

Interpretation of Section 6(d) of Pressure Equipment Safety Regulation Use of Appendices 1-9 and 1-10 of ASME Section VIII Division 1 in Alberta

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(I) Background

ASME Section VIII Division 1 includes Mandatory Appendices which “address specific subjects not covered elsewhere in this Division, and their requirements are mandatory when the subject covered is included in construction under this Division” (ASME Section VIII, Division 1, paragraph U1(b)). Appendix 1¹ is titled “Supplementary Design Formula”, and it includes Appendices 1-9 and 1-10 “ALTERNATIVE METHOD FOR DESIGN OF REINFORCEMENT FOR OPENINGS IN CYLINDRICAL AND CONICAL SHELLS UNDER INTERNAL PRESSURE”

Appendices 1-9 and 1-10 were introduced in the 2007 Edition of the ASME Section VIII Division 1. The concept and equations used in Appendix 1-10 are based on the recent development and adoption of design rules for nozzles in pressure vessels for the ASME Section VIII Division 2.

Appendix 1-9 is very specific with respect to the conditions that must be met when using this appendix as an alternate to the rules of UG-37.

Recent experiences have brought attention to concerns of the misuse or misunderstanding of the correct use of this alternative nozzle reinforcement design method. Such misuse could result in an unintended reduction in the inherent safety factor of the affected vessel component.

This document provides conditions respecting the use of Appendices 1-9 and 1-10 that must be met for the acceptance and registration of designs of pressure vessels that are to be operated in Alberta.

If the rules of Appendices 1-9 or 1-10 as complemented by the conditions (see Items (II) to (V)) stated hereinafter cannot be met, then the UG-37 and Appendix 1-7 rules shall be used. This requirement is based on the proven past experience with designs using Paragraph UG-37 and Appendix 1-7.

(II) Design for External Pressure Applications

Appendices 1-9 and 1-10 may only be used to establish the reinforcement requirements for openings under internal pressure. For openings subject to external pressure, Paragraph UG-37(d) shall be used.

¹ All Appendices and Paragraphs references, unless otherwise specified, are for ASME Section VIII Division 1.

(III) General conditions for the use of Appendices 1-9 and 1-10

Appendices 1-9 and 1-10 may be used for the design of a pressure vessel for operation in Alberta provided full and satisfactory compliance with the following:

- a) These appendices shall not be used for nozzles having a ratio R_n/R greater than 0.7, see Appendix 1-7 for notations.
- b) The nozzle may be attached to a cylindrical or conical shell only.
- c) Nozzles designed under the rules of Appendices 1-9 and 1-10 shall be specifically identified on the registration drawing, and on the Manufacturer's Data Report (MDR) under "Remarks" or on a Supplementary Sheet. The nozzle remark shall state "**Nozzle mark(s) designed to A1-9**" or "**Nozzle mark(s) designed to Appendix 1-10**" whichever is applicable.

Where "Nozzle mark(s)" can be as "N1", "N2" or "Inlet", "Outlet", etc.

- d) Nozzles designed in accordance with Appendices 1-9 and 1-10 rules, because of the provisions of the Code rules, must be located in the exact positions indicated on the registered design drawing. If a nozzle designed in accordance with Appendix 1-9 or 1-10 rules is to be located elsewhere on the vessel, the design drawing must be revised and submitted for review and re-registration prior to completion of construction.
- e) Acceptable designs having nozzles designed using Appendix 1-9 or 1-10, will be registered as Alberta Limited Designs (ALD) with the exception of designs meeting section (V)(g) below.

(IV) Specific conditions for the use of Appendix 1-9

- a) The mandatory conditions of Appendix 1-9(b)(1) through (b)(10) must be complied with.
- b) Only integrally reinforced nozzle configurations are allowed, as per paragraph UW-16(c)(1).

(V) Specific conditions for the use of Appendix 1-10

- a) The limit of reinforcement, as calculated by Appendix 1-10 rules, shall not encroach nor extend into another adjacent vessel component with a different geometric shape (e.g.: from shell into a shell of different thickness, head, conical section, flange, tubesheet, etc.).
- b) Appendix 1-10 is for reinforcement of single nozzles and as such, there shall be no other opening located within the reinforcing limit of the nozzle designed under the rules of Appendix 1-10 (no overlapping of reinforcement zones is permitted as provided in the introduction under Appendix 1-10 indicating that Paragraphs UG-40 and UG-42 are not applicable). The limit of reinforcement, as calculated under the rules of the appendix, cannot be reduced.

- c) As provided under Code rules, Appendix 1-10 shall be acceptable only for the nozzle types indicated in paragraphs 1-10(b)(1), through 1-10(b)(4). Appendix 1-10 shall not be accepted for any other types of nozzles.
- d) Nozzle configurations shall be as specified in paragraph UW-16(c)(1). Other acceptable configurations are as per sketches (a-1), (a-2) and (a-3) of figure UW-16.1. Nozzles may have internal projections.
- e) The allowable stress "S" to be used in the equations (37) and (39) shall be the lesser of the allowable stress for the shell or nozzle neck material specification.
- f) The weld joint factor "E" for use in equation (37) shall be established as follow:
 - 1) If the nozzle and its reinforcement limit doesn't intersect any weld seam then "E" = 1.0;
 - 2) If the nozzle and its reinforcement limit intersect one weld seam then efficiency factor "E" equals the efficiency factor of the weld seam; and
 - 3) If the nozzle and its reinforcement limit intersect more than one weld seam then the efficiency factor "E" equals the lesser of the efficiency factor of the intersected weld seams.
- g) Vessels having nozzles designed in accordance with Appendix 1-10 with the limit of reinforcement calculated by the rules of the appendix equal to or smaller than the limit of reinforcement calculated by the rules of UG-37 will not be registered as an Alberta Limited Design (ALD).
- h) Nozzle configurations using segmental reinforcing elements (plates) are allowed. For such design configurations full compliance with UG-37(h) is mandatory.
- i) Appendix 1-10 cannot be used for nozzle design of brazed, cast iron of any type, layered, cold stretched or impregnated graphite pressure vessels

(VI) Post Construction Repair or Alteration

Acceptance from an ABSA Design Survey Safety Codes Officer is required prior to commencement of work that involves the addition of nozzles of any size to in-service pressure vessels registered as an Alberta Limited Design (ALD) and having any nozzle designed under the rules of Appendix 1-9 or 1-10.

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