Agenda Item: 620-1040

Title: 201LN Allowable Stress in Annex Q

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Purpose: Provide a solution for welding A240 Type 201LN that does not require overmatching the material.

Source: "SUGGESTION FOR CHANGE"

Revision: 1

Impact: The business impact of this item is neutral.

Rationale: A welding consumable is not produced that matches both the tensile strength and the notch toughness of A240, Type 201LN. E308L/E316L type consumables are the industry standard for welding this material which matches the cryogenic notch toughness but does not match the specified tensile strength. The E308L/E316L type consumables have a minimum tensile strength of 75,000 lbf/in2 and an unspecified minimum yield. Therefore, the consumables "undermatch" the 95,000 lbf/in2 tensile strength of the A240, Type 201LN.

There is strengthening of deposited 308L/0316L weld metal derived from its dilution with 201LN base metal. It was observed during multiple testing. PQR testing confirms actual tensile strength of the weld joint.

Since thin weldments get a higher percentage of BM dilution than in the wider weld nuggets of thicker weldments, that makes it extra important in this metallurgy to limit the extrapolation of thin weld PQR's to thick production weldments.

As a result, it is recommended to limit the tensile strength test to the maximum thickness tested.

For Q.3.3.6, an editorial change was necessary to make it more clearer that the allowable stresses of weld metal and heat affected zone are based on any of the conditions in that paragraph section.

Proposal: Apply the similar yield and tensile strength requirements for 201LN as is applied to welding 9%, 7%, & 5% nickel and high manganese steel.

Original:

Table Q-3-Maximum Allowable Stress Values

ASTM Specification	Specified Minimum		Allowable Stress	
	Tensile Strength	Yield Strength	Design	Hydrostatic Test
A240, Type 201LN (UNS-S20153)	95000	45000	31,700	40,500

Q.3.3.6 For the base materials associated with Table Q-3, footnotes a, b, and h; if:

Proposed Change:

Table Q-3-Maximum Allowable Stress Values

ASTM Specification	**Specified Minimum**		**Allowable Stress**	
	Tensile Strength	**Yield Strength**	**Design**	**Hydrostatic Test**
A240, Type 201LN (UNS-S20153)	95000	45000	~~31,700~~ i	~~40,500~~ i

[i] The allowable stresses for these materials shall be in accordance with Q.3.3.3 through Q.3.3.5 using the following yield and tensile strength values:

a) The yield strength shall be the smaller of the published minimum yield strength of the base metal and the yield strength of the weld filler metal by the 0.2% offset method via testing of two all-weld-metal specimens that conform to the dimensional standard of Section 12.1 of AWS 5.4 specification.

b) The tensile strength shall be the smaller of the published minimum tensile strength of the base metal or the tensile strength of the weld joint determined in accordance with the welding procedure qualification test per Q.4.2.1. Weld joint tensile strength determined per Q.4.2.1 shall be used only up to the maximum thickness tested.

Q.3.3.6 For the base materials associated with Table Q-3, footnotes a, ~~b,~~ and h; the allowable stresses shall be based on the weld metal and heat affected zones as determined by Q.4.2.1 and Q.4.2.2 when one or more of the following is true ~~if~~:

a) the weld filler metal has an unspecified yield strength; or

b) the weld filler metal has specified minimum yield or ultimate tensile strength below the specified minimums for the base metal; or when

c) the welding procedure qualification tests shows the deposited weld metal tensile strength is lower than the specified minimum ultimate tensile strength of the base metal~~; then allowable stresses should be based on the weld metal and heat affected~~

~~zone strengths as determined by Q.4.2.1 and Q.4.2..~~

Reference

Q.4.2.1 Specifications for the standard welding procedure tests and confirmation of the minimum ultimate tensile strength are in 6.7.

Q.4.2.2 When required by Q.3.3.6, two all-weld-metal specimens that conform to the dimensional standard of Section 12.1 of AWS A5.11 shall be tested to determine the minimum yield and ultimate tensile strength required by Table Q-3; or for determining allowable stress values in Q.3.3.3 through Q.3.3.5. The yield strength shall be determined by the 0.2 % offset method.

Q.3.3.3 For the primary liquid container and membrane tank outer container Type M-CC, the values for the allowable design tensile stress given in Table Q-3 for materials other than bolting steel are the lesser of (a) $33^{1}/_{3}$ % of the specified minimum ultimate tensile strength for the material or (b) $66^{2}/_{3}$ % of the specified minimum yield strength, but they are 75 % of the specified minimum yield strength for the stainless steel, nickel alloy, and aluminum materials.

Q.3.3.4 The maximum allowable design tensile stress for the secondary liquid container may be higher, but shall not exceed the smaller of the following:

— 150 % of the allowable tensile stress from Table Q-3 for the secondary liquid container material;

— maximum tensile stress permitted in Q.6.2.2 for hydrotest of primary liquid containers.

Q.3.3.5 For secondary liquid containers and membrane tank outer containers Type M-CC to be considered undamaged from the contingency level earthquake (CLE or SSE), the general tensile and compressive membrane stresses determined in accordance with API 620 while using R = 1.0 shall not exceed the material's specified minimum yield strength or the critical buckling stress including imperfection and material knockdown factors, respectively.

Q.3.3.6 For the base materials associated with Table Q-3, footnotes a, b, and h; if:

a) the weld filler metal has an unspecified yield strength; or

b) the weld filler metal has specified minimum yield or ultimate tensile strength below the specified minimums for the base metal; or when

c) the welding procedure qualification test shows the deposited weld metal tensile strength is lower than the specified minimum ultimate tensile strength of the base metal, then allowable stresses should be based on the weld metal and heat affected zone strengths as determined by Q.4.2.1 and Q.4.2.2.

NOTES: