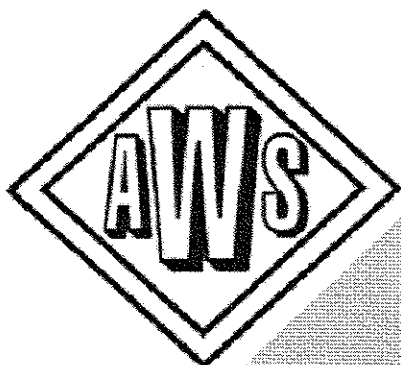




Book of Specs Ed. D Engl-Arabic 2008-12 TCD 8-11-2012

AMERICAN WELDING SOCIETY
WELDING INSPECTOR EXAMINATION

Part B

EXAMINATION BOOK OF SPECIFICATIONS

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Revision D: January 2006 with editorial corrections of December 2008 (2)

Conversions and Calculations

The International System of Units (SI) makes use of conversion factors and metric prefixes. Use the following tables:

Table of SI Conversions

PROPERTY	U.S. CUSTOMARY UNITS	SI UNITS	
	<i>To convert from</i>	<i>To</i>	<i>Multiply by</i>
force	pound-force (lbf)	newton (N)	4.5
	kip (1000 lbf)	newton	4450
linear dimension	inch (in)	millimeter (mm)	25.4
tensile strength	pounds per square inch (psi)	pascal (Pa)	6895
	(psi)	kilopascal (kPa)	6.89
	(psi)	megapascal (MPa)	0.00689
mass	pound mass (avdp)	kilogram	0.454
angle, plane	degree (angular) (°)	radian (rad)	0.0175
flow rate	cubic feet per hour (ft ³ /hr)	liters per minute (L/min)	0.472
heat input	joules per inch (J/in)	joules per meter (J/m)	39.4
travel speed, wire	inches per minute (in/min)	millimeter per second (mm/s)	0.423
temperature	degree Fahrenheit (°F)	degree Celsius (°C)	°C = (°F - 32)/1.8

Table of SI Prefixes

EXPONENTIAL EXPRESSION	MULTIPLICATION FACTOR	PREFIX	SYMBOL
10 ⁹	1 000 000 000	giga	G
10 ⁶	1 000 000	mega	M
10 ³	1 000	kilo	k
10 ⁻³	0.001	milli	m
10 ⁻⁶	0.000 001	micro	μ
10 ⁻⁹	0.000 000 001	nano	n

Formulas

PROPERTY	FORMULA		
ultimate tensile strength (uts)	uts = maximum load/original cross-sectional area		
cross-sectional area (csa)	csa = $\pi D^2/4$ (for circle) csa = width × thickness (for square or rectangle)		
temperature	degree Fahrenheit (°F)	degree Celsius (°C)	°C = (°F - 32)/1.8
	degree Celsius (°C)	degree Fahrenheit (°F)	°F = 1.8 × °C + 32

**This book is for examination purposes only.
It is not a working set of specifications nor a code.**

هذا الكتاب بغرض الامتحان فقط.

وهو ليس مجموعة مواصفات للعمل كما أنه ليس كود.

**The information contained herein may not match
the current editions of the referenced documents.**

يجوز ألا تتطابق المعلومات الواردة هنا مع

الطباعات الحالية من الوثائق المشار إليها.

Do not write in this book.

لا تكتب في هذا الكتاب.

APPENDIX I

WELDING PROCEDURE QUALIFICATION RECORD (PQR)

PROCEDURE SPECIFICATION

Material specification ASTM A 709 G36
Welding process [2]
Manual, semiautomatic, automatic: [3]
Position of welding [4]

Filler metal specification [5]
Filler metal classification [6]
Weld metal analysis [7]
Shielding gas [8]
Flow rate [9]
Single or multiple pass [10]
Single or multiple arc [11]
Welding current [12]
Welding progression [13]
Preheat temperature [14]
Welder's ID [15]
Welder's name [16]

GROOVE WELD TEST RESULTS

Tensile Strength, psi

1. 57,645 [24]
2. 63,795 [25]

Guided-Bend Tests (2 root-, 2 face-, or 4 side-bends)

Root	Face	Side
1. <u>[26]</u>	1. <u>[28]</u>	1. <u>[30]</u>
2. <u>[27]</u>	2. <u>[29]</u>	2. <u>[31]</u>
		3. <u>[32]</u>
		4. <u>[33]</u>

Radiographic-Ultrasonic Examination

RT Report No: [34]
UT Report No: [35]

FILLET WELD TEST RESULTS

Minimum size multiple pass Macroetch	Maximum size single pass Macroetch
1. <u>[36]</u>	1. <u>[39]</u>
2. <u>[37]</u>	2. <u>[40]</u>
3. <u>[38]</u>	3. <u>[41]</u>

VISUAL INSPECTION RESULTS

Appearance [17]
Undercut [18]
Piping porosity [19]

ALL-WELD-METAL TENSION TEST RESULTS

Tensile strength, psi [20]
Yield point/strength, psi [21]
Elongation in 2 in, % [22]
Laboratory Test No: [23]

Test Date [42]
Witnessed by [43]

WELDING PROCEDURE

Pass No.	Electrode Size	Welding Current		Speed of Travel	Joint Detail
		Amperes	Volts		
[44]	[45]	[46]	[47]	[48]	[49]

We, the undersigned, certify that the statements in this record are correct.

Procedure No. [50]
Revision No. [52]

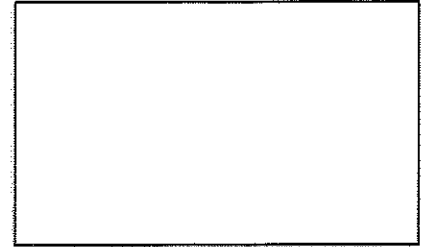
Manufacturer or Contractor [51]
Authorized by [53]
Date [54]

APPENDIX II-A

PERFORMANCE QUALIFICATION TEST RECORD (SMAW, GMAW, GTAW, FCAW, SAW, OFW, PAW)

Name _____ [1] Welder ☐ Welding Operator ☐
 I.D. No. _____ [2] WPS Used _____ [3]
 Process(es) _____ [3] Transfer Mode (GMAW) _____ [5]
 Test Base Metal Specification _____ [6] to _____ [7]
 Material Number _____ [8] to _____ [9]
 Fuel Gas (OFW) _____ [10]
 AWS Filler Metal Classification(s) _____ [11] F No. _____ [12]
 Backing Yes ☐ No ☐ Double Side ☐ Single Side ☐
 Current Polarity AC ☐ DCEP ☐ DCEN ☐
 Consumable Insert Yes ☐ No ☐ Backing Gas Yes ☐ No ☐

Test Joint Sketch



Test Weldment		Position Tested					Width (W)	Thickness (T)
Groove	Pipe	1G	2G	5G	6G		Thickness	Diameter
	Plate	1G	2G	3G	4G		Thickness	
Fillet	Pipe	1F	2F	2FR	4F	5F	Thickness	Diameter
	Plate	1F	2F	3F	4F		Thickness	
Cladding		1C	2C	3C	4C	5C	6C	Thickness
Hardfacing		1C	2C	3C	4C	5C	6C	Thickness

Progression Vertical Up ☐ Vertical Down ☐

TEST RESULTS

Visual Test Pass ☐ Fail ☐ N/A ☐
 Macro Test Pass ☐ Fail ☐ N/A ☐
 Break Test Pass ☐ Fail ☐ N/A ☐
 Bend Test Pass ☐ Fail ☐ N/A ☐
 Radiographic Test Pass ☐ Fail ☐ N/A ☐

REMARKS

[13]
 [14]
 [15]
 [16]
 [17]

QUALIFICATION LIMITS

Process(es)

Weldment		Position					Deposited Thickness		
Groove	Pipe	F	H	V	O	All	t min.	t max.	Dia. min.
	Plate		H	V	O	All	t min.	t max.	
Cladding		F	H	V	O	All	t min.	t max.	
Hardfacing		F	H		O	All	t min.	t max.	
Weldment		Position					Base Metal Thickness		
Fillet	Pipe	F	H	V	O	All	T min.	T max.	Dia. min.
	Plate	F		V	O	All	T min.	T max.	

Progression Vertical Up ☐ Vertical Down ☐

Base Metal M No(s) _____ [18]
 Filler Metal F No(s) _____ [20]
 Current Polarity AC ☐ DCEP ☐ DCEN ☐
 Backing Gas _____ [21]

Fuel Gas (OFW) _____ [19]
 Backing Yes ☐ No ☐
 Consumable Insert Yes ☐ No ☐
 Transfer Mode (GMAW) _____ [22]

We, the undersigned, certify that the statements in this record are correct.

Date tested _____ [23] Qualifier signature _____ [24]

Permission to reproduce granted by the American Welding Society.

APPENDIX II-B

Spectec, Inc.

905 Ridge Way, Eastern, Somewhere 84328, xxx-yyy-zzzz, FAX xxx-yyy-zzzz

WELDER PERFORMANCE QUALIFICATION RECORD

Welder's Name C. W. Practical ID No. 222-33-4444 Date 11-08-00
WPS No. D1.1-3G-U-CJP-B-307
Welding Process FCAW Type Manual
Specification or Code AWS D1.1:2000, Structural Welding Code-Steel

Base Metal

Material Spec/Type/Grade A 36 To: Material Spec/Type/Grade A 36
Thickness 1 in Thickness Range Qualified 1/8 in-Unlimited
Base Metal Preparation Base metal shall be clean and free of moisture, oil, dirt, paint, coatings, rust, scale, etc. Cleaning shall leave no residue.

Joint Welded Single V-Groove with steel backing
Type of Weld Joint (See Figure 4.21, Test Plate for Unlimited Thickness)
Bevel Angle 22.5° Root Face 0 Root Opening 1/4 in
Backing Yes ☒ No ☐ Backing Type 1/4 x 1 in Steel Strap

Electrode

F No. 4 Specification A 5.18 Classification E71T-1 Size Range 1/16th

Filler Metal

F No. 4 Specification A 5.18 Classification E71T-1 Size Range 1/16th

Preheat

Preheat 50°F min. Interpass Temperature Max. 400°F

Position

Position 3G Progression Up

TEST RESULTS

Visual	Bends	Radiographic	Metallographic
Pass ☒ Fail ☐	N/A ☐ Pass ☒ Fail ☐	N/A ☒ Pass ☐ Fail ☐	N/A ☒ Pass ☐ Fail ☐

Test conducted by _____ Laboratory test no. _____
per _____ Test date _____

QUALIFIED FOR

Base Metal Group No.	Type Weld	Current	Backing	Penetration	Vertical
I(a) (Carbon and Low-Alloy Steel)	Single Side ☒ Double Side ☐	AC ☐ DCEN ☐ DCEP ☒	With ☒ Type _____ Open Root ☐	Complete ☒ Partial ☐	Down ☐ Up ☒

	Position				t, in		OD, in	
					Min.	Max.	Min.	Max.
Plate—Groove	1G ☒	2G ☒	3G ☒	4G ☐	1/8	Unlimited		
Pipe/Tube—Groove	1G ☒	2G ☒	5G ☐	6G ☐	1/8	Unlimited	Over 24	Unlimited
Plate—Fillet	1F ☒	2F ☒	3F ☒	4F ☐	1/8	Unlimited		
Pipe/Tube—Fillet	1F ☒	2F ☒	5F ☐	6F ☐	1/8	Unlimited		

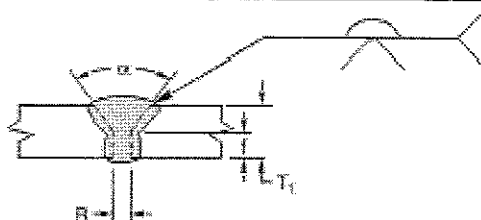
The above individual is qualified to the above limits in accordance with AWS D1.1:2000, Structural Welding Code—Steel.

Qualified By John Smith Position Weld Supervisor Date 11-10-00
(signature)

APPENDIX III

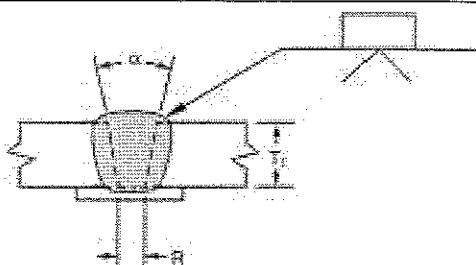
PREQUALIFIED COMPLETE JOINT PENETRATION GROOVE WELDED JOINTS

Single-V-groove weld (2)
Butt joint (B)



Welding Process	Joint Designation	Base Metal Thickness (U = unlimited)		Groove Preparation			Allowed Welding Positions	Gas Shielding for FCAW	Notes
				Root Opening Root Face Groove Angle	Tolerances				
		T ₁	T ₂		As Detailed	As Fitup			
SMAW	B-U2	U	—	R = 0 to 1/8 f = 0 to 1/8 α = 60°	+1/16, -0 +1/16, -0 +10°, -0°	+1/16, -1/8 Not limited +10°, -5°	All	—	b, c, d
GMAW FCAW	B-U2-GF	U	—	R = 0 to 1/8 f = 0 to 1/8 α = 60°	+1/16, -0 +1/16, -0 +10°, -0°	+1/16, -1/8 Not limited +10°, -5°	All	Not required	a, b, d
SAW	B-L2c-S	Over 1/2 to 1	—	R = 0 f = 1/4 max. α = 60°	R = ±0 f = +0, -f α = +10°, -0°	+1/16, -0 ±1/16 +10°, -5°	F	—	b, d
		Over 1 to 1-1/2	—	R = 0 f = 1/2 max. α = 60°					
		Over 1-1/2 to 2	—	R = 0 f = 5/8 max. α = 60°					

Single-V-groove weld (2)
Butt joint (B)



Tolerances	
As Detailed	As Fitup
R = +1/16, -0	+1/4, -1/16
$\alpha = +10^\circ, -0^\circ$	+10°, -5°

Welding Process	Joint Designation	Base Metal Thickness (U = unlimited)		Groove Preparation		Allowed Welding Positions	Gas Shielding for FCAW	Notes
		T ₁	T ₂	Root Opening	Groove Angle			
SMAW	B-U2a	U	—	R = 1/4	$\alpha = 45^\circ$	All	—	c, d
				R = 3/8	$\alpha = 30^\circ$	F, V, OH	—	c, d
				R = 1/2	$\alpha = 20^\circ$	F, V, OH	—	c, d
GMAW FCAW	B-U2a-GF	U	—	R = 3/16	$\alpha = 30^\circ$	F, V, OH	Required	a, d
				R = 3/8	$\alpha = 30^\circ$	F, V, OH	Not req.	a, d
				R = 1/4	$\alpha = 45^\circ$	F, V, OH	Not req.	a, d
SAW	B-L2a-S	2 max.	—	R = 1/4	$\alpha = 30^\circ$	F	—	d
SAW	B-U2-S	U	—	R = 5/8	$\alpha = 20^\circ$	F	—	d

^a Not prequalified for GMAW-S nor GTAW.

^b Backgouge root to sound metal before welding second side.

^c SMAW detailed joints may be used for prequalified GMAW (except GMAW-S) and FCAW.

^d The orientation of the two members in the joints may vary from 135° to 180° for butt joints, or 45° to 135° for corner joints, or 45° to 90° for Tjoints.

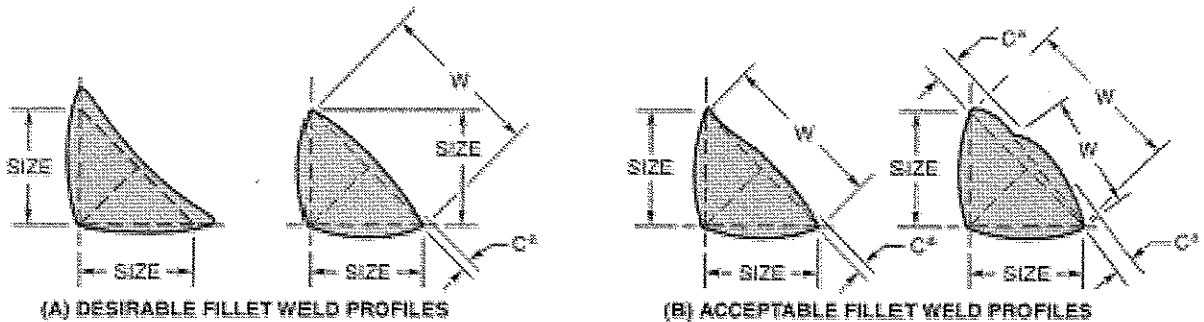
APPENDIX IV

PIPE SCHEDULES

Pipe Size	O.D. (in)	5s	5	10s	10	20	30	40s Std.	40	60	80s & E.H.	80	100	120	140	160	Dble. E.H.
1/8	0.405		0.035 0.1383	0.049 0.1863	0.049 0.1863			0.068 0.2447	0.068 0.2447		0.095 0.3145	0.095 0.3145					
1/4	0.540		0.049 0.2570	0.065 0.3297	0.065 0.3297			0.088 0.4248	0.088 0.4248		0.119 0.5351	0.119 0.5351					
3/8	0.675		0.049 0.3276	0.065 0.4235	0.065 0.4235			0.091 0.5676	0.091 0.5676		0.126 0.7388	0.126 0.7388					
1/2	0.840	0.065 0.5383	0.065 0.5383	0.083 0.6710	0.083 0.6710			0.109 0.8510	0.109 0.8510		0.147 1.088	0.147 1.088				0.188 1.304	0.294 1.714
3/4	1.050	0.065 0.6838	0.065 0.6838	0.083 0.8572	0.083 0.8572			0.113 1.131	0.113 1.131		0.154 1.474	0.154 1.474				0.219 1.937	0.308 2.441
1	1.315	0.065 0.8678	0.065 0.8678	0.109 1.404	0.109 1.404			0.133 1.679	0.133 1.679		0.179 2.172	0.179 2.172				0.250 2.844	0.358 3.659
1-1/4	1.660	0.065 1.107	0.065 1.107	0.109 1.806	0.109 1.806			0.140 2.273	0.140 2.273		0.191 2.997	0.191 2.997				0.250 3.765	0.382 5.214
1-1/2	1.900	0.065 1.274	0.065 1.274	0.109 2.085	0.109 2.085			0.145 2.718	0.145 2.718		0.200 3.631	0.200 3.631				0.281 4.859	0.400 6.408
2	2.375	0.065 1.604	0.065 1.604	0.109 2.638	0.109 2.638			0.154 3.653	0.154 3.653		0.218 5.022	0.218 5.022				0.344 7.444	0.436 9.029
2-1/2	2.875	0.083 2.475	0.083 2.475	0.120 3.531	0.120 3.531			0.203 5.793	0.203 5.793		0.276 7.661	0.276 7.661				0.375 10.01	0.552 13.70
3	3.500	0.083 3.029	0.083 3.029	0.120 4.332	0.120 4.332			0.216 7.576	0.216 7.576		0.300 10.25	0.300 10.25				0.438 14.32	0.600 18.58
3-1/2	4.000	0.083 3.472	0.083 3.472	0.120 4.973	0.120 4.973			0.226 9.109	0.226 9.109		0.318 12.51	0.318 12.51					0.636 22.65
4	4.500	0.083 3.915	0.083 3.915	0.120 5.613	0.120 5.613			0.237 10.79	0.237 10.79	0.281 12.66	0.337 14.98	0.337 14.98		0.438 19.01		0.531 22.51	0.674 27.54
4-1/2	5.000							0.247 12.53			0.355 17.61						0.710 32.53
5	5.563	0.109 6.349	0.109 6.349	0.134 7.770	0.134 7.770			0.238 14.62	0.258 14.62		0.375 20.78	0.375 20.78		0.500 27.04		0.625 32.96	0.750 38.55
6	6.625	0.109 7.585	0.109 7.585	0.134 9.290	0.134 9.290			0.280 18.97	0.280 18.97		0.432 28.57	0.432 28.57		0.562 36.39		0.719 45.30	0.864 43.16
7	7.625							0.301 23.57			0.500 38.05						0.875 63.08
8	8.625	0.109 9.914	0.109 9.914	0.148 13.40	0.148 13.40	0.250 22.36	0.277 24.70	0.322 28.55	0.322 28.55	0.406 35.64	0.500 43.39	0.500 43.39	0.594 50.87	0.719 60.93	0.812 67.76	0.906 74.69	0.875 72.42
9	9.625							0.342 33.90			0.500 48.72						
10	10.750	0.134 15.19	0.134 15.19	0.165 18.65	0.165 18.70	0.250 28.04	0.307 34.24	0.365 40.48	0.365 40.48	0.500 54.74	0.500 54.74	0.594 64.33	0.719 76.93	0.844 89.20	1.000 104.1	1.125 115.7	
11	11.750							0.375 45.55			0.500 60.07						
12	12.750	0.156 21.07	0.165 22.18	0.180 24.16	0.180 24.20	0.250 33.38	0.330 43.77	0.375 49.56	0.375 53.33	0.562 73.16	0.500 65.42	0.688 88.51	0.844 107.2	1.000 125.5	1.125 139.7	1.312 160.3	
14	14.000	0.156 23.07		0.188 27.73	0.250 36.71	0.312 45.68	0.375 54.57	0.375 54.57	0.438 63.37	0.594 84.91	0.500 72.09	0.750 106.1	0.938 130.7	1.094 150.7	1.250 170.2	1.406 189.1	
16	16.000	0.165 27.90		0.188 31.75	0.250 42.05	0.312 52.36	0.375 62.58	0.375 62.58	0.500 82.77	0.656 107.5	0.500 82.77	0.844 136.5	1.031 164.8	0.129 192.3	1.438 223.5	1.594 245.1	
18	18.000	0.165 31.43		0.188 35.76	0.250 47.39	0.312 59.03	0.438 82.06	0.375 70.59	0.562 104.8	0.750 138.2	0.500 93.45	0.938 170.8	1.156 208.0	1.375 244.1	1.562 274.2	1.781 308.5	
20	20.000	0.188 39.78		0.218 46.05	0.250 52.73	0.375 78.60	0.500 104.1	0.375 78.60	0.594 122.9	0.812 166.4	0.500 104.1	1.031 208.9	1.281 256.1	1.500 296.4	1.750 341.1	1.969 379.0	
24	24.000	0.218 55.37		0.250 63.41	0.250 63.41	0.375 94.62	0.562 140.8	0.375 94.62	0.688 171.2	0.969 238.1	0.500 125.5	1.219 296.4	1.531 367.4	1.812 429.4	2.062 483.1	2.343 541.9	
UPPER FIGURES Wall Thickness in inches		DIMENSIONS AND WEIGHTS OF SEAMLESS AND WELDED STEEL PIPE															LOWER FIGURES Weight per foot in pounds

APPENDIX V

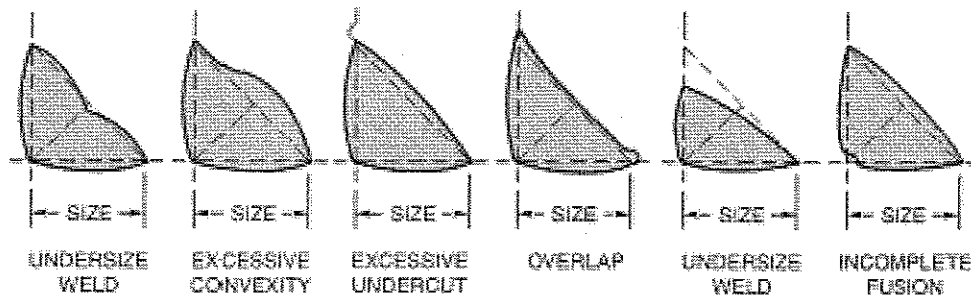
ACCEPTABLE AND UNACCEPTABLE WELD PROFILES



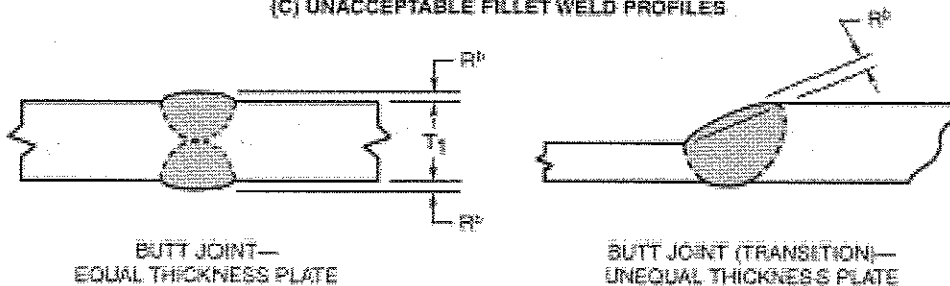
^aConvexity, C, of a weld or individual surface bead with dimension W shall not exceed the value of the following table:

0.3/2

WIDTH OF WELD FACE OR INDIVIDUAL SURFACE BEAD, W	MAX. CONVEXITY, C
$W \leq 5/16$ in.	1/16 in.
$W > 5/16$ in. TO $W < 1$ in.	1/8 in.
$W \geq 1$ in.	3/16 in.

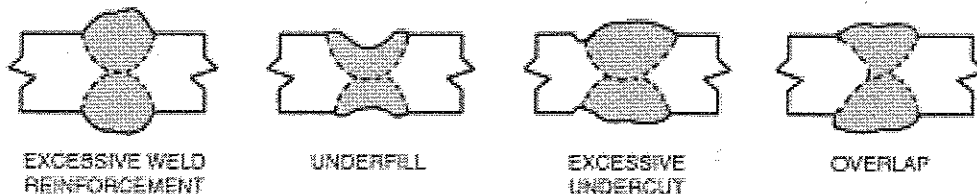


(C) UNACCEPTABLE FILLET WELD PROFILES



^bReinforcement R shall not exceed 1/8 in.

(D) ACCEPTABLE GROOVE WELD PROFILE IN BUTT JOINT



(E) UNACCEPTABLE GROOVE WELD PROFILES IN BUTT JOINTS