



$$RT_{K_{Ia}} = T_0 + 80.95 \exp(-0.00613T_0)$$

(SI Units)

$$T_0 + 90.267 \exp(-0.003406 T_0)$$

$$RT_{T_0} = T_0 + 19.4^\circ\text{C}$$

$$RT_{K_{Ia}} = T_0 + 44.97 \exp(-0.00613T_0)$$

Determination of  $RT_{T_0}$  and  $RT_{K_{Ia}}$  shall be the responsibility of the Owner and subject to the approval of the regulatory authority having jurisdiction at the plant site.

### A-4300 FATIGUE CRACK GROWTH RATE

(a) The fatigue crack growth rate  $da/dN$  of the material is characterized in terms of the range of applied stress intensity factor  $\Delta K_I$ . This characterization is generally of the form:

$$da/dN = C_o (\Delta K_I)^n \tag{1}$$

where

$C_o$  = a scaling constant

$n$  = the slope of the  $\log (da/dN)$  versus  $\log (\Delta K_I)$

(15)

Approval Date: November 5, 2014

Code Cases will remain available for use until annulled by the applicable Standards Committee.

**Case N-851**  
**Alternative Method for Establishing the Reference Temperature for Pressure Retaining Materials Section XI, Division 1**

*Inquiry:* Is it permissible to use fracture toughness test data as an alternative to the methods specified in Nonmandatory Appendix A, A-4200, based on  $RT_{NDT}$ , and Nonmandatory Appendix G, G-2110 to establish a fracture-toughness-based reference temperature,  $RT_{T_0}$ , for pressure retaining materials, other than bolting?

*Reply:* It is the opinion of the Committee that fracture toughness test data may be used as an alternative to the methods specified in Nonmandatory Appendix A, A-4200, based on  $RT_{NDT}$ , and Nonmandatory Appendix G, G-2110 to establish a fracture-toughness-based reference temperature,  $RT_{T_0}$ , for pressure retaining materials other than bolting, in accordance with the following additional requirements.

(a) Fracture toughness testing for specific base metal or weld materials shall be performed in accordance with ASTM E1921-97, "Standard Test Method for the Determination of Reference Temperature,  $T_0$ , for Ferritic Steels in the Transition Range." The minimum test requirements of the test method shall be satisfied for the specific material being evaluated. Test data shall satisfy the validity requirements specified in the test method.

(b) Test specimen location and orientation shall be in accordance with the requirements of NB-2300 for Charpy V-notch specimens. Different specimen geometries may be used in accordance with ASTM E1921-97.

(c) The value of  $T_0$  for the test data shall be determined in accordance with (a) above.

(d) The value of  $T_0$  shall be used to calculate the reference temperature  $RT_{T_0}$  in the following equation:

(U.S. Customary Units)

$$RT_{T_0} = T_0 + 35^\circ\text{F}$$

(SI Units)

$$RT_{T_0} = T_0 + 19.4^\circ\text{C}$$

(e) The reference temperature  $RT_{T_0}$  may be used as an alternative indexing reference temperature to  $RT_{NDT}$  for the  $K_{Ic}$  toughness curve, as applicable in Nonmandatory Appendices A and G. For the  $K_{Ia}$  curve in Nonmandatory Appendix A, the reference temperature,  $RT_{K_{Ia}}$ , may be used in place of  $RT_{NDT}$ , where  $RT_{K_{Ia}}$  is related to  $T_0$  and  $RT_{T_0}$  as follows:

$$T_0 + 90.267 \exp(-0.003406 T_0)$$

(U.S. Customary Units)

$$RT_{K_{Ia}} = T_0 + 80.95 \exp[-0.00613 T_0] = RT_{T_0} - 35^\circ\text{F} + 80.95 \exp[-0.00613 (RT_{T_0} - 35^\circ\text{F})]$$

(SI Units)

$$RT_{K_{Ia}} = T_0 + 44.97 \exp[-0.00613 T_0] = RT_{T_0} - 19.4^\circ\text{C} + 44.97 \exp[-0.00613 (RT_{T_0} - 19.4^\circ\text{C})]$$

(f) Use of this Case shall be identified in the applicable documentation.

$$90.267 \exp[-0.003406 RT_{T_0}] - 35^\circ\text{F}$$

The Committee's function is to establish rules of safety, relating only to pressure integrity, governing the construction of boilers, pressure vessels, transport tanks and nuclear components, and inservice inspection for pressure integrity of nuclear components and transport tanks, and to interpret these rules when questions arise regarding their intent. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks and nuclear components, and the inservice inspection of nuclear components and transport tanks. The user of the Code should refer to other pertinent codes, standards, laws, regulations or other relevant documents.

