

Title:	API 650 Annex X, addition of UNS S82441		Agenda Item # 650-2084
Date:	5/7/2026		
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Purpose:	Addition of duplex stainless steel UNS S82441 to relevant paragraphs of API 650 Annex X.		
Source:	C. Tigerstrand, RATIONALE AND SUPPORTING DATA FOR INCLUSION OF DUPLEX STAINLESS STEEL UNS S82441 (TYPE 2404) IN API 650 AND API 620 ANNEX X.		
Revision:	Rev. 2 in Red. Original API 650 Text in Black.		
Impact:	Alloy and specifications to be included in paragraphs: X.1.1 and X.2.3.1. Alloy and values to be included in tables: X.1, X.2a, X.2b, X.4a, X.4b, X.5a, and X.5b.		
Rationale:	The duplex stainless steel grade UNS S82441, 2404, is developed with the objective of filling the gap between duplex grades 2304 (S32304) and 2205 (S32205/S31803). The alloy is designed using leaner chemistry than 2205. Its corrosion resistance is significantly higher than Austenitic SS Type 316, approaching that of 2205. The mechanical strength of 2404 is higher than both 2304 and 2205, enabling shell thickness reduction of larger tanks.		
Current Document:	API 650 14th Edition, Annex X.		

Proposed Document

X.1.1 This Annex covers materials, design, fabrication, erection, and testing requirements for vertical, cylindrical, aboveground, closed- and open-top, welded, duplex stainless steel storage tanks constructed of material grades 2205 (UNS S31803), 2003 (UNS S32003), 2101 (UNS S32101), 2102 (UNS S82011), 2202 (UNS S32202), 2205 (UNS S32205), 2304 (UNS S32304), **2404 (UNS S82441)** 255 (UNS S32550), 255+ (UNS S32520), 2507 (UNS S32750), and Z100 (UNS S32760). This Annex does not cover stainless steel clad plate or strip lined construction.

X.2.3.1 Tests for detecting detrimental intermetallic phases for ASTM A923 are required from one plate per heat treat lot as follows:

NOTE 4 For dual certified materials, S31803/S32205 and S32550/S32520, use the allowable stress of the grade specified by the Purchaser.

Table X.2b—Allowable Stresses for Tank Shells (USC)

Alloy	Nominal Plate Thickness, <i>t</i>	Min Yld	Min Ten	Allowable Stress PSI for Design Temp Not Exceeding (<i>S_ts</i>)					
	in.	lb/in ²	lb/in ²	100 °F	200 °F	300 °F	400 °F	500 °F	<i>S_t</i> ambient
S31803		65,000	90,000	36,000	36,000	34,700	33,400	32,600	38,600
S32003		65,000	95,000	38,000	33,600	33,600	31,200	30,700	40,800
S32101		65,000	94,000	37,600	34,000	32,400	31,200	30,700	40,300
S82011		65,000	95,000	38,000	37,300	33,600	31,300	30,000	40,700
S32202		65,000	94,000	38,000	37,000	32,900	31,000	30,300	40,800
S32205		65,000	95,000	38,000	34,000	32,700	30,000	28,700	40,800
S32304		58,000	87,000	34,800	33,200	30,900	29,700	29,000	37,300
S32550		80,000	110,000	44,000	43,800	41,400	40,400	39,400	47,200
S32520		80,000	112,000	44,800	39,200	38,400	37,200	36,400	48,000
S32750		80,000	116,000	46,400	46,200	43,200	40,500	38,900	49,800
S32760		80,000	108,000	43,200	39,200	37,600	37,200	37,200	46,300
S82441	<i>t</i> < 0.4	78,000	107,000	42,900	40,500	36,700	35,300	34,500	45,900
	<i>t</i> ≥ 0.4	70,000	99,000	39,400	36,000	32,600	31,300	30,700	42,400

NOTE 1 *S_ts* may be interpolated between temperatures.

NOTE 2 The design stress shall be the lesser of 2/5 of the minimum tensile strength or 2/3 of the minimum yield strength.

NOTE 3 The hydrotest stress shall be the lesser of 3/7 of the minimum tensile strength or 3/4 of the minimum yield strength.

NOTE 4 For dual certified materials, S31803/S32205 and S32550/S32520, use the allowable stress of the grade specified by the Purchaser.

Table X.4a—Yield Strength Values in MPa

Alloy	Nominal Plate Thickness, <i>t</i>	Yield Strength MPa for Design Temp Not Exceeding				
	mm	40 °C	90 °C	150 °C	200 °C	260 °C
S31803		450	396	370	353	342
S32003		450	386	352	331	317
S32101		450	379	351	324	317
S82011		450	385	347	323	310
S32202		448	387	339	321	314
S32205		450	358	338	319	286
S32304		400	343	319	307	299
S32550		550	484	443	421	407
S32520		550	448	421	400	379
S32750		550	486	446	418	402
S32760		550	455	428	414	400
S82441	<i>t</i> < 10	497	423	379	366	357
	<i>t</i> ≥ 10	441	376	337	325	317

NOTE 1 Interpolate between temperatures.

NOTE 2 Reference: Table Y-1 of ASME Section II, Part D. or manufacturers' data sheets.

Table X.4b—Yield Strength Values in PSI

Alloy	Nominal Plate Thickness, t	Yield Strength lbf/in ² for Design Temp Not Exceeding				
	in.	100 °F	200 °F	300 °F	400 °F	500 °F
S31803		65,000	57,500	51,000	48,000	46,000
S32003		65,000	56,000	51,000	47,000	46,000
S32101		65,000	55,000	49,000	45,000	43,000
S82011		65,000	55,900	50,400	46,900	45,000
S32202		65,000	55,500	49,300	46,500	45,500
S32205		65,000	52,000	49,000	45,000	43,000
S32304		58,000	49,800	46,300	44,500	43,400
S32550		80,000	70,200	64,300	61,000	59,000
S32520		80,000	65,000	61,000	58,000	55,000
S32750		80,000	70,500	64,700	60,700	58,300
S32760		80,000	66,000	62,000	60,000	58,000
S82441	$t < 0.4$	73,000	60,700	55,100	52,900	51,800
	$t \geq 0.4$	65,000	54,000	48,900	47,000	46,100

NOTE 1 Interpolate between temperatures.

NOTE 2 Reference: Table Y-1 of ASME Section II, Part D. or manufacturers' data sheets.

Table X.5a—Modulus of Elasticity at the Maximum Design Temperature (SI)

Alloy	Modulus of Elasticity in MPa for Design Temperatures Not Exceeding				
	40 °C	90 °C	150 °C	200 °C	260 °C

S82441 201000 200000 195000 190000 184000

Table X.5b—Modulus of Elasticity at the Maximum Design Temperature (USC)

Alloy	Modulus of Elasticity (x 10 ⁶ PSI) for Design Temperatures Not Exceeding				
	100 °F	200 °F	300 °F	400 °F	500 °F

S82441 29.7 29.2 29.0 29.0 28.3

Table X.6a—Hot Forming Temperatures (SI)

Alloy	°C Max	°C Min	°C Min Soaking
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S82441 1150 900 1000

Table X.6b—Hot Forming Temperatures (USC)

Alloy	°F Max	°F Min	°F Min Soaking
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S82441 2100 1650 1830