

## ANEXOS

### ANEXO A Composición química del acero ASTM A707 L5 (ASTM 2013:2)

Element	Grade							
	L1 <sup>A</sup>	L2 <sup>A</sup>	L3	L4	L5	L6	L7 <sup>B</sup>	L8
Carbon, max, %								
Heat analysis	0.20	0.30	0.22	0.18	0.07	0.07	0.20	0.20
Product analysis	0.23	0.33	0.25	0.20	0.09	0.09	0.22	0.22
Manganese, %								
Heat analysis	0.60-1.50	0.60-1.35	1.15-1.50	0.45-0.65	0.40-0.70	1.85-2.20	0.90 max	0.20-0.40
Product analysis	0.55-1.60	0.55-1.45	1.05-1.60	0.40-0.70	0.35-0.75	1.75-2.30	1.00 max	0.15-0.45
Phosphorus, max, %								
Heat analysis	0.030	0.030	0.025	0.025	0.025	0.025	0.025	0.020
Product analysis	0.035	0.035	0.030	0.030	0.030	0.030	0.030	0.025
Sulfur, max, %								
Heat analysis	0.030	0.030	0.025	0.025	0.025	0.025	0.025	0.020
Product analysis	0.040	0.040	0.035	0.035	0.035	0.035	0.035	0.025
Silicon, max, %								
Heat analysis	0.35	0.35	0.30	0.35	0.35	0.15	0.35	0.35
Product analysis	0.37	0.37	0.32	0.37	0.37	0.17	0.37	0.37
Chromium, %								
Heat analysis	0.30 max	0.30 max	0.30 max	0.30 max	0.60-0.90	0.30 max	0.30 max	1.50-2.00
Product analysis	0.34 max	0.34 max	0.34 max	0.34 max	0.56-0.94	0.34 max	0.34 max	1.44-2.06
Nickel, %								
Heat analysis	0.40 max	0.40 max	0.40 max	1.65-2.00	0.70-1.00	0.40 max	3.2-3.7	2.8-3.9
Product analysis	0.43 max	0.43 max	0.43 max	1.60-2.05	0.67-1.03	0.43 max	3.18-3.82	2.68-3.97
Molybdenum, %								
Heat analysis	0.12 max	0.12 max	0.12 max	0.20-0.30	0.15-0.25	0.25-0.35	0.12 max	0.40-0.60
Product analysis	0.13 max	0.13 max	0.13 max	0.19-0.33	0.14-0.28	0.22-0.38	0.13 max	0.35-0.65
Vanadium, %								
Heat analysis	0.05 max	0.05 max	0.04-0.11	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max
Product analysis	0.06 max	0.06 max	0.03-0.13	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max
Nitrogen, %								
Heat analysis	...	...	0.010-0.030	...	...	...	...	...
Product analysis	...	...	0.005-0.035	...	...	...	...	...
Copper, %								
Heat analysis	0.40 max	0.40 max	0.20 min <sup>C</sup>	0.40 max	1.00-1.30	0.40 max	0.40 max	0.40 max
Product analysis	0.43 max	0.43 max	0.18 min <sup>C</sup>	0.43 max	0.95-1.35	0.43 max	0.43 max	0.43 max
Columbium, %								
Heat analysis	0.02 max	0.02 max	0.02 max	0.02 max	0.03 min	0.06-0.10	0.02 max	0.02 max
Product analysis	0.03 max	0.03 max	0.03 max	0.03 max	0.02 min	0.05-0.11	0.03 max	0.03 max

<sup>A</sup> The sum of copper, nickel, chromium, and molybdenum shall not exceed 1.00 % on heat analysis.

<sup>B</sup> The sum of chromium, molybdenum and vanadium shall not exceed 0.32 % on heat analysis.

<sup>C</sup> When specified.

### ANEXO B Propiedades mecánicas del acero ASTM A707 L5 Cl 4 (ASTM 2013:3)

Property	Class 1	Class 2	Class 3	Class 4
Yield strength <sup>A</sup> min, ksi [MPa]	42 [290]	52 [360]	60 [415]	75 [515]
Tensile strength, min, ksi [MPa]	60 [415]	66 [455]	75 [515]	90 [620]
Elongation in 2 in. or 50 mm, min, %	22	22	20	20
Reduction of area, min, %	40	40	40	40
Hardness, HBW	149-207	149-217	156-235	179-265
Cv energy absorption, <sup>B,C</sup> min, avg, ft-lbf [J]	30 [41]	40 [54]	50 [68]	50 [68]
C <sub>v</sub> energy absorption, <sup>B,D</sup> min, ft-lbf [J]	24 [33]	32 [43]	40 [54]	40 [54]

<sup>A</sup> 0.2 % offset.

<sup>B</sup> For a set of three full-size [10 by 10 mm] Charpy V-notch specimens. Acceptance values for sub-size specimens are reduced in proportion to the reduction in width of the specimen.

<sup>C</sup> These requirements are intended to minimize fracture initiation. They are not intended to give assurance against fracture propagation. If minimization of fracture propagation is of interest, consideration should be given to specifying Supplementary Requirement S7 at the operating temperature.

<sup>D</sup> Minimum impact energy permitted for one specimen only of a set of three specimens.

ANEXO C Composición química del acero API 5L X70 PSL1 (API 2013:28)

Steel grade (Steel name)	Mass fraction, based upon heat and product analyses <sup>a, g</sup>							
	C max. <sup>b</sup>	Mn max. <sup>b</sup>	P %		S max.	V max.	Nb max.	Ti max.
Seamless pipe								
L175 or A25	0,21	0,60	—	0,030	0,030	—	—	—
L175P or A25P	0,21	0,60	0,045	0,080	0,030	—	—	—
L210 or A	0,22	0,90	—	0,030	0,030	—	—	—
L245 or B	0,28	1,20	—	0,030	0,030	c,d	c,d	d
L290 or X42	0,28	1,30	—	0,030	0,030	d	d	d
L320 or X46	0,28	1,40	—	0,030	0,030	d	d	d
L360 or X52	0,28	1,40	—	0,030	0,030	d	d	d
L390 or X56	0,28	1,40	—	0,030	0,030	d	d	d
L415 or X60	0,28 <sup>e</sup>	1,40 <sup>e</sup>	—	0,030	0,030	f	f	f
L450 or X65	0,28 <sup>e</sup>	1,40 <sup>e</sup>	—	0,030	0,030	f	f	f
L485 or X70	0,28 <sup>e</sup>	1,40 <sup>e</sup>	—	0,030	0,030	f	f	f

ANEXO D Propiedades mecánicas del acero API 5L X70 PSL1 (API 2013:31)

Pipe grade	Pipe body of seamless and welded pipes			Weld seam of EW, LW, SAW and COW pipes
	Yield strength <sup>a</sup> $R_{10,5}$ MPa (psi) minimum	Tensile strength <sup>a</sup> $R_m$ MPa (psi) Minimum	Elongation (on 50 mm or 2 in) $A_f$ % minimum	Tensile strength <sup>d</sup> $R_m$ MPa (psi) Minimum
L175 or A25	175 (25 400)	310 (45 000)	c	310 (45 000)
L175P or A25P	175 (25 400)	310 (45 000)	c	310 (45 000)
L210 or A	210 (30 500)	335 (48 600)	c	335 (48 600)
L245 or B	245 (35 500)	415 (60 200)	c	415 (60 200)
L290 or X42	290 (42 100)	415 (60 200)	c	415 (60 200)
L320 or X46	320 (46 400)	435 (63 100)	c	435 (63 100)
L360 or X52	360 (52 200)	460 (66 700)	c	460 (66 700)
L390 or X56	390 (56 600)	490 (71 100)	c	490 (71 100)
L415 or X60	415 (60 200)	520 (75 400)	c	520 (75 400)
L450 or X65	450 (65 300)	535 (77 600)	c	535 (77 600)
L485 or X70	485 (70 300)	570 (82 700)	c	570 (82 700)

<sup>a</sup> For intermediate grades, the difference between the specified minimum tensile strength and the specified minimum yield strength for the pipe body shall be as given in the table for the next higher grade.

<sup>b</sup> For intermediate grades, the specified minimum tensile strength for the weld seam shall be the same value as was determined for the pipe body using footnote a).

<sup>c</sup> The specified minimum elongation,  $A_f$ , expressed in percent and rounded to the nearest percent, shall be as determined using the following equation:

$$A_f = C \frac{A_{xe}^{0,2}}{U^{0,9}}$$

where

C is 1 940 for calculations using SI units and 625 000 for calculations using USC units;

$A_{xe}$  is the applicable tensile test piece cross-sectional area, expressed in square millimetres (square inches), as follows:

- for circular cross-section test pieces, 130 mm<sup>2</sup> (0.20 in<sup>2</sup>) for 12,7 mm (0.500 in) and 8,9 mm (0.350 in) diameter test pieces; and 65 mm<sup>2</sup> (0.10 in<sup>2</sup>) for 6,4 mm (0.250 in) diameter test pieces;
- for full-section test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) and b) the cross-sectional area of the test piece, derived using the specified outside diameter and the specified wall thickness of the pipe, rounded to the nearest 10 mm<sup>2</sup> (0.01 in<sup>2</sup>);
- for strip test pieces, the lesser of a) 485 mm<sup>2</sup> (0.75 in<sup>2</sup>) and b) the cross-sectional area of the test piece, derived using the specified width of the test piece and the specified wall thickness of the pipe, rounded to the nearest 10 mm<sup>2</sup> (0.01 in<sup>2</sup>);

U is the specified minimum tensile strength, expressed in megapascals (pounds per square inch).

ANEXO E Especificaciones técnicas Invertec V350-pro (Lincoln Electric 2001:A1)

VOLTAJE DE CA DE ENTRADA Y SALIDA DE CD						
Nombre del Producto	Información para Pedidos	Voltaje de CA de entrada	Salida de CD nominal Amps/Voltios/Ciclo de Trabajo	Rango de Salida (continuo)	Peso con Cable	Dimensiones AxAxP
Invertec V350-PRO 60/50 Hz	K1728-1 Factory	200	350A / 34V / 60%	AMPS 5-425	Factory 82.5lbs (37.4 kg)	14.8" x 13.3" x 27.8" (373 x 338 x 706)mm * Incluye manijas
	K1728-2 Construction	208-230/ 380-400/ 415-460/ 575	275A / 31V /100%		Construction 81.5lbs. (36.9 kg)	
	K1728-4 Advance Process	1 & 3 Phase 60/50 Hz			Advance Process 82.5lbs (37.4 kg)	

\*Longitud General Incluyendo Manijas, 706 mm (27.8") sin agarraderas.

CORRIENTE DE ENTRADA V350-PRO						
Tamaños de Fusibles Recomendados con Base en el Código Eléctrico Nacional de los E.U.A. y Salidas Máximas de la Máquina						
Entrada 50/60 Hz		Salida		Recomendado		Notas
Voltaje	Fases	275Amps a 31Volts(100%)	350Amps a 34Volts(60%)	Cable de Alimentación	Tamaño de Fusible	
200	1	No Recomendado	No Recomendado			Nota 1
208	1	70	94	2	125A	Nota 2
230	1	62	85	4	125A	Nota 2
380	1	No Recomendado	No Recomendado			Nota 1
400	1	No Recomendado	No Recomendado			Nota 1
415	1	38	54	6	80A	Nota 2
460	1	34	42	8	70A	
575	1	27	37	8	50A	
200	3	37	50	8	80A	Nota 2
208	3	36	50	6	80A	Nota 2
230	3	31	42	8	70A	
380	3	21	28	8	50A	
400	3	20	27	8	50A	
415	3	19	26	8	50A	
460	3	17	23	8	50A	
575	3	14	18	8	35A	

Nota 1. Lo que no está clasificado se indica con 4 x en la caja, en la placa de capacidad nominal.

Nota 2. Cuando opere en estas entradas, deberá cambiar el cable de alimentación a un conductor de entrada de 6 AWG o may

CABLES DE SALIDA, CONEXIONES Y LIMITACIONES			
Seleccione el tamaño del cable de salida conforme a la siguiente tabla.			
Tamaños de Cables para Longitud Combinada de Electrodo y Cable de Trabajo (Cobre) Clasificados a 75C:			
CICLO DE TRABAJO	CORRIENTE	LONGITUD HASTA 61m (200 pies)	61-76m (200-250 pies)
100%	275	1/0	1/0
60%	350	1/0	2/0

ANEXO F Características del API 5L X70 (ASME 2010:110)

Spec. No.	Type or Grade	UNS No.	Minimum Specified Tensile, ksi (MPa)	Welding		Brazing	ISO 15608 Group	Nominal Composition	Product Form
				P-No.	Group No.	P-No.			
SA-965	F321	S32100	70 (485)	8	1	102	8.1	18Cr-10Ni-Ti	Forgings
SA-965	F321H	S32109	70 (485)	8	1	102	8.1	18Cr-10Ni-Ti	Forgings
SA-965	F347	S34700	70 (485)	8	1	102	8.1	18Cr-10Ni-Cb	Forgings
SA-965	F347H	S34709	70 (485)	8	1	102	8.1	18Cr-10Ni-Cb	Forgings
SA-965	F348	S34800	70 (485)	8	1	102	8.1	18Cr-10Ni-Cb	Forgings
SA-965	F348H	S34809	65 (450)	8	1	102	8.1	18Cr-10Ni-Cb	Forgings
A 992	...	...	65 (450)	1	1	101	1.1	C-Mn-Si	Shapes
SA-995	2A	J93345	95 (655)	10H	1	102	10.2	24Cr-10Ni-4Mo-N	Casings
SA-995	1B	J93372	100 (690)	10H	1	102	10.2	25Cr-5Ni-3Mo-2Cu	Casings
SA-1008	CS Type A	...	40 (275)	1	1	101	1.1	C	Sheet
SA-1008	CS Type B	...	40 (275)	1	1	101	1.1	C	Sheet
A 1008	DS Type B	...	40 (275)	1	1	101	1.1	C	Sheet & strip
SA-1010	40	S41003	66 (455)	7	1	102	...	12Cr-1Ni	Plate, sheet & strip
SA-1010	50	S41003	70 (485)	7	1	102	...	12Cr-1Ni	Plate, sheet & strip
A 1011	CS Type B	...	40 (275)	1	1	101	1.1	C	Sheet & strip
A 1011	DS Type B	...	40 (275)	1	1	101	1.1	C	Sheet & strip
API 5L	A25, Cl. I	...	45 (310)	1	1	101	1.1	C-Mn	Smls. & welded pipe & tube
API 5L	A25, Cl. II	...	45 (310)	1	1	101	1.1	C-Mn	Smls. & welded pipe & tube
API 5L	A	...	49 (330)	1	1	101	1.1	C-Mn	Smls. & welded pipe & tube
API 5L	B	...	60 (415)	1	1	101	1.1	C-Mn	Smls. & welded pipe & tube
API 5L	X42	...	60 (415)	1	1	101	1.2	C-Mn	Smls. & welded pipe & tube
API 5L	X46	...	63 (435)	1	1	101	1.2	C-Mn	Smls. & welded pipe & tube
API 5L	X52	...	66 (455)	1	1	101	1.2	C-Mn	Smls. & welded pipe & tube
API 5L	X56	...	71 (490)	1	2	101	1.3	C-Mn	Smls. & welded pipe & tube
API 5L	X60	...	75 (515)	1	2	101	1.3	C-Mn	Smls. & welded pipe & tube
API 5L	X65	...	77 (530)	1	2	101	1.3	C-Mn	Smls. & welded pipe & tube
API 5L	X70	...	82 (565)	1	3	101	1.3	C-Mn	Smls. & welded pipe & tube
API 5L	X80	...	90 (620)	1	4	101	1.3	C-Mn	Smls. & welded pipe & tube
MSS SP-75	WPHY-42	...	60 (415)	1	1	101	1.1	C-Mn	Smls./welded fittings
MSS SP-75	WPHY-46	...	63 (435)	1	1	101	1.1	C-Mn	Smls./welded fittings
MSS SP-75	WPHY-52	...	66 (455)	1	1	101	1.1	C-Mn	Smls./welded fittings
MSS SP-75	WPHY-56	...	71 (490)	1	2	101	1.1	C-Mn	Smls./welded fittings
MSS SP-75	WPHY-60	...	75 (515)	1	2	101	1.1	C-Mn	Smls./welded fittings
MSS SP-75	WPHY-65	...	77 (530)	1	2	101	1.1	C-Mn	Smls./welded fittings

ANEXO G Rango de espesores y cantidad de probetas requeridas (ASME 2010:144)

Thickness <i>T</i> of Test Coupon, Welded, in. (mm)	Range of Thickness <i>T</i> of Base Metal, Qualified, in. (mm) [Notes (1) and (2)]		Maximum Thickness <i>t</i> of Deposited Weld Metal, Qualified, in. (mm) [Notes (1) and (2)]	Type and Number of Tests Required (Tension and Guided-Bend Tests) [Note (2)]			
	Min.	Max.		Tension, QW-150	Side Bend, QW-160	Face Bend, QW-160	Root Bend, QW-160
Less than 1/16 (1.5)	<i>T</i>	2 <i>T</i>	2 <i>t</i>	2	...	2	2
1/16 to 3/8 (1.5 to 10), incl.	1/16 (1.5)	2 <i>T</i>	2 <i>t</i>	2	Note (5)	2	2
Over 3/8 (10), but less than 3/4 (19)	3/16 (5)	2 <i>T</i>	2 <i>t</i>	2	Note (5)	2	2
3/4 (19) to less than 1 1/2 (38)	3/16 (5)	2 <i>T</i>	2 <i>t</i> when <i>t</i> < 3/4 (19)	2 [Note (4)]	4	...	...
3/4 (19) to less than 1 1/2 (38)	3/16 (5)	2 <i>T</i>	2 <i>t</i> when <i>t</i> ≥ 3/4 (19)	2 [Note (4)]	4	...	...
1 1/2 (38) to 6 (150), incl.	3/16 (5)	8 (200) [Note (3)]	2 <i>t</i> when <i>t</i> < 3/4 (19)	2 [Note (4)]	4	...	...
1 1/2 (38) to 6 (150), incl.	3/16 (5)	8 (200) [Note (3)]	8 (200) [Note (3)] when <i>t</i> ≥ 3/4 (19)	2 [Note (4)]	4	...	...
Over 6 (150)	3/16 (5)	1.33 <i>T</i>	2 <i>t</i> when <i>t</i> < 3/4 (19)	2 [Note (4)]	4	...	...
Over 6 (150)	3/16 (5)	1.33 <i>T</i>	1.33 <i>T</i> when <i>t</i> ≥ 3/4 (19)	2 [Note (4)]	4	...	...

NOTES:

- The following variables further restrict the limits shown in this table when they are referenced in QW-250 for the process under consideration: QW-403.9, QW-403.10, QW-404.32, and QW-407.4. Also, QW-202.2, QW-202.3, and QW-202.4 provide exemptions that supersede the limits of this table.
- For combination of welding procedures, see QW-200.4.
- For the SMAW, SAW, GMAW, PAW, and GTAW welding processes only; otherwise per Note (1) or 2*T*, or 2*t*, whichever is applicable.
- See QW-151.1, QW-151.2, and QW-151.3 for details on multiple specimens when coupon thicknesses are over 1 in. (25 mm).
- Four side-bend tests may be substituted for the required face- and root-bend tests, when thickness *T* is 3/8 in. (10 mm) and over.

ANEXO H Composición química del consumible ER70S-3 (AWS 2001:2)

AWS Classification <sup>b</sup>			Weight Percent <sup>a</sup>												
A5.18	A5.18M	UNS <sup>c</sup> Number	C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu <sup>d</sup>	Ti	Zr	Al
ER70S-2	ER48S-2	K10726	0.07	0.90 to 1.40	0.40 to 0.70	0.025	0.035	0.15	0.15	0.15	0.03	0.50	0.05 to 0.15	0.02 to 0.12	0.05 to 0.15
ER70S-3	ER48S-3	K11022	0.06 to 0.15	0.90 to 1.40	0.45 to 0.75	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-4	ER48S-4	K11132	0.06 to 0.15	1.00 to 1.50	0.65 to 0.85	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-6	ER48S-6	K11140	0.06 to 0.15	1.40 to 1.85	0.80 to 1.15	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-7	ER48S-7	K11125	0.07 to 0.15	1.50 to 2.00 <sup>e</sup>	0.50 to 0.80	0.025	0.035	0.15	0.15	0.15	0.03	0.50	—	—	—
ER70S-G	ER48S-G	—	Not Specified <sup>f</sup>												

Notes:

- a. Single values are maximum.
- b. The letter "N" as a suffix to a classification indicates that the weld metal is intended for the core belt region of nuclear reactor vessels, as described in the Annex to the specification. This suffix changes the limits on the phosphorus and copper as follows:  
P = 0.012% maximum  
Cu = 0.08% maximum
- c. SAE/ASTM Unified Numbering System for Metals and Alloys.
- d. Copper due to any coating on the electrode or rod plus the copper content of the filler metal itself, shall not exceed the stated 0.50% max.
- e. In this classification, the maximum Mn may exceed 2.0%. If it does, the maximum C must be reduced 0.01% for each 0.05% increase in Mn or part thereof.
- f. Chemical requirements are not specified but there shall be no intentional addition of Ni, Cr, Mo, or V. Composition shall be reported. Requirements are those agreed to by the purchaser and the supplier.

ANEXO I Propiedades mecánicas del consumible ER70S-3 (AWS 2001:4)

AWS Classification <sup>a</sup>		Shielding Gas	Tensile Strength (minimum)		Yield Strength <sup>b</sup> (minimum)		Elongation <sup>b</sup> Percent (minimum)
A5.18	A5.18M		psi	MPa	psi	MPa	
ER70S-2 ER70S-3	ER48S-2 ER48S-3	CO <sub>2</sub> <sup>c</sup>	70 000	480	58 000	400	22
ER70S-4	ER48S-4						
ER70S-6	ER48S-6						
ER70S-7	ER48S-7						
ER70S-G	ER48S-G						
E70C-3X E70C-6X	E48C-3X E48C-6X	75–80% Ar/balance CO <sub>2</sub> or CO <sub>2</sub>	70 000	480	58 000	400	22
E70C-G(X)	E48C-G(X)	d	70 000	480	58 000	400	22
E70C-GS(X)	E48C-GS(X)	d	70 000	480	Not Specified		Not Specified

Notes:

- a. The final X shown in the classification represents a "C" or "M" which corresponds to the shielding gas with which the electrode is classified. The use of "C" designates 100% CO<sub>2</sub> shielding (AWS A5.32 Class SG-C); "M" designates 75–80% Ar/balance CO<sub>2</sub> (AWS A5.32 Class SG-AC-Y, where Y is 20 to 25). For E70C-G [E48C-G] and E70C-GS [E48C-GS], the final "C" or "M" may be omitted.
- b. Yield strength at 0.2% offset and elongation in 2 in. [50 mm] gage length (or 1.4 in. [36 mm] gage length for the 0.350 in. [9.0 mm] tensile specimen recommended in A4.2 for the optional acceptance test using gas tungsten arc).
- c. CO<sub>2</sub> = carbon dioxide shielding gas (AWS A5.32 Class SG-C). The use of CO<sub>2</sub> for classification purposes shall not be construed to preclude the use of Ar/CO<sub>2</sub> (AWS A5.32 Class SG-AC-Y) or Ar/O<sub>2</sub> (AWS A5.32 Class SG-AO-X) shielding gas mixtures. A filler metal tested with gas blends, such as Ar/O<sub>2</sub>, or Ar/CO<sub>2</sub>, may result in weld metal having higher strength and lower elongation. Testing with 100% argon shielding (AWS A5.32 Class SG-A) is required when classification testing is based on GTAW only (see A4.2 in Annex A).
- d. Shielding gas shall be as agreed to between purchaser and supplier, unless designated by the C or M suffix.

ANEXO J F No. del consumible ER70S-3 (ASME 2010:134)

F-No.	ASME Specification	AWS Classification	UNS No.
Steel and Steel Alloys			
1	SFA-5.1	EXX20	...
1	SFA-5.1	EXX22	...
1	SFA-5.1	EXX24	...
1	SFA-5.1	EXX27	...
1	SFA-5.1	EXX28	...
1	SFA-5.4	EXXX(X)-26	...
1	SFA-5.5	EXX20-X	...
1	SFA-5.5	EXX27-X	...
2	SFA-5.1	EXX12	...
2	SFA-5.1	EXX13	...
2	SFA-5.1	EXX14	...
2	SFA-5.1	EXX19	...
2	SFA-5.5	E(X)XX13-X	...
3	SFA-5.1	EXX10	...
3	SFA-5.1	EXX11	...
3	SFA-5.5	E(X)XX10-X	...
3	SFA-5.5	E(X)XX11-X	...
4	SFA-5.1	EXX15	...
4	SFA-5.1	EXX16	...
4	SFA-5.1	EXX18	...
4	SFA-5.1	EXX18M	...
4	SFA-5.1	EXX48	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-15	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-16	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-17	...
4	SFA-5.5	E(X)XX15-X	...
4	SFA-5.5	E(X)XX16-X	...
4	SFA-5.5	E(X)XX18-X	...
4	SFA-5.5	E(X)XX18M	...
4	SFA-5.5	E(X)XX18M1	...
4	SFA-5.5	E(X)XX45	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-15	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-16	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-17	...
6	SFA-5.2	All classifications	...
6	SFA-5.9	All classifications	...
6	SFA-5.18	All classifications	...
6	SFA-5.18	All classifications	...
6	SFA-5.22	All classifications	...
6	SFA-5.23	All classifications	...
6	SFA-5.25	All classifications	...
6	SFA-5.26	All classifications	...
6	SFA-5.28	All classifications	...
6	SFA-5.29	All classifications	...
6	SFA-5.30	INMs-X	...
6	SFA-5.30	IN5XX	...
6	SFA-5.30	IN3XX(X)	...

ANEXO K Composición química del electrodo E8010-C3 (AWS 1996:4)

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Wt. Percent <sup>a, b</sup>									Additional Elements	
		C	Mn	Si	P	S	Ni	Cr	Mo	Type	Amt.	
Chromium-Molybdenum Steel Electrodes (continued)												
E9016-B9	W50426	0.08-0.13	1.25	0.30	0.01	0.01	1.0	8.0-10.5	0.85-1.20	V	0.15-0.30	
										Cu	0.25	
										Al	0.04	
										Nb(Cb)	0.02-0.10	
										N	0.02-0.07	
E9018-B9	W50428	0.08-0.13	1.25	0.30	0.01	0.01	1.0	8.0-10.5	0.85-1.20	V	0.15-0.30	
										Cu	0.25	
										Al	0.04	
										Nb(Cb)	0.02-0.10	
										N	0.02-0.07	
Nickel Steel Electrodes												
E8016-C1	W22016	0.12	1.25	0.60	0.03	0.03	2.00-2.75	—	—	—	—	
E8018-C1	W22018	0.12	1.25	0.80	0.03	0.03	2.00-2.75	—	—	—	—	
E7015-C1L	W22115	0.05	1.25	0.50	0.03	0.03	2.00-2.75	—	—	—	—	
E7016-C1L	W22116	0.05	1.25	0.50	0.03	0.03	2.00-2.75	—	—	—	—	
E7018-C1L	W22118	0.05	1.25	0.50	0.03	0.03	2.00-2.75	—	—	—	—	
E8016-C2	W23016	0.12	1.25	0.60	0.03	0.03	3.00-3.75	—	—	—	—	
E8018-C2	W23018	0.12	1.25	0.80	0.03	0.03	3.00-3.75	—	—	—	—	
E7015-C2L	W23115	0.05	1.25	0.50	0.03	0.03	3.00-3.75	—	—	—	—	
E7016-C2L	W23116	0.05	1.25	0.50	0.03	0.03	3.00-3.75	—	—	—	—	
E7018-C2L	W23118	0.05	1.25	0.50	0.03	0.03	3.00-3.75	—	—	—	—	
E8016-C3	W21016	0.12	0.40-1.25	0.80	0.03	0.03	0.80-1.10	0.15	0.35	V	0.05	
E8018-C3 <sup>e</sup>	W21018	0.12	0.40-1.25	0.80	0.03	0.03	0.80-1.10	0.15	0.35	V	0.05	
E7018-C3L	W20918	0.08	0.40-1.40	0.50	0.03	0.03	0.80-1.10	0.15	0.35	V	0.05	
E8016-C4	W21916	0.10	1.25	0.60	0.03	0.03	1.10-2.00	—	—	—	—	
E8018-C4	W21918	0.10	1.25	0.80	0.03	0.03	1.10-2.00	—	—	—	—	
E9015-C5L	W25018	0.05	0.40-1.00	0.50	0.03	0.03	6.00-7.25	—	—	—	—	

ANEXO L Propiedades mecánicas del electrodo E8018-C3 (AWS 1996:6)

AWS Classification <sup>a</sup>	Tensile Strength		Yield Strength, at 0.2% Offset		Elongation Percent	Postweld Condition <sup>d</sup>
	ksi	MPa	ksi	MPa		
E7010-P1	70	480	60	415	22	AW
E7010-A1	70	480	57	390	22	PWHT
E7010-G	70	480	57	390	22	AW or PWHT
E7011-A1	70	480	57	390	22	PWHT
E7011-G	70	480	57	390	22	AW or PWHT
E7015-X	70	480	57	390	25	PWHT
E7015-B2L	75	520	57	390	19	PWHT
E7015-G	70	480	57	390	25	AW or PWHT
E7016-X	70	480	57	390	25	PWHT
E7016-B2L	75	520	57	390	19	PWHT
E7016-G	70	480	57	390	25	AW or PWHT
E7018-X	70	480	57	390	25	PWHT
E7018-B2L	75	520	57	390	19	PWHT
E7018-C3L	70	480	57	390	25	AW
E7018-W1	70	480	60	415	25	AW
E7018-G	70	480	57	390	25	AW or PWHT
E7020-A1	70	480	57	390	25	PWHT
E7020-G	70	480	57	390	25	AW or PWHT
E7027-A1	70	480	57	390	25	PWHT
E7027-G	70	480	57	390	25	AW or PWHT
E8010-P1	80	550	67	460	19	AW
E8010-G	80	550	67	460	19	AW or PWHT
E8011-G	80	550	67	460	19	AW or PWHT
E8013-G	80	550	67	460	16	AW or PWHT
E8015-X	80	550	67	460	19	PWHT
E8015-B3L	80	550	67	460	17	PWHT
E8015-G	80	550	67	460	19	AW or PWHT
E8016-X	80	550	67	460	19	PWHT
E8016-C3	80	550	68 to 80 <sup>e</sup>	470 to 550 <sup>e</sup>	24	AW
E8016-C4	80	550	67	460	19	AW
E8016-G	80	550	67	460	19	AW or PWHT
E8018-X	80	550	67	460	19	PWHT
E8018-B3L	80	550	67	460	17	PWHT
E8018-C3	80	550	68 to 80 <sup>e</sup>	470 to 550 <sup>e</sup>	24	AW
E8018-C4	80	550	67	460	19	AW
E8018-NM1	80	550	67	460	19	AW
E8018-W2	80	550	67	460	19	AW
E8018-G	80	550	67	460	19	AW or PWHT

ANEXO M F No. del electrodo E8010-C3 (ASME 2010:134)

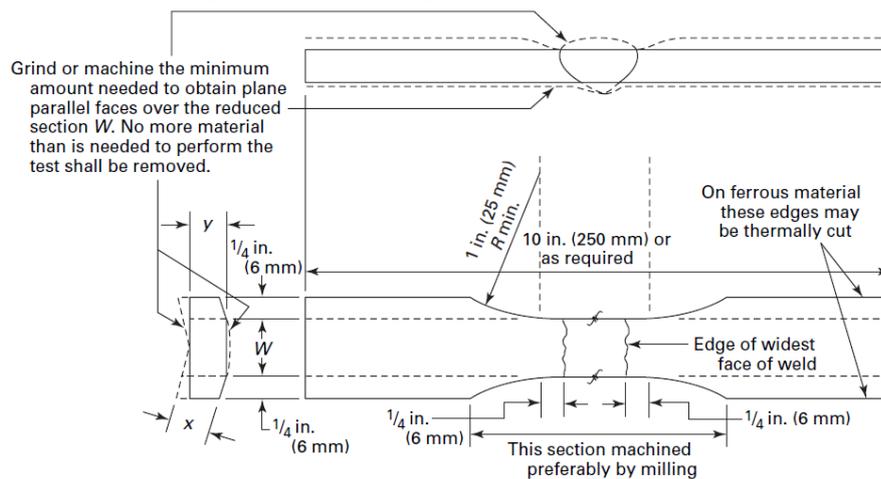
Steel and Steel Alloys

1	SFA-5.1	EXX20	...
1	SFA-5.1	EXX22	...
1	SFA-5.1	EXX24	...
1	SFA-5.1	EXX27	...
1	SFA-5.1	EXX28	...
1	SFA-5.4	EXXX(X)-26	...
1	SFA-5.5	EXX20-X	...
1	SFA-5.5	EXX27-X	...
2	SFA-5.1	EXX12	...
2	SFA-5.1	EXX13	...
2	SFA-5.1	EXX14	...
2	SFA-5.1	EXX19	...
2	SFA-5.5	E(X)XX13-X	...
3	SFA-5.1	EXX10	...
3	SFA-5.1	EXX11	...
3	SFA-5.5	E(X)XX10-X	...
3	SFA-5.5	E(X)XX11-X	...
4	SFA-5.1	EXX15	...
4	SFA-5.1	EXX16	...
4	SFA-5.1	EXX18	...
4	SFA-5.1	EXX18M	...
4	SFA-5.1	EXX48	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-15	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-16	...
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-17	...
4	SFA-5.5	E(X)XX15-X	...
4	SFA-5.5	E(X)XX16-X	...
4	SFA-5.5	E(X)XX18-X	...
4	SFA-5.5	E(X)XX18M	...
4	SFA-5.5	E(X)XX18M1	...
4	SFA-5.5	E(X)XX45	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-15	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-16	...
5	SFA-5.4 austenitic and duplex	EXXX(X)-17	...
6	SFA-5.2	All classifications	...
6	SFA-5.9	All classifications	...
6	SFA-5.17	All classifications	...
6	SFA-5.18	All classifications	...
6	SFA-5.20	All classifications	...
6	SFA-5.22	All classifications	...
6	SFA-5.23	All classifications	...
6	SFA-5.25	All classifications	...
6	SFA-5.26	All classifications	...
6	SFA-5.28	All classifications	...
6	SFA-5.29	All classifications	...
6	SFA-5.30	INMs-X	...
6	SFA-5.30	INsXX	...
6	SFA-5.30	INsXX(X)	...

ANEXO N Temperaturas de precalentamiento y de interfase mínima para diferentes condiciones (Fosca 2007:155)

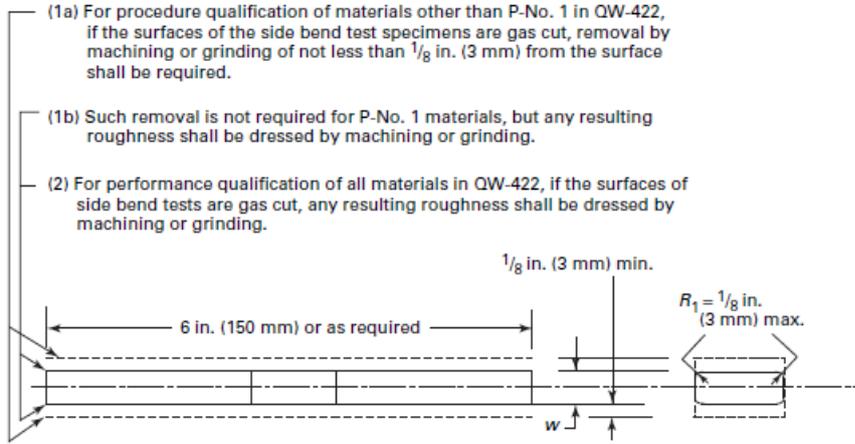
		Índice de susceptibilidad al agrietamiento						
Nivel de restricción	Espesor (mm)	A	B	C	D	E	F	G
		3,0	3,1-3,5	3,6-4,0	4,1-4,5	4,6-5,0	5,1-5,5	5,6-7,0
Bajo	<10	<20°	<20°	<20°	<20°	60°	140°	150°
	10 a 20	<20°	<20°	20°	60°	100°	140°	150°
	20 a 38	<20°	<20°	20°	80°	110°	140°	150°
	38 a 75	20°	20°	40°	95°	120°	140°	150°
	>75	20°	20°	40°	95°	120°	140°	150°
Medio	<10	<20°	<20°	<20°	<20°	70°	140°	160°
	10 a 20	<20°	<20°	20°	80°	115°	145°	160°
	20 a 38	20°	20°	75°	110°	140°	150°	160°
	38 a 75	20°	80°	110°	130°	150°	150°	160°
	>75	95°	120°	140°	150°	160°	160°	160°
Alto	<10	<20°	<20°	<20°	40°	110°	150°	160°
	10 a 20	<20°	20°	65°	105°	140°	160°	160°
	20 a 38	20°	85°	115°	140°	150°	160°	160°
	38 a 75	115°	130°	150°	150°	160°	160°	160°
	>75	115°	130°	150°	150°	160°	160°	160°

ANEXO O Configuración de probeta para ensayo de tracción (ASME 2010:158)

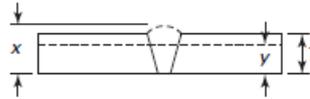


- T = coupon thickness excluding reinforcement
- W = specimen width, 3/4 in. (19 mm)
- x = coupon thickness including reinforcement
- y = specimen thickness

**ANEXO P** Configuración de probeta para ensayo de doblado lateral (ASME 2010:161)



T, in. (mm)	y, in. (mm)	w, in. (mm)	
		P-No. 23, F-No. 23, or P-No. 35	All other metals
$\frac{3}{8}$ to $< 1\frac{1}{2}$ (10 to $< 38$ )	T [Note (1)]	$\frac{1}{8}$ (3)	$\frac{3}{8}$ (10)
$\geq 1\frac{1}{2}$ ( $\geq 38$ )	Notes (1) and (2)	$\frac{1}{8}$ (3)	$\frac{3}{8}$ (10)



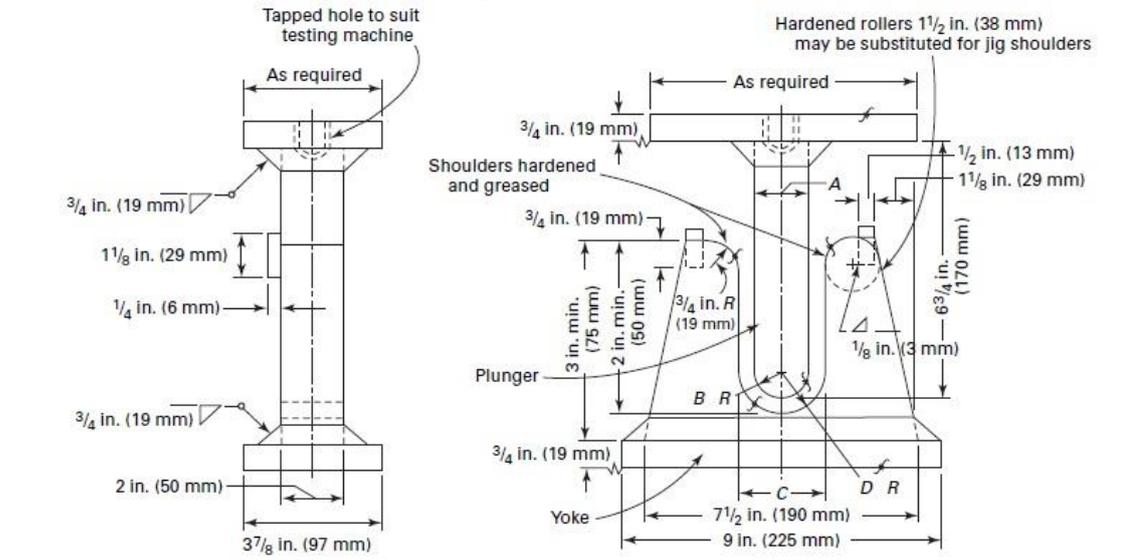
GENERAL NOTE: Weld reinforcement and backing strip or backing ring, if any, may be removed flush with the surface of the specimen. Thermal cutting, machining, or grinding may be employed. Cold straightening is permitted prior to removal of the reinforcement.

NOTES:

- (1) When weld deposit  $t$  is less than coupon thickness  $T$ , side-bend specimen thickness may be  $t$ .
- (2) When coupon thickness  $T$  equals or exceeds  $1\frac{1}{2}$  in. (38 mm), use one of the following:
  - (a) Cut specimen into multiple test specimens of thickness  $y$  of approximately equal dimensions [ $\frac{3}{4}$  in. (19 mm) to  $1\frac{1}{2}$  in. (38 mm)].  $y$  = tested specimen thickness when multiple specimens are taken from one coupon.
  - (b) The specimen may be bent at full width. See requirements on jig width in QW-466.1.



ANEXO Q Dimensiones del dispositivo de ensayo de doblado (ASME 2010:187)



SI Units

Material	Thickness of Specimen, mm	A, mm	B, mm	C, mm	D, mm
P-No. 23 to P-No. 21 through P-No. 25; P-No. 21 through P-No. 25 with F-No. 23; P-No. 35; any P-No. metal with F-No. 33, 36, or 37	3 $t = 3$ or less	52.4 $16\frac{1}{2}t$	26.2 $8\frac{3}{4}t$	60.4 $18\frac{1}{2}t + 1.6$	30.2 $9\frac{3}{4}t + 0.8$
P-No. 11; P-No.25 to P-No. 21 or P-No. 22 or P-No. 25	10 $t = 10$ or less	63.5 $6\frac{2}{5}t$	31.8 $3\frac{1}{2}t$	85.8 $8\frac{2}{5}t + 3.2$	42.9 $4\frac{1}{5}t + 1.6$
P-No. 51; P-No. 49	10 $t = 10$ or less	76.2 $8t$	38.1 $4t$	98.4 $10t + 3.2$	49.2 $5t + 1.6$
P-No. 52; P-No. 53; P-No. 61; P-No. 62	10 $t = 10$ or less	95.2 $10t$	47.6 $5t$	117.5 $12t + 3.2$	58.7 $6t + 1.6$
All others with greater than or equal to 20% elongation	10 $t = 10$ or less	38.1 $4t$	19.0 $2t$	60.4 $6t + 3.2$	30.2 $3t + 1.6$
Materials with 3% to less than 20% elongation	$t =$ [see Note (b)]	$32\frac{7}{16}t$ max.	$16\frac{7}{16}t$ max.	$A + 2t + 1.6$ max.	$\frac{1}{2}C + 0.8$ max.

GENERAL NOTES:

- (a) For P-Numbers, see QW/QB-422; for F-Numbers, see QW-432.
- (b) The dimensions of the test jig shall be such as to give the bend test specimen a calculated percent outer fiber elongation equal to at least that of the base material with the lower minimum elongation as specified in the base material specification.

$$\text{percent outer fiber elongation} = \frac{100t}{A + t}$$

The following formula is provided for convenience in calculating the bend specimen thickness:

$$\text{thickness of specimen } (t) = \frac{A \times \text{percent elongation}}{[100 - (\text{percent elongation})]}$$

- (c) For guided-bend jig configuration, see QW-466.2, QW-466.3, and QW-466.4.
- (d) The weld and heat-affected zone, in the case of a transverse weld bend specimen, shall be completely within the bend portion of the specimen after testing.
- (e) For materials with less than 3% elongation, a macro-etch specimen shall be used in lieu of bend test at each bend test location. Acceptance criteria shall be in accordance with QW-183(a).