Alberta Municipal Affairs

ABSA
the pressure equipment safety authority

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INTERPRETATION
Justification of SA-105 Flanges for Low Temperature Service in ASME Section VIII-1 2019 Edition

Introduction

This Information Bulletin provides compliance guidance to designers, manufacturers, end-users and inspectors of certain pressure vessels constructed to the 2019 Edition of ASME Section VIII, Division 1. This Information Bulletin has been issued to address the many questions and concerns that have come up on the shop floor concerning the Code changes regarding the use of flanges made of SA-105 materials in pressure vessel construction. Circumstances that arise on the shop floor for which additional clarification regarding the application of this guidance should be directed to the Authorized Inspector Supervisors.

Background

Based on industry experience with SA-105 flanges having poor low-temperature toughness properties, the 2019 edition of ASME VIII-1 introduced more stringent requirements for impact test exemption of SA-105 flange materials. Prior to these changes, in November 2016, ABSA issued Information Bulletin IB16-018 warning about this issue and suggesting that equipment owners and manufacturers make themselves aware of the documented problems with SA-105 flanges and consider taking precautions in advance of anticipated changes to code rules.

It should be noted that similar changes have also been introduced in the 2019 edition of ASME Section VIII-2. Although discussion herein is limited to the changes as introduced in Section VIII-1, similar attention is warranted to Section VIII-2 applications.

Reassignment of SA-105 Flanges from Figure UCS-66 Curve ‘B’ to Curve ‘A’

SA-105 material used for flanges has been reassigned from Figure UCS-66 curve ‘B’ to curve ‘A’, with the stipulation that curve ‘B’ can still be used if the flanges are produced to fine grain practice and are either normalized, normalized and tempered, or quenched and tempered after forging.

Reassignment of this material from curve ‘B’ to curve ‘A’ most obviously affects flanges that rely on subparagraph UCS-66(a) for impact test exemption, but may also affect flanges that rely on subparagraphs UG-20(f), UCS-66(b), or UCS-68(c).

Associated Changes to Subparagraph UCS-66(c) for Exemption of Standard Flanges

Subparagraph UCS-66(c) provides for a separate impact test exemption for certain ASME B16.5, B16.47, and long weld neck flanges, and has similarly been revised to raise the impact test exemption temperature for ferritic steel flanges to 0°F (-18°C) when they are provided in the as-forged condition. An exemption temperature of -20°F (-29°C) is still permitted for such flanges when they are produced to fine-grain practice and either normalized, normalized and tempered, or quenched and tempered after forging.

Since UCS-66(c) mentions ferritic steel flanges but does not specifically mention the SA-105 material specification, this change affects all such ferritic steel flanges, and is not limited to the SA-105 material specification.

Continued Use of Existing Registered Designs

Authorized Inspectors can continue to accept the use of existing registered designs which make use of SA-105 flange material for new construction without requiring the CRN to be revised, when all of the following are true:

- The minimum design metal temperature (MDMT) is -20°F (-29°C) or warmer[1]
- Either subparagraph UCS-66(c) is listed on the registered drawing for impact test exemption, or UG-20(f) is the *only* impact test exemption listed on the drawing
- All SA-105 and other ferritic steel flanges are standard flanges: ASME B16.5, ASME B16.47, or long weld neck as described in UCS-66(c)(3)
- All SA-105 and other ferritic steel flanges shall be normalized, normalized and tempered, or quenched and tempered after forging, and shall meet the requirements given below for documentation for flanges produced to fine grain practice

Documentation Required for Flanges Produced to Fine Grain Practice

It should be noted that since the SA-105 material specification does not provide a definition for ‘fine grain practice’, Figure UCS-66 General Note (e)(2) refers to SA-20 for its definition.

In order for SA-105 flange material to be acceptable for use as having been produced to fine grain practice, the requirements of SA-20 §8.3, ‘Fine Austenitic Grain Size’ must be met. It is not acceptable for the material test report or any separate correspondence or certificate issued by the material manufacturer to simply indicate that the material was produced to fine grain practice. The material test report issued by the material manufacturer is required to be marked with one of the following, to the satisfaction of the Authorized Inspector:

- Indication of a McQuaid Ehn austenitic grain size number of 5 or more for the heat, as required by SA-20, §8.3.1
- Indication of a total aluminum content of 0.020% or more by heat analysis, as required by SA-20, §8.3.2.1

[1] It is not permitted to adjust the MDMT of an existing registered design in order to meet this requirement, without obtaining a new CRN.

- Indication of an acid-soluble aluminum content of 0.015% or more by heat analysis, as required by SA-20, §8.3.2.2

Requirements for Design Submissions

When a submission is required to Design Survey which for impact test exemption relies on flange materials being produced to fine grain practice and either normalized, normalized and tempered, or quenched and tempered, the submitted design drawings shall indicate that those materials are produced to fine grain practice and normalized, normalized and tempered, or quenched and tempered, as required to justify the impact test exemptions being used.

Use of UG-20(f) for Impact Test Exemption

When impact test exemption of SA-105 flanges relies on the provisions UG-20(f), it should be noted that due to the change of material curve from Figure UCS-66 curve 'B' to curve 'A' when provided in the as-forged condition, UG-20(f)(1) has a lower limit on the maximum governing thickness to which it applies; the applicability of UG-20(f) must be re-evaluated.

Use of UCS-66(b) for Impact Test Exemption Temperature Reduction

Subparagraphs UCS-66(b)(1)(-b) and UCS-66(b)(1)(-c) allow a code user to use Figure UCS-66.1 to apply a temperature reduction to the MDMT of flanges that will not be subjected to their full pressure capacity at the MDMT. When applying such a temperature reduction, careful consideration must be given to determining the correct initial temperature to which the reduction is applied, with consideration of the changes made to subparagraphs UCS-66(a) and UCS-66(c).

Use of UCS-68(c) for Impact Test Exemption Temperature Reduction

Subparagraph UCS-68(c) allows a code user to apply a temperature reduction of 30°F (17°C) to the MDMT of flanges that are subject to post-weld heat treatment that is not otherwise required by the code. When applying such a temperature reduction to SA-105 flanges, careful consideration must be given to determining the correct starting temperature in accordance with UCS-66(a), given the present change to the Figure UCS-66 curve assignment for this material.

It should be noted also that UCS-68(c) specifically requires Figure UCS-66 to be used to determine the temperature to which the reduction is applied, and does not permit UCS-66(c) to be used to determine the starting temperature.

Note: Although Interpretation VIII-1-95-160 permits a user to use a temperature determined by UCS-66(c), this interpretation is not acceptable for use in Alberta because this was not supported by subsequent revision to subparagraph UCS-68(c) to allow a reduction to be applied to the temperature determined by UCS-66(c).

Use of SA-105 Flanges Permitted by Other Codes of Construction

Other construction codes have not yet been revised to reflect the recognized problems with SA-105 flange material, and may continue to allow it to be used to an MDMT of -20°F without imposing additional requirements.

Code users and pressure equipment owners are reminded that their responsibility for ensuring the safety and suitability of their equipment goes beyond meeting the specific requirements of the codes and standards adopted by regulation. The Pressure Equipment Safety Regulation makes this warning explicit in section 7, where it warns that a code or standard being declared in force by the regulation is not a guarantee as to the life expectancy, durability, or operating performance of equipment and materials described therein.

It should also be noted that conformance with adopted codes and standards is only one of several methods that are used to determine the standard of care to which persons are held in determining liability in cases of negligence.

Attention is again drawn to ABSA's original publication, Information Bulletin IB16-018, which discusses this issue, and caution is warranted when considering the use of SA-105 flanges in low-temperature services for which they may not be suitable.

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