

Information Bulletin No. IB05-001

January 5, 2005

**VARIANCE**

**(VA05-001)**

**to Section 5(1)(c) of the Design, Construction and Installation of Boilers and Pressure Vessels Regulations (AR 227/1975)**

In accordance with Section 38(1) of the *Safety Codes Act* (with amendments in force as of June 1, 2004), a variance is hereby issued to the *Design, Construction and Installation of Boilers and Pressure Vessels Regulations* (AR 227/1975, with amendments up to and including Alberta Regulation 17/2004).

This Variance applies to CSA Z662-99, *Oil and Gas Pipeline Systems*, Clause 14, *Oilfield Steam Distribution Pipelines*. Clause 14 shall apply except as varied herein.

This Variance permits the use of the design methodology for establishing pipe and component wall thicknesses as presented in Chapter IX of ASME B31.3, *Process Piping*, as an alternative to the methodology currently provided in Clause 14.

**Details of Variance**

- Under the alternate rules provided for by this Variance, the minimum wall thickness of straight pipe under internal pressure shall be:

$$t = [(OD-2c_o)/2] \cdot [1 - \exp(-1.155P/S)]$$

where the variables have the meanings ascribed to them in ASME B31.3, paragraph K304.1, and

S = the basic allowable stress for materials listed in ASME B31.3, per paragraph K302.3.2(b), or

S = not more than the lower of two-thirds of the specified minimum yield strength (SMYS) at room temperature or two-thirds of the yield strength at temperature for materials listed in ASME Section II Part D, *Properties*, or

S = not more than the lower of two-thirds of the specified minimum yield strength (SMYS) at room temperature or two-thirds of the yield strength at temperature for materials not listed in ASME Section II, Part D, *Properties*.

- Pipe shall be seamless or longitudinal submerged arc welded only.
- Pipe purchased otherwise in accordance with CSA Z245.1-02, *Steel Pipe*, is permitted to have a yield strength in excess of the maximum listed in that standard.
- The allowable displacement stress range (thermal stress) and the sum of longitudinal stresses due to pressure, mass and other sustained loads shall be limited in accordance with paragraphs K302.3.5(c) and K302.3.5(d) of ASME B31.3.

- Flexibility analysis shall be performed for each piping system, in accordance with ASME B31.3 paragraphs 319.1 through 319.7, except that the displacement stress range shall be within the allowable displacement stress range calculated in accordance with paragraphs K302.3.5(c) and K302.3.5(d) of ASME B31.3.
- The designer shall consider the need to perform a fatigue analysis per ASME B31.3, paragraph K304.8
- The minus tolerance on the pipe wall thickness may be as agreed upon by the purchaser and the pipe manufacturer.
- The governing thickness for postweld heat treatment shall be as per CSA Z662 Clause 7.9.16 of the 2003 Edition of CSA Z662.
- For materials not listed in ASME B31.3, Appendix K or ASME Section II, Part D, tension tests shall be conducted at room temperature and the maximum design temperature for each grade, wall thickness, outside diameter, wall thickness, and heat number combination, to confirm adequate mechanical properties.
- Procedure qualification welds shall be done for each combination of pipe material specification and grade and welding electrode classification. This shall include an all-weld-metal tensile test to ensure that the yield strength of the deposited weld metal is no less than the SMYS of the pipe and the yield strength of the pipe at design temperature. The all-weld-metal test shall be as described in ASME Section II, Part C, *Specifications for Welding Rods, Electrodes and Filler Metals*, for the applicable electrode classification, except that the postweld heat treatment (PWHT) shall not be done unless the welding procedure specification requires PWHT.
- Pipe, bends or fitting material, seam welds and heat-affected zones shall have Charpy impact properties at the minimum design temperature that meet or exceed the following:
  - For thicknesses not more than 25 mm, the average of 3 transverse Charpy V-notch specimens shall be a minimum of 27 Joules absorbed energy. Of the three specimens, one may break below the 27 Joule average, but that one shall demonstrate an absorbed energy no less than 20 Joules.
  - For thicknesses greater than 25 mm but not greater than 50 mm, the average of 3 transverse Charpy V-notch specimens shall be a minimum of 34 Joules absorbed energy. Of the three specimens, one may break below the 34 Joule average, but that one shall demonstrate an absorbed energy no less than 27 Joules.
  - For thicknesses not more than 25 mm, the average of 3 longitudinal Charpy V-notch specimens shall be a minimum of 54 Joules absorbed energy. Of the three specimens, one may break below the 54 Joule average, but that one shall demonstrate an absorbed energy no less than 41 Joules.
  - For thicknesses greater than 25 mm but not greater than 50 mm, the average of 3 longitudinal Charpy V-notch specimens shall be a minimum of 68 Joules absorbed energy. Of the three specimens, one may break below the 68 Joule average, but that one shall demonstrate an absorbed energy no less than 54 Joules.

- The minimum design temperature may be considered as the lowest temperature at which a pressure stress exceeding 50 MPa may exist in the pipe.
- Branch connections, such as those for vents, drains and instrumentation connections may be made with integrally reinforced outlet connections per MSS SP-97, attached by a full penetration weld. Set-on couplings or half couplings are to be avoided.
- Bullplugs or threaded caps for drain or vent valves are permitted for up to NPS 2 (DN 50). Bullplugs shall be solid.
- Induction bends shall be in accordance with ASME B16.49, *Factory-made Wrought Steel Buttwelding Induction Bends for Transportation and Distribution Systems*.
- Supports may be directly welded to the pipeline.
- For the welding of pressure-retaining pipe and components and any attachments thereto, the following shall apply:
  - Detailed welding procedure specifications shall be established and qualified in accordance with Section IX of the ASME *Boiler and Pressure Vessel Code*
  - Welders and welding operators shall be qualified in accordance with Section IX of the ASME *Boiler and Pressure Vessel Code*, and in addition,
    - Procedure qualification welds shall be done for each combination of material and welding electrode classification.
    - The procedure qualification record (PQR) shall include an all-weld-metal tensile test to ensure that the yield strength of the deposited weld metal is no less than the SMYS of the pipe at room temperature and at the design temperature of the piping system. The all-weld-metal test shall be as described in ASME Section II, Part C, *Specifications for Welding Rods, Electrodes and Filler Metals*, for the applicable electrode classification, except that the postweld heat treatment (PWHT) shall not be done unless the welding procedure specification requires PWHT.
    - Circumferential welds and heat affected zones shall meet the transverse Charpy V-notch absorbed energy requirements for the material to be joined.
    - Mechanical testing is required for all qualification and performance tests. Non-destructive methods of welder or welding operator performance qualification may not be used.
    - Charpy V-notch tests are required for all procedure and performance qualification tests.
    - Procedure and performance qualification tests shall be conducted using the same classification of electrode and specification and grade of material as will be used in production welding. The PQR test weld must be done in a similar method as the field welding, e. g. weld position, any interruption between the hot pass and the remainder of the weld with a similar time delay as anticipated in production welding, preheat and interpass temperatures.

- The progressive examination requirements of ASME B31.3, paragraph 341.3.4 shall apply where random radiography, if permitted by Clause 14 of CSA Z662, reveals a defect.
- Mechanized ultrasonic examination (UT) may be substituted for radiographic examination, as permitted by Clause 7 of CSA Z662.
- Visual examination as defined in ASME B31.3, paragraph 344.2.1 is required for all radiographically or ultrasonically examined welds.
- For liquid-medium testing of aboveground pipelines, strength tests shall be conducted in accordance with the applicable requirements of CSA Z662, Clause 8, for a minimum duration of one hour at the lesser of 1.5 times the design pressure multiplied by the ratio of (SMYS at test temperature/SMYS at design temperature) or a pressure that will produce a simple hoop stress ( $PD/2t$ ) of 100% of the room temperature SMYS in the limiting component. The minimum metal temperature during testing shall not be colder than the impact test temperature.
- All oilfield steam distribution piping system designs shall be certified by an Alberta-registered Professional Engineer.
- Contractors building piping systems covered by this Variance shall hold a valid Certificate of Authorization from ABSA to construct such piping.
- This Variance is valid until parallel changes are made in CSA Z662 or until it is rescinded, whichever comes first.

## Background

This variance is provided to allow the advance use of proposed changes to Clause 14 of CSA Z662-03, *Oil and Gas Pipeline Systems*. Twenty years' experience with the high yield strength materials used for oilfield steam distribution pipelines provides a high confidence level as to the properties that can be guaranteed in these steels. Flow rates and transmission distances currently required for oilfield steam distribution pipelines mandate the use of larger diameter lines, the wall thicknesses of which, under the existing design formulae, exceed the capacity of the mills to manufacture the pipes. There is a definite need for the pipeline companies to be able to take full advantage of the high yield strengths that have been demonstrated for these materials over the years.

Because of the long lead times that are required for booking mill space and getting pipe on order, this Variance is needed on an urgent basis. The CSA standards-development and publishing process means that CSA would not be able to publish the proposed changes until sometime in 2007.

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