dependent and may vary from 0 and 10%, unless other project specific values are specified.

2. Are distributor areas included in calculation of the heat transfer surface area?

Distributor areas are normally not included.

3. Should filters be installed to prevent plugging?

To avoid most plugging issues, filters must be installed on all streams. For more information, see Section 8.2.2.1 of the *ALPEMA* Standards.

4. How can plate-fin heat exchangers be cleaned on site?

Cleaning procedures depend on the nature of the fouling or plugging. For more information, see Section 8.2.

5. What is the lifetime of a plate-fin heat exchanger?[1]

Under steady-state conditions the lifetime of a plate-fin heat exchanger is comparable to that of other heat exchange equipment types. Well operated plate-fin heat exchangers installed over 40 years ago are still in operation. Situations that can reduce BAHX lifetime can include operation outside recommended operation conditions, even occasionally, and repairs. Great care should be taken in performance monitoring and leak detection under these conditions. Refer to Section 8 for recommended good practice.

6. How can plate-fin heat exchangers be repaired on site? Are there standard repair procedures?[1]

Repair procedures depend on the type of damage. Seal welding of leakages or blocking of damaged passages may apply. It is recommended that any repair be carried out only by the manufacturer or a recognised specialist repair team. All repairs should be accompanied by thermal and hydraulic reviews. For more information, see Section 4.12.

[1] Modified May 2019

7. **What are recommended maintenance intervals and procedures?**
   Normally no routine maintenance should be required; see Section 4.10 of the *ALPEMA* Standards.

8. **What are the allowable nozzle loads?**
   The associated piping can impose forces and moments on the heat exchanger nozzles. See Section 5.12.2.4 of the *ALPEMA* Standards for nozzle loadings.

9. **Why were the allowable nozzle loads increased in the 3rd edition of the Standards?**
   Loads were increased to bring them in line with industrial practice. Note that Table 5-1 has been updated with values increased compared to past values. Therefore, any additional multipliers applied to ALPEMA allowable forces and moments should be reconsidered.

10. **What are the limits for temperature differences?**
    Temperature differences and thermal stresses are associated, and these stresses must remain within the acceptable limits. See Sections 4.9.1, 5.8 and 8.1.3 (item 6) of the *ALPEMA* Standards for guidance.

11. **Why is mercury concentration important?**
    In general, mercury will not react with aluminium unless it is allowed to exist in contact with the heat exchanger in its liquid state and there is water present. If these conditions exist within a heat exchanger, then mercury contamination can result in problems. This attack is most severe when coupled with another corrosion process.

    Another possible problem resulting from mercury in the process stream affects aluminium alloys that contain a high level of magnesium. A rapid reaction of mercury with a magnesium-based secondary phase within the aluminium can take place in the absence of water. If features are not designed into the equipment to address this problem and conditions are conducive, mercury corrosion cracking can occur and propagate at substantially lower levels of stress than that required if mercury were not present.

    Mercury concentrations in feed gases can vary with time, even from the same source.

12. **What mercury concentrations can be handled?**
    Plate-fin heat exchanger systems should not be operated in environments where mercury concentrations are greater than 0.1 micrograms/Nm^3. Above this limit, mercury guard beds should be installed and mercury tolerant features should be considered in the design of the exchanger. See Section 8.3.2 for guidance.

13. **Can plate-fin heat exchangers be used in water service?**
    Yes, provided freezing is avoided and other considerations, such as pH values between 4.5 and 8.5, are followed. See Section 8.3.1 for additional guidance.

14. **What amount of input data is required with an inquiry?**
    Generally the process conditions are required as shown on Fig.7-3 (lines 2-25) and Fig.7-4 (download here). A preferred alternative to tabulated physical properties and temperatures is to provide a process simulation data file.

15. **Is there a recommended filter mesh size?**
    A mesh size of 177 microns (80 Tyler) is recommended for most applications. See Section 8.2.2.1 for more information.

16. **Are fouling factors used in BAHX design?**
    Because clean fluids are processed, fouling factors are not used unless specified by the customer. See Section 8.2.1.

17. **What is a 'cold box'?**
    The term cold box is used to describe a carbon steel casing which houses cryogenic equipment. See Section 9.2.

18. What is the minimum temperature approach (pinch point) for a BAHX?

A good guideline is 1 to 3 K depending upon the application. Minimum temperature approaches even lower than 1 K are possible in a few applications.

19. How are BAHXs thermally insulated?

By either filling a casing (cold box) with perlite or using slab insulation. Both types of insulation are installed on site.

20. When do we need two-phase separator drums?

For any design with two phase inlets, the effect of gas/liquid mal-distribution should be assessed. If the effect is significant, a separation drum is included with the most cost effective two phase injection hardware to ensure good gas/liquid distribution. See Sections 1.2.8 and 7.6.3 in the ALPEMA Standards for more information.

21. What does ALPEMA recommend for monitoring the operating status of exchangers? Are any special instruments needed?

ALPEMA recommends pressure and temperature measurement devices on every stream, preferably at the inlet and outlet of each stream in the heat exchanger. Flow measurements are desirable when practical. Flow rates can often be estimated from a material balance. A user should evaluate what instrumentation is appropriate and cost effective.

22. What type of transition joints are used in block-in-shell exchangers?

Bi-metallic transition joints are used, typically with 304 stainless steel on one side, and 5083 aluminium on the other side. There are a number of suppliers and a number of options in this area. See Section 5.12.3.3 in the ALPEMA Standards for more information.

23. If one pass loses flow, what should we do with the other streams?

If one pass loses flow, often it is best to adjust the flows of the other streams to balance the duty, as appropriate. Attention should be given to monitoring the stream and metal temperatures during transient conditions to be sure that the temperature guidelines contained in the ALPEMA specification are maintained (see Sections 5 and Section 8 in the ALPEMA Standards for more details). A user should evaluate what instrumentation is appropriate and cost effective.

24. We have had issues with plugging; at how high a pressure drop can we operate?

Maldistribution of flow is the main concern, not necessarily pressure drop. Maldistribution can cause flow and temperature profiles to become unbalanced creating a potential for excessive thermal stress build up. In addition, if a stream becomes heavily plugged it is possible that the local velocity of the fluid reaches a point where erosion of the thin internal fins could become a mechanical problem. ALPEMA members do not recommend operating with excessive pressure drop as this can lead to other potential mechanical problems in the equipment. Contact the original equipment manufacturer for more guidance if required.

25. What is a 'Block-in-Shell'?

The term block-in-shell is used to describe a heat exchanger system of one or more aluminium plate-fin heat exchanger blocks installed in a shell made either of aluminium or steel (see Figure 9-1 in the ALPEMA Standards). Enclosing the block in a larger shell is sometimes advantageous because it avoids the need to have a separate knock-out drum. The arrangement is similar to a tubular exchanger known as a kettle reboiler. Hence these are sometimes also known as block-in-shell exchangers. The block-in-shell exchanger offers several advantages over the tubular kettle reboiler. See Section 9.1 in the ALPEMA Standards for more information.

26. Can a plate-fin heat exchanger simply replace a conventional shell-and-tube heat exchanger?

Such replacement typically requires a deep look into the technical details. Materials, fouling, ability to clean, fluid compatibility, temperature differences, installation space, nozzle locations, support structures, etc., need to be checked. Adjustment of certain process parameters could become necessary. Typically shell-and-tube heat exchangers are operated with larger temperature differences, which could jeopardize the mechanical integrity of the plate-fin heat exchanger.

27. Does the "Effective width" on line 33 of the Typical Specification Sheet (Chapter 7, Figure 7-3) correspond to the installed width?

Not always. The effective width is the one used for thermal and hydraulic performance calculations in exchanger simulation software and other methods. In these calculations, it is usual to assume counter-current flow arrangements and apply the same effective width to all layers in all streams (see Chapter 1.2.9).

28. What is meant by temperature in the Standards? Is it operating or metal temperature?

Unless stated otherwise, the Standards refer to operating temperatures.

29. Are the ALPEMA Standards and API 662 the same?

No, there are differences. Guidance will be provided later.

30. What are the operational guidelines of plate-fin heat exchangers regarding flow fluctuations?

Continuous flow fluctuations should be avoided because they can generate cyclic thermal stresses and sometimes become the cause of damage. Continuous flow fluctuations could occur due to reasons such as inadequate plant control systems or flow instabilities, and can be monitored by suitable flow instrumentation. When such flow instruments are not available, other indicators (e.g. pressure drops, valve openings or liquid levels in thermosyphons) could be utilized to identify flow fluctuations. As a result of stable flow operation, the temperature fluctuation in all streams of plate-fin heat exchangers shall be less than ±1°C per minute. See Sections 8.1.2 and 8.1.3 of the ALPEMA Standards.

31. Can specifications for heat exchanger types such as shell-and-tubes or plate-and-frames be used for procurement of plate-fin heat exchangers?

No. Additional information that may not be necessary for the procurement of other heat exchanger types is essential for plate-fins, and must be provided. These include detailed material and process information. A typical specification sheet that illustrates the information necessary for plate-fins is available for download here.

32. Are generic pressure vessel specifications applicable to plate-fins or aluminium drums?

Not usually. Such specifications must be clearly restricted to carbon steel or stainless steel exchangers or drums if the requested supply contains such items.

33. Do generic welding specifications apply to plate-fins?

No. Such specifications do not usually contain any reference to aluminium welding. They must be restricted to carbon steel or stainless steel parts if the requested supply contains such items, and not used for aluminium welding.

34. What are the ALPEMA recommendations for BAHX-related relief valve sizing for fire conditions? More specifically, what can be assumed to be the "wetted surface" area of a BAHX exposed to fire, thus allowing estimation of the rate of vaporization of the fluids and the relief valve sizing?[2]

As a simplified approach for the "wetted surface" of a BAHX, it is recommended to take into account for each of the BAHX passes the full outer surface of a BAHX (i.e. the 6 surfaces of the BAHX) and to ignore all BAHX internals. A fire protection layer, if any, is taken into account as well. These parameters can then be used to estimate the fire induced heat input and the rates of vaporization of the fluids, which are required to escape the BAHX through the relief valves.

35. Is it essential to proof pressure test with oxygen-free nitrogen, as stated in Section 4.7.2?

The statement in Section 4.7.2, "Oxygen-free nitrogen of dewpoint -40°C or better should be used as the test medium" is unnecessarily restrictive. The following statement, consistent with Section 3.7.6, is proposed: "Dry, oil-free, gaseous nitrogen or air should be used as the test medium.".

[2] Added May 2019 and modified July 2019