Proposed Revision Summary of Changes:

UCS-56(d)(2), UCS-56(d)(5), and UNF-56(c): Replace the word “plate” with “material”.
UCS-56(d)(2): Add new text to describe maximum heating rates for tube-to-tubesheet welds.
UCS-56(d)(5), and UNF-56(c): Add new text to describe maximum cooling rates for tube-to-tubesheet welds.

These changes are marked up on the following pages.
UCS-28  THICKNESS OF SHELLS UNDER EXTERNAL PRESSURE

(a) Cylindrical and spherical shells under external pressure shall be designed by the rules in UC-28, using the applicable figures in Section II, Part D, Subpart 3 and the temperature limits of UC-20(c).

(b) Corrugated shells subject to external pressure may be used in pressure vessels in accordance with Section I, PFT-19.

UCS-29  STIFFENING RINGS FOR SHELLS UNDER EXTERNAL PRESSURE

Rules covering the design of stiffening rings are given in UC-29.

UCS-30  ATTACHMENT OF STIFFENING RINGS TO SHELL

Rules covering the attachment of stiffening rings are given in UC-30.

UCS-33  FORMED HEADS, PRESSURE ON CONVEX SIDE

Ellipsoidal, torispherical, hemispherical, and conical heads having pressure on the convex side (minus heads) shall be designed by the rules of UC-33, using the applicable figures in Section II, Part D, Subpart 3.

(19) UCS-56  REQUIREMENTS FOR POSTWELD HEAT TREATMENT

(a) Before applying the detailed requirements and exemptions in these paragraphs, satisfactory weld procedure qualifications of the procedures to be used shall be performed in accordance with all the essential variables of Section IX including conditions of postweld heat treatment or lack of postweld heat treatment and including other restrictions listed below.

Except as otherwise specifically provided in the notes to Tables UCS-56-1 through UCS-56-11 and Table UCS-56.1, all welds in pressure vessels or vessel vessel parts shall be given a postweld heat treatment at a temperature not less than specified in those Tables when the nominal thickness, as defined in UW-40(f), including corrosion allowance, exceeds the limits in those Tables. The exemptions provided in Tables UCS-56-1 through UCS-56-11 or Table UCS-56.1 are not permitted when the vessel or vessel part shall be held at or above 800°F (425°C) at the time the vessel or part is placed in it.

(b) Above 800°F (425°C), the rate of heating shall not be more than 400°F/hr (222°C/h) divided by the maximum metal thickness of the shell or head plate in inches, but in no case more than 400°F/hr (222°C/h). During the heating period there shall not be a greater variation in temperature throughout the portion of the vessel being heated than 250°F (140°C) within any 15 ft (4.6 m) interval.

(c) The vessel or vessel part shall be held at or above the temperature specified in Table UCS-56-11 or Table UCS-56.1 for the time specified in the Tables. During the holding period, the temperature of the vessel being heated shall not be a greater difference than 150°F (83°C) between the highest and lowest temperature throughout the portion of the vessel being heated, except where the range is further limited in Tables UCS-56-1 through UCS-56-11.

(d) For tube-to-tubesheet welds, when postweld heat treatment is performed with no other components, the heating rate above 800°F (425°C) shall not exceed 250°F/hr (140°C/h) regardless of thickness.

Insert new text as new paragraph under (2):

For tube-to-tubesheet welds, when postweld heat treatment is performed with no other components, the heating rate above 800°F (425°C) shall not exceed 250°F/hr (140°C/h) regardless of thickness.

Replace “plate” with “material”
(5) Above 800°F (425°C), cooling shall be done in a closed furnace or cooling chamber at a rate not greater than 500°F/hr (280°C/h) divided by the maximum metal thickness of the shell or head plate 4 inches, but in no case more than 500°F/hr (280°C/h). At temperatures above 800°F (425°C), temperature variations within the heated portion during the cooling phase shall not be greater than 250°F (140°C) within any 15 ft (4.6 m) interval. From 800°F (425°C), the vessel may be cooled in still air.

(c) Except as permitted in (f) below, vessels or parts of vessels that have been postweld heat treated in accordance with the requirements of this paragraph shall again be postweld heat treated after welded repairs have been made.

(f) Weld repairs to P-No. 1 Group Nos. 1, 2, and 3 materials and to P-No. 3 Group Nos. 1, 2, and 3 materials, to the weld metals used to join these materials, and to P-No. 3 Group Nos. 1, 2, and 3 materials, and to P-No. 3 Group Nos. 1, 2, and 3 materials, except as permitted in (f) below, vessels or parts of vessels that have been postweld heat treated in accordance with UW-2(a), except for the exemptions in Tables UCS-56-1 through UCS-56-11, or as a service requirement in accordance with UCS-68. The welded repairs shall meet the requirements of (1) through (6) below. These requirements do not apply when the welded repairs are minor restorations of the material surface, such as those required after removal of construction fixtures, and provided that the surface is not exposed to the vessel contents.

(1) The Manufacturer shall give prior notification of the repair to the user or to his designated agent and shall not proceed until acceptance has been obtained. Such repairs shall be recorded on the Data Report.

(2) The total repair depth shall not exceed 1 1/2 in. (38 mm) for P-No. 1 Group Nos. 1, 2, and 3 materials and 7/64 in. (16 mm) for P-No. 3 Group Nos. 1, 2, and 3 materials. The total depth of a weld repair shall be taken as the sum of the depths for repairs made from both sides of a weld at a given location.

(3) After removal of the defect, the groove shall be examined, using either the magnetic particle or the liquid penetrant examination methods, in accordance with Mandatory Appendix 6 for MT and Mandatory Appendix 8 for PT.

(4) In addition to the requirements of Section IX for qualification of Welding Procedure Specifications for groove welds, the following requirements shall apply:

(a) The weld metal shall be deposited by the manual shielded metal arc process using low hydrogen electrodes. The electrodes shall be properly conditioned in accordance with Section II, Part C, SFA-5.1, Annex A, A6.11; and SFA-5.5, Annex A, A6.12. The maximum bead width shall be four times the electrode core diameter.

(b) For P-No. 1 Group Nos. 1, 2, and 3 materials, the repair area shall be preheated and maintained at a minimum temperature of 200°F (95°C) during welding.

(c) For P-No. 3 Group Nos. 1, 2, and 3 materials, the repair weld method shall be limited to the half bead weld repair and weld temper bead reinforcement technique. The repair area shall be preheated and maintained at a minimum temperature of 350°F (175°C) during welding. The maximum temperature shall be 450°F (232°C) for the heat treating. The weld metal shall be deposited using 5/32 in. (4 mm) maximum diameter root pass electrodes in such a manner as to assure tempering of the heat-affected zones. A final temper bead shall be applied to a level above the base material base metal. After the finished repair weld has reached ambient temperature, it shall be inspected using the same non-destructive examination that was used in (3) above, except that for P-No. 3, Group No. 3 materials, the examination shall be made after the material has been at ambient temperature for a minimum period of 48 hr to determine the presence of possible delayed cracking of the weld. If the examination is by the magnetic particle method, only the alternating current yoke type is acceptable. In addition, welded repairs greater than 7/64 in. (10 mm) deep in materials and in welds that are required to be radiographed by the rules of this Division, shall be radiographically examined to the requirements of UW-51.

(6) The vessel shall be hydrostatically tested after making the welded repair.

(g) Capacitor discharge or electric resistance welding may be used for attaching bare-wire thermocouples, without subsequent postweld heat treatment, provided the energy output for welding is limited to 125 W-sec max. and any requirements specified in the applicable notes as found in Tables UCS-56-1 through UCS-56-11 shall apply. A welding procedure specification shall be prepared, and the content shall describe, as a minimum, the capacitor discharge equipment, the combination of materials to be joined, and the technique of application. Qualification of the welding procedure is not required.
UNF-28  THICKNESS OF SHELLS UNDER EXTERNAL PRESSURE

Cylindrical and spherical shells under external pressure shall be designed by the rules in UG-28, using the applicable figures in Section II, Part D, Subpart 3 and the temperature limits of UG-20(c).

UNF-30  STIFFENING RINGS

Rules covering the design and attachment of stiffening rings are given in UG-29 and UG-30.

UNF-33  FORMED HEADS, PRESSURE ON CONVEX SIDE

Ellipsoidal, torispherical, hemispherical, and conical heads having pressure on the convex side (minus heads) shall be designed by the rules of UG-33, using the applicable figures in Section II, Part D, Subpart 3.

UNF-56  POSTWELD HEAT TREATMENT

(a) Postweld heat treatment of nonferrous materials is not normally necessary nor desirable.

(b) Except as in (c) and (d) below, no postweld heat treatment shall be performed except by agreement between the user and the Manufacturer. The temperature, time and method of heat treatment shall be covered by agreement.

(c) Within 14 days after welding, all products of zirconium Grade R60705 shall be heat treated at 1,000°F to 1,100°F (540°C to 595°C) for a minimum of 1 hr for thicknesses up to 1 in. (25 mm) plus ½ hr for each additional inch of thickness. Above 800°F (425°C), cooling shall be done in a closed furnace or cooling chamber at a rate not greater than 500°F/hr (278°C/h) divided by the maximum metal thickness of the shell or head plate in inches but in no case more than 500°F/hr (278°C/h). From 800°F (425°C), the vessel may be cooled in still air.

(d) Postweld Heat Treatment of UNS Nos. N08800, N08810, and N08811 Alloys

(1) Pressure boundary welds and welds to pressure boundaries in vessels with design temperatures above 1000°F fabricated from UNS No. N08800 (Alloy 800), UNS No. N08810 (Alloy 800H), and UNS No. N08811 (Alloy 800HT) shall be postweld heat treated. The postweld heat treatment shall consist of heating to a minimum temperature of 1,625°F (885°C) for 1½ hr for thicknesses up to 1 in. (25 mm), and for 1½ hr + 1 hr/in. of thickness for thicknesses in excess of 1 in. (25 mm). Cooling and heating rates shall be by agreement between the user or his designated agent and the Manufacturer. As an alternative, solution annealing in accordance with the material specification is acceptable. Postweld heat treatment of tube-to-tubesheet and expansion bellows attachment welds is neither required nor prohibited.

Table UNF-23.4
Nonferrous Metals — Titanium and Titanium Alloys

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GENERAL NOTE: Maximum allowable stress values in tension for the materials listed in the above table are contained in Section II, Part D, Subpart 1 (see UG-23).

Table UNF-23.5
Nonferrous Metals — Zirconium

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GENERAL NOTE: Maximum allowable stress values in tension for the materials listed in the above table are contained in Section II, Part D, Subpart 1 (see UG-23).