

AWS D1.1/D1.1M:2010
An American National Standard



Structural Welding Code— Steel



American Welding Society®



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An American National Standard

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Structural Welding Code— **Steel**

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Prepared by the
American Welding Society (AWS) D1 Committee on Structural Welding

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This code covers the welding requirements for any type of welded structure made from the commonly used carbon and low-alloy constructional steels. Clauses 1 through 8 constitute a body of rules for the regulation of welding in steel construction. There are nine normative and twelve informative annexes in this code. A Commentary of the code is included with the document.



American Welding Society®

550 N.W. LeJeune Road, Miami, FL 33126

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Dedication

The D1 Committee on Structural Welding and the D1Q Subcommittee on Steel Structures humbly dedicate this edition of D1.1/D1.1M, *Structural Welding Code—Steel*, to the memory of two longstanding volunteers.

FRED C. BREISMEISTER

1940–2009

Since 1985, Fred tirelessly helped improve several D1 Structural Welding Codes, including the D1.1, *Structural Welding Code—Steel*, D1.6, *Structural Welding Code—Stainless Steel*, and most recently the D1.8, *Structural Welding Code—Seismic Supplement*. For many years, he chaired the D1B Prequalification Subcommittee. The D1 Committee will unquestionably miss a dear friend and contributor to the team.

DONALD A. SHAPIRA

1956–2009

Since 1996, Don enthusiastically contributed to several D1 Codes, including D1.1, *Structural Welding Code—Steel*, D1.6, *Structural Welding Code—Stainless Steel*, and the D1.8, *Structural Welding Code—Seismic Supplement*. As an officer of the D1K Subcommittee, he oversaw the latest publication of D1.6, *Structural Welding Code—Stainless Steel*. The D1 Committee remembers Don's efforts with warm thoughts and appreciation.

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O. W. Blodgett	<i>The Lincoln Electric Company (Retired)</i>
M. V. Davis	<i>Consultant</i>

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Advisors to the D1M Standing Task Group on New Materials

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Foreword

This foreword is not part of AWS D1.1/D1.1M:2010, *Structural Welding Code—Steel*, but is included for informational purposes only.

The first edition of the *Code for Fusion Welding and Gas Cutting in Building Construction* was published by the American Welding Society in 1928 and called Code 1 Part A. It was revised and reissued in 1930 and 1937 under the same title. It was revised again in 1941 and given the designation D1.0. D1.0 was revised again in 1946, 1963, 1966, and 1969. The 1963 edition published an amended version in 1965, and the 1966 edition published an amended version in 1967. The code was combined with D2.0, *Specifications for Welding Highway and Railway Bridges*, in 1972, given the designation D1.1, and retitled *AWS Structural Welding Code*. D1.1 was revised again in 1975, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, and 2008. From 1972 to 1988, the D1.1 code covered the welding of both buildings and bridges. In 1988, AWS published its first edition of AASHTO/AWS D1.5, *Bridge Welding Code*; coincident with this, the D1.1 code changed references of buildings and bridges to statically loaded and dynamically loaded structures, respectively, in order to make the document applicable to a broader range of structural applications. This 2010 edition is the 22nd edition of D1.1.

Underlined text in the subclauses, tables, or figures indicates an editorial or technical change from the 2008 edition. A vertical line in the margin indicates a revision from the 2008 edition.

The following is a summary of the most significant technical revisions contained in D1.1/D1.1M:2010:

Clause 1.7—Revised for clarification.

Clause 2.3.3—Revised for clarification on ESW and EGW limitations.

Clause 3.3 Table—Revisions made to clarify differences between matching and under-matching filler metal strengths.

Clause 3.6—Revised in order to clarify prequalified essential variables.

Clause 3.7.3—Reference to “ASTM A 588” replaced to “weathering.”

Clause 3.13.2—New section added in order to clarify acceptable prequalified backing for CJP groove welds.

Table 3.1—Updated in accordance with the latest ASTM, ABS, and API specifications. Added ASTM A 709 HPS 50W material to Group II.

Table 3.2—Added ASTM A 709 Grade HPS 50W to Group B.

Table 3.3—Deleted note restricting its use to ASTM A 588 and A 709 only.

Table 3.8—New table added in order to clarify and list the essential variables for prequalified WPSs.

Figures 3.3 and 3.4 Note (c)—Revised to match verbiage in 2.18.2.

Clause 4.36.3—Revised to clarify when new CVN PQRs and WPSs are necessary.

Table 4.9—Added ASTM A 1043 Grades 36 and 50.

Table 4.10—Notes (1) and (2) have been deleted.

Table 4.12—Notes (3) and (4) have been deleted.

Clause 5.2.2.2—Revised to include shelf bar requirements.

Clause 5.10.2—Revised in order to clarify the requirements for full length backing in statically loaded applications.

Clause 5.15.4.3—Roughness requirements changed to meet the criteria in AWS C4.1.

Clause 5.17—Extensively revised provisions for beam copes and access holes. Added section for galvanized shapes.

Clause 5.24—Extensively revised section to address shelf bars and modified acceptable weld profiles.

Table 5.9—New table added to clarify applicable weld profiles.

Table 5.10—New table added to determine allowable convexity based on weld profile schedule thickness.

Figure 5.2—Notes and sketch changed to clarify web to flange access holes geometry.

Figure 5.4—Extensively revised to illustrate acceptable and unacceptable weld profiles for groove welds in butt joints, corner joints, T-joints, lap joints, as well as to address welds on shelf bars.

Clause 6.17.7—Modified to address pipe welds and steel backing.

Clause 6.22.7.7—Revised to cover other IIW type blocks.

Clause 6.23.1—Revised to allow the use of any IIW UT type blocks conforming to ASTM E 164.

Clause 6.29.2.3—Revised to address the number of indications for IIW type UT blocks.

Table 6.1(2)—Verbiage revised for clarification on acceptable fusion.

Table 6.6.—Notes (1) and (2) were deleted from table and incorporated into Clause 6.17.7.

Figure 6.19—Modified to address typical IIW type blocks.

Clause 6.26.6.4—Calculation for Attenuation Factor corrected in SI units.

Clause 7.2.5—Revised to specify unacceptable defects on stud finishes.

Clause 7.2.5.2—New section added to clarify acceptable and unacceptable cracks in headed studs.

Table 7.1—Note b modified to address concrete anchorage design.

Figure 7.1—Shank diameters for headed studs revised to be less restrictive. Also added 3/8 in [10 mm] studs.

Table I.2—Thickness range revised to be inclusive of 3/8 in [10 mm] and corrected metric values.

Annex K—Added new term for “shelf bar” and modified term for “NDT” to relate to the context of the D1 code only. The term “machine welding” was deleted and replaced with the standard term “mechanized welding” in the annex and throughout the code. The definitions for “tubular” and “pipe” have also been modified.

Annex N—Revised sample form for stud welding application N-9. Form N-3 has been corrected.

Clause C-3.7.3—Modified to address weathering steel in general instead of restricting to ASTM A 588 only.

C-Table 3.8—New commentary added to explain Table 3.8 on prequalified essential variables.

Clause C-5.4.1—New commentary section added concerning ESW and EGW processes.

Clause C-5.10.2—Commentary revised to address discontinuities in backing.

Clause C- 5.16—Commentary added regarding minimum radii for reentrant corners.

Clause C-5.17—Commentary content deleted and moved into Clause C-5.16.

Clause C-6.22.7.2—Revised to explain parameters of Tables 6.2 and 6.3.

Clause C-6.23—Modified to clarify the code’s allowance of IIW type blocks.

Clause 6.26.6—Commentary added to explain scanning techniques required by Tables 6.2 and 6.3.

Clause C-7.2.5—New calculation added to determine crack length or burst for headed studs.

Figure C-7.1—New figure added illustrating crack length calculation.

AWS B4.0, *Standard Methods for Mechanical Testing of Welds*, provides additional details of test specimen preparation and details of test fixture construction.

Commentary. The Commentary is nonmandatory and is intended only to provide insightful information into provision rationale.

Normative Annexes. These annexes address specific subjects in the code and their requirements are mandatory requirements that supplement the code provisions.

Informative Annexes. These annexes are not code requirements but are provided to clarify code provisions by showing examples, providing information, or suggesting alternative good practices.

Index. As in previous codes, the entries in the Index are referred to by subclause number rather than by page number. This should enable the user of the Index to locate a particular item of interest in minimum time.

Errata. It is the Structural Welding Committee's Policy that all errata should be made available to users of the code. Therefore, any significant errata will be published in the Society News Section of the *Welding Journal* and posted on the AWS web site at: <http://www.aws.org/technical/d1/>.

Suggestions. Your comments for improving AWS D1.1/D1.1M:2010, *Structural Welding Code—Steel* are welcome. Submit comments to the Managing Director, Technical Services Division, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; telephone (305) 443-9353; fax (305) 443-5951; e-mail info@aws.org; or via the AWS web site <<http://www.aws.org>>.

Errata

The following Errata have been identified and will be incorporated into the next reprinting of this document.

Page 8—2.4.3.6—Correct “2.3.2.8” reference to “2.4.2.8.”

Page 23—2.27.1.1—Correct “2.24” reference to “2.25.”

Page 132—4.19.1.1—Correct “Table 4.11” reference to “Table 4.10.”

Page 150—Note e—Correct “(see 4.12.4.2)” reference to “(see 4.13.4.2).”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection CJP Groove Welds, correct “Nominal Wall or Plate Thickness Qualified, in” to “Nominal Wall or Plate Thickness^d Qualified, in.”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection CJP Groove Welds, correct “Dihedral Angles Qualified^g” to “Dihedral Angles Qualified^h.”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection Fillet Welds, correct “Dihedral Angles Qualified^g” to “Dihedral Angles Qualified^h.”

Page 190—Figure 4.38—Correct metric dimension for 3/4 in from “[75 mm]” to “[20 mm].”

Page 192—Table 4.40—Correct metric dimension for 1/2 in from “[1/2 mm]” to “[12 mm].”

Page 200—5.18.2(1)—Correct “2.16.2” reference to “2.17.2.”

Page 202—5.22.1.1—Correct “2.13” reference to “2.14.”

Page 207—5.27—Correct “2.20.6.6(3)” reference to “2.21.6.6(3).”

Page 231—6.26.6.4—First sentence, fourth line, correct “...or be...” to “...or by....”

Page 281—7.1—Correct “C7.6.1” reference to “C-7.6.1.”

Page 496—C-Table 6.7—Correct three “Table 6.6” references to “Table 6.7.”

Page 497—C-6.26.6—This paragraph appears twice. Delete the first appearance.

Page 507—C-7.2.5—Correct last entry “CL ≤ 0.125 in” to read “CL ≤ 0.125 in [3.2 mm].”

Page 533—Index—PJP groove welds—Correct entry “4.14,4.20” to read “4.14, 4.21.”

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Table of Contents

	Page No.
<i>Dedication</i>	v
<i>Personnel</i>	vii
<i>Foreword</i>	xv
<i>List of Tables</i>	xxiv
<i>List of Figures</i>	xxvi
1. General Requirements	1
1.1 Scope	1
1.2 Limitations	1
1.3 Definitions	1
1.4 Responsibilities	2
1.5 Approval	2
1.6 Welding Symbols	3
1.7 Safety Precautions	3
1.8 Standard Units of Measurement	3
1.9 Reference Documents	3
2. Design of Welded Connections	5
2.1 <u>Scope</u>	5
Part A—Common Requirements for Design of Welded Connections (Nontubular and Tubular Members)	5
2.2 <u>General</u>	5
2.3 <u>Contract Plans and Specifications</u>	5
2.4 <u>Effective Areas</u>	6
Part B—Specific Requirements for Design of Nontubular Connections (Statically or Cyclically Loaded)	8
2.5 <u>General</u>	8
2.6 <u>Stresses</u>	8
2.7 <u>Joint Configuration and Details</u>	9
2.8 <u>Joint Configuration and Details—Groove Welds</u>	10
2.9 <u>Joint Configuration and Details—Fillet Welded Joints</u>	10
2.10 <u>Joint Configuration and Details—Plug and Slot Welds</u>	11
2.11 <u>Filler Plates</u>	11
2.12 <u>Built-Up Members</u>	12
Part C—Specific Requirements for Design of Nontubular Connections (Cyclically Loaded)	12
2.13 <u>General</u>	12
2.14 <u>Limitations</u>	12
2.15 <u>Calculation of Stresses</u>	13
2.16 <u>Allowable Stresses and Stress Ranges</u>	13
2.17 <u>Detailing, Fabrication, and Erection</u>	14
2.18 <u>Prohibited Joints and Welds</u>	15
2.19 <u>Inspection</u>	15
Part D—Specific Requirements for Design of Tubular Connections (Statically or Cyclically Loaded)	15
2.20 <u>General</u>	15
2.21 <u>Allowable Stresses</u>	15
2.22 <u>Identification</u>	17

2.23	Symbols.....	17
2.24	Weld Design	17
2.25	Limitations of the Strength of Welded Connections	18
2.26	Thickness Transition	22
2.27	Material Limitations.....	22
3.	Prequalification of WPSs.....	59
3.1	Scope.....	59
3.2	Welding Processes.....	59
3.3	Base Metal/Filler Metal Combinations	59
3.4	Engineer’s Approval for Auxiliary Attachments	60
3.5	Minimum Preheat and Interpass Temperature Requirements	60
3.6	Limitation of WPS Variables	60
3.7	General WPS Requirements.....	60
3.8	Common Requirements for Parallel Electrode and Multiple Electrode SAW	61
3.9	Fillet Weld Requirements.....	61
3.10	Plug and Slot Weld Requirements.....	61
3.11	Common Requirements of PJP and CJP Groove Welds	61
3.12	PJP Requirements	62
3.13	CJP Groove Weld Requirements.....	62
3.14	Postweld Heat Treatment	63
4.	Qualification	125
4.1	Scope.....	125
	Part A—General Requirements.....	125
4.2	General.....	125
4.3	Common Requirements for WPS and Welding Personnel Performance Qualification	126
	Part B—Welding Procedure Specification (WPS)	126
4.4	Production Welding Positions Qualified	126
4.5	Type of Qualification Tests	126
4.6	Weld Types for WPS Qualification.....	126
4.7	Preparation of WPS.....	126
4.8	Essential Variables	127
4.9	Methods of Testing and Acceptance Criteria for WPS Qualification	127
4.10	CJP Groove Welds for Nontubular Connections.....	129
4.11	PJP Groove Welds for Nontubular Connections	129
4.12	Fillet Welds for Tubular and Nontubular Connections	129
4.13	CJP Groove Welds for Tubular Connections	130
4.14	PJP Tubular T-, Y-, or K-Connections and Butt Joints.....	131
4.15	Plug and Slot Welds for Tubular and Nontubular Connections	131
4.16	Welding Processes Requiring Qualification.....	131
4.17	WPS Requirement (GTAW).....	132
4.18	WPS Requirements (ESW/EGW).....	132
	Part C—Performance Qualification	132
4.19	General	132
4.20	Type of Qualification Tests Required.....	132
4.21	Weld Types for Welder and Welding Operator Performance Qualification.....	133
4.22	Preparation of Performance Qualification Forms	133
4.23	Essential Variables	133
4.24	CJP Groove Welds for Nontubular Connections.....	133
4.25	PJP Groove Welds for Nontubular Connections	134

4.26	Fillet Welds for Nontubular Connections.....	134
4.27	CJP Groove Welds for Tubular Connections	134
4.28	PJP Groove Welds for Tubular Connections.....	134
4.29	Fillet Welds for Tubular Connections	134
4.30	Plug and Slot Welds for Tubular and Nontubular Connections	134
4.31	Methods of Testing and Acceptance Criteria for Welder and Welding Operator Qualification	134
4.32	Method of Testing and Acceptance Criteria for Tack Welder Qualification.....	136
4.33	Retest.....	136
	Part D—Requirements for CVN Testing	136
4.34	General	136
4.35	Test Locations	136
4.36	CVN Tests	137
4.37	Test Requirements.....	137
4.38	Retest.....	137
4.39	Reporting.....	137
5.	Fabrication.....	193
5.1	Scope.....	193
5.2	Base Metal.....	193
5.3	Welding Consumables and Electrode Requirements	193
5.4	ESW and EGW Processes.....	195
5.5	WPS Variables.....	195
5.6	Preheat and Interpass Temperatures.....	196
5.7	Heat Input Control for Quenched and Tempered Steels	196
5.8	Stress-Relief Heat Treatment	196
5.9	Backing, Backing Gas, or Inserts.....	197
5.10	Backing	197
5.11	Welding and Cutting Equipment.....	197
5.12	Welding Environment	197
5.13	Conformance with Design	198
5.14	Minimum Fillet Weld Sizes	198
5.15	Preparation of Base Metal.....	198
5.16	Reentrant Corners	199
5.17	<u>Weld Access Holes, Beam Copes, and Connection Material</u>	200
5.18	Tack Welds and Construction Aids	200
5.19	Camber in Built-Up Members.....	201
5.20	Splices in Cyclically Loaded Structures	201
5.21	Control of Distortion and Shrinkage.....	201
5.22	Tolerance of Joint Dimensions.....	201
5.23	Dimensional Tolerance of Welded Structural Members	203
5.24	Weld Profiles	205
5.25	Technique for Plug and Slot Welds.....	205
5.26	Repairs	205
5.27	Peening.....	206
5.28	Caulking.....	207
5.29	Arc Strikes.....	207
5.30	Weld Cleaning.....	207
5.31	Weld Tabs.....	207
6.	Inspection.....	219
	Part A—General Requirements.....	219
6.1	Scope.....	219
6.2	Inspection of Materials and Equipment	220

	Page No.
6.3 Inspection of WPSs.....	220
6.4 Inspection of Welder, Welding Operator, and Tack Welder Qualifications	220
6.5 Inspection of Work and Records	220
Part B—Contractor Responsibilities.....	221
6.6 Obligations of the Contractor.....	221
Part C—Acceptance Criteria.....	221
6.7 Scope.....	221
6.8 Engineer’s Approval for Alternate Acceptance Criteria	221
6.9 Visual Inspection.....	221
6.10 PT and MT	221
6.11 NDT	222
6.12 RT.....	222
6.13 UT	223
Part D—NDT Procedures	224
6.14 Procedures	224
6.15 Extent of Testing	225
Part E—Radiographic Testing (RT).....	225
6.16 RT of Groove Welds in Butt Joints	225
6.17 RT Procedures	225
6.18 Supplementary RT Requirements for Tubular Connections	227
6.19 Examination, Report, and Disposition of Radiographs.....	228
Part F—Ultrasonic Testing (UT) of Groove Welds.....	228
6.20 General.....	228
6.21 Qualification Requirements	228
6.22 UT Equipment.....	228
6.23 Reference Standards.....	229
6.24 Equipment Qualification	229
6.25 Calibration for Testing	230
6.26 Testing Procedures	230
6.27 UT of Tubular T-, Y-, and K-Connections	232
6.28 Preparation and Disposition of Reports	233
6.29 Calibration of the UT Unit with IIW <u>Type</u> or Other Approved Reference Blocks (Annex H).....	234
6.30 Equipment Qualification Procedures	235
6.31 Discontinuity Size Evaluation Procedures	236
6.32 Scanning Patterns	237
6.33 Examples of dB Accuracy Certification.....	237
Part G—Other Examination Methods.....	237
6.34 General Requirements.....	237
6.35 Radiation Imaging Systems	237
6.36 Advanced Ultrasonic Systems.....	237
6.37 Additional Requirements	238
7. Stud Welding	281
7.1 Scope.....	281
7.2 General Requirements.....	281
7.3 Mechanical Requirements.....	282
7.4 Workmanship/Fabrication	282
7.5 Technique	282
7.6 Stud Application Qualification Requirements	283

	Page No.
7.7 Production Control	284
7.8 Fabrication and Verification Inspection Requirements	285
7.9 Manufacturers' Stud Base Qualification Requirements.....	285
8. Strengthening and Repairing Existing Structures	291
8.1 General	291
8.2 Base Metal.....	291
8.3 Design for Strengthening and Repair	291
8.4 Fatigue Life Enhancement	291
8.5 Workmanship and Technique	292
8.6 Quality	292
<i>Annexes</i>	293
Annex A (Normative)—Effective Throat	295
Annex B (Normative)—Effective Throats of Fillet Welds in Skewed T-Joints.....	297
Annex D (Normative)—Flatness of Girder Webs—Statically Loaded Structures.....	301
Annex E (Normative)—Flatness of Girder Webs—Cyclically Loaded Structures	305
Annex F (Normative)—Temperature-Moisture Content Charts	311
Annex G (Normative)—Manufacturers' Stud Base Qualification Requirements.....	315
Annex H (Normative)—Qualification and Calibration of UT Units with Other Approved Reference Blocks.....	317
Annex I (Normative)—Guideline on Alternative Methods for Determining Preheat.....	321
Annex J (Normative)—Symbols for Tubular Connection Weld Design	331
Annex K (Informative)—Terms and Definitions	333
Annex L (Informative)—Guide for Specification Writers	341
Annex M (Informative)—UT Equipment Qualification and Inspection Forms	343
Annex N (Informative)—Sample Welding Forms	353
Annex O (Informative)—Guidelines for the Preparation of Technical Inquiries for the Structural Welding Committee	365
Annex P (Informative)—Local Dihedral Angle	367
Annex Q (Informative)—Contents of Prequalified WPS.....	373
Annex R (Informative)—Safe Practices	375
Annex S (Informative)—UT Examination of Welds by Alternative Techniques	379
Annex T (Informative)—Ovalizing Parameter Alpha	395
Annex U (Informative)—List of Reference Documents	397
Annex V (Informative)—Filler Metal Strength Properties	399
<i>Commentary</i>	411
Foreword.....	413
Index	527
List of AWS Documents on Structural Welding.....	539

List of Tables

Table	Page No.
2.1	Effective Size of Flare-Groove Welds Filled Flush..... 24
2.2	Z Loss Dimension (Nontubular) 24
2.3	Allowable Stresses 25
2.4	Equivalent Strength Coefficients for Obliquely Loaded Fillet Welds..... 26
2.5	Fatigue Stress Design Parameters 27
2.6	Allowable Stresses in Tubular Connection Welds 37
2.7	Stress Categories for Type and Location of Material for Circular Sections 39
2.8	Fatigue Category Limitations on Weld Size or Thickness and Weld Profile (Tubular Connections)..... 41
2.9	Z Loss Dimensions for Calculating Prequalified PJP T-, Y-, and K-Tubular Connection Minimum Weld Sizes..... 41
2.10	Terms for Strength of Connections (Circular Sections)..... 42
3.1	Prequalified Base Metal—Filler Metal Combinations for Matching Strength 64
3.2	Prequalified Minimum Preheat and Interpass Temperature..... 68
3.3	Filler Metal Requirements for Exposed Bare Applications of Weathering Steels..... 71
3.4	Minimum Prequalified PJP Weld Size (E)..... 71
3.5	Joint Detail Applications for Prequalified CJP T-, Y-, and K-Tubular Connections..... 71
3.6	Prequalified Joint Dimensions and Groove Angles for CJP Groove Welds in Tubular T-, Y, and K-Connections Made by SMAW, GMAW-S, and FCAW..... 72
3.7	Prequalified WPS Requirements..... 73
3.8	<u>Prequalified WPS Variables</u> 74
4.1	WPS Qualification—Production Welding Positions Qualified by Plate, Pipe, and Box Tube Tests 138
4.2	WPS Qualification—CJP Groove Welds: Number and Type of Test Specimens and Range of Thickness and Diameter Qualified..... 139
4.3	Number and Type of Test Specimens and Range of Thickness Qualified—WPS Qualification; PJP Groove Welds..... 141
4.4	Number and Type of Test Specimens and Range of Thickness Qualified—WPS Qualification; Fillet Welds 141
4.5	PQR Essential Variable Changes Requiring WPS Requalification for SMAW, SAW, GMAW, FCAW, and GTAW 142
4.6	PQR Supplementary Essential Variable Changes for CVN Testing Applications Requiring WPS Requalification for SMAW, SAW, GMAW, FCAW, and GTAW 145
4.7	PQR Essential Variable Changes Requiring WPS Requalification for ESW or EGW 146
4.8	Table 3.1, Table 4.9, and Unlisted Steels Qualified by PQR 147
4.9	Code-Approved Base Metals and Filler Metals Requiring Qualification per Clause 4 148
4.10	Welder and Welding Operator Qualification—Production Welding Positions Qualified by Plate, Pipe, and Box Tube Tests 150
4.11	Welder and Welding Operator Qualification—Number and Type of Specimens and Range of Thickness and Diameter Qualified..... 151
4.12	Welding Personnel Performance Essential Variable Changes Requiring Requalification 155
4.13	Electrode Classification Groups..... 155
4.14	CVN Test Requirements 156
4.15	CVN Test Temperature Reduction 156
5.1	Allowable Atmospheric Exposure of Low-Hydrogen Electrodes..... 208
5.2	Minimum Holding Time 208
5.3	Alternate Stress-Relief Heat Treatment 208

Table	Page No.
5.4	Limits on Acceptability and Repair of Mill Induced Laminar Discontinuities in Cut Surfaces.....208
5.5	Tubular Root Opening Tolerances209
5.6	Camber Tolerance for Typical Girder209
5.7	Camber Tolerance for Girders without a Designed Concrete Haunch.....209
5.8	Minimum Fillet Weld Sizes209
<u>5.9</u>	<u>Weld Profiles</u>210
<u>5.10</u>	<u>Weld Profile Schedules</u>210
6.1	Visual Inspection Acceptance Criteria239
6.2	UT Acceptance-Rejection Criteria (Statically Loaded Nontubular Connections).....240
6.3	UT Acceptance-Rejection Criteria (Cyclically Loaded Nontubular Connections).....241
6.4	Hole-Type IQI Requirements242
6.5	Wire IQI Requirements242
6.6	IQI Selection and Placement.....243
6.7	Testing Angle244
7.1	Mechanical Property Requirements for Studs287
7.2	Minimum Fillet Weld Size for Small Diameter Studs287
B.1	Equivalent Fillet Weld Leg Size Factors for Skewed T-Joints298
D.1	Intermediate Stiffeners on Both Sides of Web302
D.2	No Intermediate Stiffeners302
D.3	Intermediate Stiffeners on One Side Only of Web.....303
E.1	Intermediate Stiffness on Both Sides of Web, Interior Girders.....306
E.2	Intermediate Stiffness on One Side Only of Web, Fascia Girders307
E.3	Intermediate Stiffness on One Side Only of Web, Interior Girders308
E.4	Intermediate Stiffness on Both Sides of Web, Fascia Girders309
E.5	No Intermediate Stiffeners, Interior or Fascia Girders.....309
I.1	Susceptibility Index Grouping as Function of Hydrogen Level “H” and Composition Parameter P_{cm}324
I.2	Minimum Preheat and Interpass Temperatures for Three Levels of Restraint324
S.1	Acceptance-Rejection Criteria384
<i>Commentary</i>	
C-2.1	Survey of Diameter/Thickness and Flat Width/Thickness Limits for Tubes436
C-2.2	Suggested Design Factors437
C-2.3	Values of JD437
C-2.4	Structural Steel Plates438
C-2.5	Structural Steel Pipe and Tubular Shapes439
C-2.6	Structural Steel Shapes.....439
C-2.7	Classification Matrix for Applications.....440
C-2.8	CVN Testing Conditions440
C-3.1	Typical Current Ranges for GMAW-S on Steel459
C-4.1	CVN Test Values469
C-4.2	HAZ CVN Test Values.....469
C-6.1	UT Acceptance Criteria for 2 in [50 mm] Welding, Using a 70° Probe500
C-8.1	Guide to Welding Suitability.....517
C-8.2	Relationship Between Plate Thickness and Burr Radius517

List of Figures

Figure	Page No.
2.1	Maximum Fillet Weld Size Along Edges in Lap Joints 43
2.2	Transition of Butt Joints in Parts of Unequal Thickness (Cyclically Loaded Nontubular) 44
2.3	Transition of Thicknesses (Statically Loaded Nontubular)..... 45
2.4	Transversely Loaded Fillet Welds 45
2.5	Minimum Length of Longitudinal Fillet Welds at End of Plate or Flat Bar Members 46
2.6	Termination of Welds Near Edges Subject to Tension..... 46
2.7	End Return at Flexible Connections 47
2.8	Fillet Welds on Opposite Sides of a Common Plane 47
2.9	Thin Filler Plates in Splice Joint 48
2.10	Thick Filler Plates in Splice Joint 48
2.11	Allowable Stress Range for Cyclically Applied Load (Fatigue) in Nontubular Connections (Graphical Plot of Table 2.5)..... 49
2.12	Transition of Width (Cyclically Loaded Nontubular)..... 50
2.13	Allowable Fatigue Stress and Strain Ranges for Stress Categories (see Table 2.7), Redundant Tubular Structures for Atmospheric Service..... 50
2.14	Parts of a Tubular Connection..... 51
2.15	Fillet Welded Lap Joint (Tubular) 54
2.16	Tubular T-, Y-, and K-Connection Fillet Weld Footprint Radius 54
2.17	Punching Shear Stress..... 55
2.18	Detail of Overlapping Joint..... 55
2.19	Limitations for Box T-, Y-, and K-Connections..... 56
2.20	Overlapping K-Connections..... 56
2.21	Transition of Thickness of Butt Joints in Parts of Unequal Thickness (Tubular) 57
3.1	Weld Bead in which Depth and Width Exceed the Width of the Weld Face 76
3.2	Fillet Welded Prequalified Tubular Joints Made by SMAW, GMAW, and FCAW 76
3.3	Prequalified PJP Groove Welded Joint Details (Dimensions in Millimeters)..... 78
3.4	Prequalified CJP Groove Welded Joint Details (Dimensions in Inches) 94
3.5	Prequalified Joint Details for PJP T-, Y-, and K-Tubular Connections 116
3.6	Prequalified Joint Details for CJP T-, Y-, and K-Tubular Connections 119
3.7	Definitions and Detailed Selections for Prequalified CJP T-, Y-, and K-Tubular Connections 120
3.8	Prequalified Joint Details for CJP Groove Welds in Tubular T-, Y-, and K-Connections— Standard Flat Profiles for Limited Thickness 121
3.9	Prequalified Joint Details for CJP Groove Welds in Tubular T-, Y-, and K-Connections— Profile with Toe Fillet for Intermediate Thickness 122
3.10	Prequalified Joint Details for CJP Groove Welds in Tubular T-, Y-, and K-Connections— Concave Improved Profile for Heavy Sections or Fatigue..... 123
3.11	Prequalified Skewed T-Joint Details (Nontubular) 124
4.1	Positions of Groove Welds 157
4.2	Positions of Fillet Welds 158
4.3	Positions of Test Plates for Groove Welds 159
4.4	Positions of Test Pipe or Tubing for Groove Welds..... 160
4.5	Positions of Test Plate for Fillet Welds 161
4.6	Positions of Test Pipes or Tubing for Fillet Welds..... 162
4.7	Location of Test Specimens on Welded Test Pipe 163
4.8	Location of Test Specimens for Welded Box Tubing 164

Figure	Page No.
4.9	Location of Test Specimens on Welded Test Plates—ESW and EGW—WPS Qualification 165
4.10	Location of Test Specimens on Welded Test Plate Over 3/8 in [10 mm] Thick—WPS Qualification 166
4.11	Location of Test Specimens on Welded Test Plate 3/8 in [10 mm] Thick and Under— WPS Qualification 167
4.12	Face and Root Bend Specimens 168
4.13	Side Bend Specimens 169
4.14	Reduced-Section Tension Specimens 170
4.15	Guided Bend Test Jig 171
4.16	Alternative Wraparound Guided Bend Test Jig 172
4.17	Alternative Roller-Equipped Guided Bend Test Jig for Bottom Ejection of Test Specimen 172
4.18	All-Weld-Metal Tension Specimen 173
4.19	Fillet Weld Soundness Tests for WPS Qualification 174
4.20	Pipe Fillet Weld Soundness Test—WPS Qualification 175
4.21	Test Plate for Unlimited Thickness—Welder Qualification 176
4.22	Test Plate for Unlimited Thickness—Welding Operator Qualification 176
4.23	Location of Test Specimen on Welded Test Plate 1 in [25 mm] Thick—Consumables Verification for Fillet Weld WPS Qualification 177
4.24	Tubular Butt Joint—Welder or WPS Qualification—without Backing 178
4.25	Tubular Butt Joint—WPS Qualification with and without Backing 178
4.26	Acute Angle Heel Test (Restraints not Shown) 179
4.27	Test Joint for T-, Y-, and K-Connections without Backing on Pipe or Box Tubing—Welder and WPS Qualification 180
4.28	Test Joint for T-, Y-, and K-Connections without Backing on Pipe or Box Tubing (<4 in [100 mm] O.D.)—Welder and WPS Qualification 181
4.29	Corner Macroetch Test Joint for T-, Y-, and K-Connections without Backing on Box Tubing for CJP Groove Welds—Welder and WPS Qualification 182
4.30	Optional Test Plate for Unlimited Thickness—Horizontal Position—Welder Qualification 183
4.31	Test Plate for Limited Thickness—All Positions—Welder Qualification 184
4.32	Optional Test Plate for Limited Thickness—Horizontal Position—Welder Qualification 185
4.33	Fillet Weld Root Bend Test Plate—Welder or Welding Operator Qualification—Option 2 186
4.34	Location of Test Specimens on Welded Test Pipe and Box Tubing—Welder Qualification 187
4.35	Method of Rupturing Specimen—Tack Welder Qualification 188
4.36	Butt Joint for Welding Operator Qualification—ESW and EGW 188
4.37	Fillet Weld Break and Macroetch Test Plate—Welder or Welding Operator Qualification Option 1 189
4.38	Plug Weld Macroetch Test Plate—Welder or Welding Operator Qualification and WPS Qualification 190
4.39	Fillet Weld Break Specimen—Tack Welder Qualification 191
4.40	CVN Test Specimen Locations 192
5.1	Edge Discontinuities in Cut Material 211
5.2	Weld Access Hole Geometry 212
5.3	Workmanship Tolerances in Assembly of Groove Welded Joints 213
5.4	<u>Requirements for Weld Profiles</u> 214
6.1	Discontinuity Acceptance Criteria for Statically Loaded Nontubular and Statically or Cyclically Loaded Tubular Connections 247
6.2	Discontinuity Acceptance Criteria for Cyclically Loaded Nontubular Connections in Tension (Limitations of Porosity and Fusion Discontinuities) 252
6.3	Discontinuity Acceptance Criteria for Cyclically Loaded Nontubular Connections in Compression (Limitations of Porosity or Fusion-Type Discontinuities) 257
6.4	Class R Indications 262
6.5	Class X Indications 264
6.6	Hole-Type IQI 265
6.7	Wire IQI 266

Figure	Page No.
6.8	RT Identification and Hole-Type or Wire IQI Locations on Approximately Equal Thickness Joints 10 in [250 mm] and Greater in Length 267
6.9	RT Identification and Hole-Type or Wire IQI Locations on Approximately Equal Thickness Joints Less than 10 in [250 mm] in Length 268
6.10	RT Identification and Hole-Type or Wire IQI Locations on Transition Joints 10 in [250 mm] and Greater in Length 269
6.11	RT Identification and Hole-Type or Wire IQI Locations on Transition Joints Less than 10 in [250 mm] in Length 270
6.12	RT Edge Blocks 270
6.13	Single-Wall Exposure—Single-Wall View 271
6.14	Double-Wall Exposure—Single-Wall View 271
6.15	Double-Wall Exposure—Double-Wall (Elliptical) View, Minimum Two Exposures 272
6.16	Double-Wall Exposure—Double-Wall View, Minimum Three Exposures 272
6.17	Transducer Crystal 273
6.18	Qualification Procedure of Search Unit Using IIW Reference Block 273
6.19	<u>Typical IIW Type Block</u> 274
6.20	Qualification Blocks 275
6.21	Plan View of UT Scanning Patterns 277
6.22	Scanning Techniques 278
6.23	Transducer Positions (Typical) 279
7.1	Dimension and Tolerances of Standard-Type <u>Headed Studs</u> 288
7.2	Typical Tension Test Fixture 288
7.3	Torque Testing Arrangement and Table of Testing Torques 289
7.4	Bend Testing Device 290
7.5	Suggested Type of Device for Qualification Testing of Small Studs 290
F.1	Temperature-Moisture Content Chart to be Used in Conjunction with Testing Program to Determine Extended Atmospheric Exposure Time of Low-Hydrogen SMAW Electrodes 312
F.2	Application of Temperature-Moisture Content Chart in Determining Atmospheric Exposure Time of Low-Hydrogen SMAW Electrodes 313
H.1	Other Approved Blocks and Typical Transducer Position 319
I.1	Zone Classification of Steels 326
I.2	Critical Cooling Rate for 350 HV and 400 HV 326
I.3	Graphs to Determine Cooling Rates for Single-Pass SAW Fillet Welds 327
I.4	Relation Between Fillet Weld Size and Energy Input 330
S.1	Standard Reference Reflector 385
S.2	Recommended Calibration Block 385
S.3	Typical Standard Reflector (Located in Weld Mock-Ups and Production Welds) 386
S.4	Transfer Correction 387
S.5	Compression Wave Depth (Horizontal Sweep Calibration) 387
S.6	Compression Wave Sensitivity Calibration 388
S.7	Shear Wave Distance and Sensitivity Calibration 388
S.8	Scanning Methods 389
S.9	Spherical Discontinuity Characteristics 390
S.10	Cylindrical Discontinuity Characteristics 390
S.11	Planar Discontinuity Characteristics 391
S.12	Discontinuity Height Dimension 391
S.13	Discontinuity Length Dimension 392
S.14	Display Screen Marking 392
S.15	Report of UT (Alternative Procedure) 393
T.1	Definition of Terms for Computed Alpha 395
<i>Commentary</i>	
C-2.1	Balancing of Fillet Welds About a Neutral Axis 441
C-2.2	Shear Planes for Fillet and Groove Welds 441

Figure	Page No.
C-2.3 Eccentric Loading	442
C-2.4 Load Deformation Relationship for Welds	442
C-2.5 Example of an Obliquely Loaded Weld Group.....	443
C-2.6 Graphical Solution of the Capacity of an Obliquely Loaded Weld Group	444
C-2.7 Single Fillet Welded Lap Joints	445
C-2.8 Illustrations of Branch Member Stresses Corresponding to Mode of Loading	445
C-2.9 Improved Weld Profile Requirements	446
C-2.10 Simplified Concept of Punching Shear	446
C-2.11 Reliability of Punching Shear Criteria Using Computed Alpha	447
C-2.12 Transition Between Gap and Overlap Connections	448
C-2.13 Upper Bound Theorem.....	448
C-2.14 Yield Line Patterns	449
C-3.1 Oscillograms and Sketches of GMAW-S Metal Transfer	459
C-3.2 Examples of Centerline Cracking	460
C-3.3 Details of Alternative Groove Preparations for Prequalified Corner Joints.....	460
C-4.1 Type of Welding on Pipe That Does Not Require Pipe Qualification.....	469
C-5.1 Examples of Unacceptable Reentrant Corners.....	480
C-5.2 Examples of Good Practice for Cutting Copcs	480
C-5.3 Permissible Offset in Abutting Members.....	481
C-5.4 Correction of Misaligned Members	481
C-5.5 Typical Method to Determine Variations in Girder Web Flatness	482
C-5.6 Illustration Showing Camber Measurement Methods.....	483
C-5.7 Measurement of Flange Warpage and Tilt	484
C-5.8 Tolerances at Bearing Points	485
C-6.1 90° T- or Corner Joints with Steel Backing	501
C-6.2 Skewed T- or Corner Joints	501
C-6.3 Butt Joints with Separation Between Backing and Joint	502
C-6.4 Effect of Root Opening on Butt Joints with Steel Backing	502
C-6.5 Scanning with Seal Welded Steel Backing	503
C-6.6 Resolutions for Scanning with Seal Welded Steel Backing.....	503
C-6.7 Illustration of Discontinuity Acceptance Criteria for Statically Loaded Nontubular and Statically or Cyclically Loaded Tubular Connections.....	504
C-6.8 Illustration of Discontinuity Acceptance Criteria for Statically Loaded Nontubular and Statically or Cyclically Loaded Tubular Connections 1-1/8 in [30 mm] and Greater, Typical of Random Acceptable Discontinuities	505
C-6.9 Illustration of Discontinuity Acceptance Criteria for Cyclically Loaded Nontubular Connections in Tension	506
<u>C-7.1 Allowable Defects in the Heads of Headed Studs.....</u>	<u>510</u>
C-8.1 Microscopic Intrusions.....	518
C-8.2 Fatigue Life	518
C-8.3 Toe Dressing with Burr Grinder.....	519
C-8.4 Toe Dressing Normal to Stress.....	519
C-8.5 Effective Toe Grinding	520
C-8.6 End Grinding	520
C-8.7 Hammer Peening.....	521
C-8.8 Toe Remelting	522