



RULES FOR BUILDING AND CLASSING

OFFSHORE INSTALLATIONS 2018

**American Bureau of Shipping
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Introduction

1. The year 2018 edition of the *Rules for Building and Classing Offshore Installations* consists of the eight (8) booklets as shown in Table 1. With regard to two booklets, Part 1 and Part 2:
 - a) The purpose of the generic title *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* is to reflect the expanded contents of PART 1, as a result of including consolidated requirements for “Classification” applicable to all types of and sizes of units, installations, vessels or systems in offshore service, etc., as specified in the Foreword to Part 1. Additional specific requirements are contained in Part 1 of these *Rules for Building and Classing Single Point Moorings*.
 - b) The purpose of the generic title *ABS Rules for Materials and Welding* of PART 2 is to emphasize the common applicability of the requirements to ABS-classed vessels, other marine structures and their associated machinery, and thereby make PART 2 more readily a common “PART” of various ABS Rules and Guides, as appropriate.
2. The numbering system applied in the Rules is shown in Table 2.
3. The changes contained in the previously published Notices 1, 2, and 3 to the 1997 *Rules for Building and Classing Offshore Installations* (together with Corrigenda items) have also been incorporated into the text of the 2018 *Rules for Building and Classing Offshore Installations*.
4. The effective date of each technical change since 1993 is shown in parenthesis at the end of the subsection/paragraph titles within the text of each Part. Unless a particular date and month are shown, the years in parentheses refer to the following effective dates:

(2000) and after	1 January 2000 (and subsequent years)	(1996)	9 May 1996
(1999)	12 May 1999	(1995)	15 May 1995
(1998)	13 May 1998	(1994)	9 May 1994
(1997)	19 May 1997	(1993)	11 May 1993
5. Until the next edition of the *Rules for Building and Classing Offshore Installations* is published, Notices and/or Corrigenda, as necessary, will be published on the ABS website – www.eagle.org – only, and will be available free for downloading. It is not intended to publish hard copies of future Notices and/or Corrigenda to existing Rules or Guides. The consolidated edition of the *Rules for Building and Classing Offshore Installations*, which includes Notices and/or Corrigenda using different colors for easy recognition, will be published on the ABS website only when Notices and/or Corrigenda are issued.
6. The listing of CLASSIFICATION SYMBOLS AND NOTATIONS is available from the ABS website www.eagle.org for download.

TABLE 1
Applicable Editions of Booklets Comprising 2018 Offshore Installation Rules

Rules for Building and Classing Offshore Installations		
Notices and General Information		2018
Part 1:	Conditions of Classification (Supplement to the <i>ABS Rules for Conditions of Classification – Offshore Units and Structures</i>) ⁽¹⁾	2018
Part 2:	Materials and Welding (Supplement to the <i>ABS Rules for Materials and Welding</i>) ⁽²⁾	2018
Part 3:	Design	2018
Part 4:	Extension of Use and Reuse	2018
Part 5:	Testing and Surveys	2018
Rules for Conditions of Classification – Offshore Units and Structures – not included ^(1,3)		
Part 1:	Rules for Conditions of Classification – Offshore Units and Structures	2018
Rules for Materials and Welding – not included ⁽³⁾		
Part 2:	Rules for Materials and Welding	2018

Notes:

- 1 The requirements for conditions of classification are contained in the separate, generic *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.
- 2 The requirements for materials and welding for steel are contained in the separate, generic *ABS Rules for Materials and Welding (Part 2)*.
- 3 The latest edition of these Rules is to be referred to. These Rules may be downloaded from the ABS website at www.eagle.org, Rules and Guides, Downloads or may be ordered separately from the ABS Publications online catalog at www.eagle.org, Rules and Guides, Catalog.

TABLE 2
Division and Numbering of the Rules

<i>Division</i>	<i>Number</i>
Part	Part 1
Chapter	Part 1, Chapter 1
Section	Section 1-1-1
Subsection (see Note 1)	1-1-1/1
Paragraph (see Note 1)	1-1-1/1.1
Subparagraph	1-1-1/1.1.1
Item	1-1-1/1.1.1(a)
Subitem	1-1-1/1.1.1(a)i
Appendix	Appendix 1-1-A1 or Appendix 1-A1-1

Note:

- 1 An odd number (1, 3, 5, etc.) numbering system is used for the Rules. The purpose is to permit future insertions of even-numbered paragraphs (2, 4, 6, etc.) of text and to avoid the necessity of having to renumber the existing text and associated cross-references, as applicable, within the Rules and associated process instructions, check sheets, etc.

TABLE 3
Comparison of the Numbering System of the 1997 Rules vs. 2018 Rules

In the Table below, the following abbreviations apply:

CC = ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)

MW = ABS Rules for Materials and Welding (Part 2)

OI 1997	Title	OI 2018
Part 1	Conditions of Classification	
Whole Part	The requirements for “Conditions of Classification” in Part 1 of the 1997 edition of the <i>Rules for Building and Classing Offshore Installations</i> were relocated to the generic <i>ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)</i>, which includes consolidated requirements applicable to all offshore units and structures. Those classification requirements specific to offshore installations were retained in a supplemental Part 1 of the <i>Offshore Installations Rules</i>. In the list below, references to the <i>ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)</i> are given as “CC 1-1-X/Y.Y.Y” and references to Part 1 of the <i>Offshore Installations Rules</i> are given as “1-1-X/Y.Y.Y”.	Part 1
Part 1	Classification, Testing and Surveys	
Section 1	Scope and Conditions of Classification	
1/1.1	Classification	CC 1-1-1
1/1.1.1	Process	CC 1-1-1/1
1/1.1.2	Certificates and Reports	CC 1-1-1/3
1/1.1.2a	---	CC 1-1-1/3.1
1/1.1.2b	---	CC 1-1-1/3.3
1/1.1.2c	---	CC 1-1-1/3.5
1/1.1.3	Representations as to Classification	CC 1-1-1/5
1/1.1.4	Scope of Classification	CC 1-1-1/7
1/1.2	Suspension and Cancellation of Class	CC 1-1-2
1/1.2.1	Termination of Classification	CC 1-1-2/1
1/1.2.2	Notice of Surveys	CC 1-1-2/3
1/1.2.3	Special Notations	CC 1-1-2/5
1/1.2.4	Suspension of Class includes	CC 1-1-2/7
1/1.2.4a	---	CC 1-1-2/7.3
1/1.2.4b	---	CC 1-1-2/7.5ii)
1/1.2.4c	---	CC 1-1-2/7.7
1/1.2.4d	---	CC 1-1-2/7.5iii)
1/1.2.4e	---	CC 1-1-2/7.9
1/1.2.5	Cancellation of Class	CC 1-1-2/11
1/1.2.5a	---	CC 1-1-2/11.1
1/1.2.5b	---	CC 1-1-2/11.3
1/1.3	Class Designation	1-1-2
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1/1.3.2	Offshore Installations Not Built Under Survey	1-1-2/3
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1/1.5.3	Novel Features	CC 1-1-4/11
1/1.5.4	Effective Date of Rule Changes	CC 1-1-4/3
1/1.5.4a	Six Month Rule	CC 1-1-4/3.1
1/1.5.4b	Implementation of Rule Changes	CC 1-1-4/3.3
1/1.5.5	Other Conditions	CC 1-1-4/5
1/1.7	Other Regulations	CC 1-1-5
1/1.7.1	Governmental and Other Regulation	CC 1-1-5/1
1/1.7.2	Governmental Regulations	CC 1-1-5/5.1
1/1.9	IACS Audit	CC 1-1-6
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1/1.11.3	Submission of Plans and Specification	1-1-4/5
1/1.11.4	Information Memorandum	1-1-4/7

Notices and General Information

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1/1.15.1a		Examination and Repair	CC 1-1-8/1.1
1/1.15.1b		Representation	CC 1-1-8/1.7
1/1.15.2		Notification and Availability for Survey	CC 1-1-8/3
1/1.15.3		Attendance at Port State Request	CC 1-1-8/5
1/1.17		Fees	CC 1-1-9
1/1.19		Disagreement	CC 1-1-10
1/1.19.1		Rules	CC 1-1-10/1
1/1.19.2		Surveyors	CC 1-1-10/3
1/1.21		Limitations of Liability	CC 1-1-11
Part	1	Classification, Testing and Surveys	
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1/2.1.1		Scope	5-1-1/1
1/2.1.2		Quality Control Program	5-1-1/3
1/2.1.3		Access and Notification	5-1-1/5
1/2.1.4		Identification of Materials	5-1-1/7
1/2.3		Steel Structures	5-1-2
1/2.3.1		Quality Control Program	5-1-2/1
1/2.3.2		Material Quality and Traceability	5-1-2/3
1/2.3.3		Steel Forming	5-1-2/5
1/2.3.4		Welder Qualification and records	5-1-2/7
1/2.3.5		Welding Procedure Specifications and Qualifications	5-1-2/9
1/2.3.6		Weld Inspection	5-1-2/11
1/2.3.7		Tolerances and Alignments	5-1-2/13
1/2.3.8		Corrosion Control Systems	5-1-2/15
1/2.3.9		Tightness and Hydrostatic Testing Procedures	5-1-2/17
1/2.3.10		Nondestructive Testing	5-1-2/19
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1/4.1.5	Consultant	3-1-1/1.9
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---	Gravity Structure	3-1-1/1.15.2
---	Compliant Tower	3-1-1/1.15.3
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1/4.1.9	Extension of Use	3-1-1/1.17
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1/4.3.3	Plans and Other Data	3-1-1/3.5
Part 2	Materials and Welding	
Whole Part	Some of the requirements for “Materials and Welding” in Part 2 of the 1997 edition of the <i>Rules for Building and Classing Offshore Installations</i> were relocated to the generic <i>ABS Rules for Materials and Welding (Part 2)</i>, which includes consolidated requirements applicable to all offshore units and structures. Those materials and welding requirements specific to offshore installations were retained in a supplemental Part 2 of the <i>Offshore Installations Rules</i>. In the list below, references to the <i>ABS Rules for Materials and Welding (Part 2)</i> are given as “MW 2-X-X/Y.Y.Y” and references to Part 2 of the <i>Offshore Installations Rules</i> are given as “2-X-X/Y.Y.Y”.	Part 2
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2/1.3.1a	Scope	2-1-2/1.1
2/1.3.1b	Zones	2-1-2/1.3
2/1.3.2	Cement	2-1-2/3
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2/1.3.11b	Chlorides and Sulphates	2-1-2/21.3
2/1.3.11c	Contents	2-1-2/21.5
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2/2.3.2	Workmanship and Supervision	MW 2-4-1/1.5
2/2.3.3	Welding Procedures	MW 2-4-1/1.7
2/2.5	Preparation for Welding	MW 2-4-1/3
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2/2.5.2	Alignment	MW 2-4-1/3.3
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PART

1

Conditions of Classification
(Supplement to the ABS Rules for Conditions of Classification – Offshore Units and Structures)

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PART

1

Foreword (1 January 2008)

For the 2008 edition, Part 1, “Conditions of Classification” was consolidated into a generic booklet, entitled *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)* for all vessels other than those in offshore service. The purpose of this consolidation was to emphasize the common applicability of the classification requirements in “Part 1” to ABS-classed vessels, other marine structures and their associated machinery, and thereby make “Conditions of Classification” more readily a common Rule of the various ABS Rules and Guides, as appropriate.

Thus, this supplement specifies only the unique requirements applicable to single point moorings. This supplement is always to be used with the aforementioned *Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

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CHAPTER 1 Scope and Conditions of Classification

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PART

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CHAPTER 1 Scope and Conditions of Classification

SECTION 1 Classification (*1 January 2008*)

The requirements for conditions of classification are contained in the separate, generic *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

Additional requirements specific to offshore installations are contained in the following Sections of this Chapter.

PART

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CHAPTER 1 Scope and Conditions of Classification

SECTION 2 Classification Symbols and Notations (1 January 2008)

A listing of Classification Symbols and Notations available to the Owners of vessels, offshore drilling and production units and other marine structures and systems, "List of ABS Notations and Symbols" is available from the ABS website "<http://www.eagle.org>".

1 Offshore Installations Built Under Survey

Offshore Installations which have been built under the supervision of the ABS Surveyors to the requirements of these Rules or to their equivalent, where approved by the Classification Committee, will be classed and distinguished in the *Record* by the symbols **✕ A1 Offshore Installation**.

Offshore Installations which have been built to the satisfaction of the ABS Surveyors, to the requirements as contained in the *ABS Rules for Building and Classing Facilities on Offshore Installations* and/or *ABS Guide for Building and Classing Subsea Pipeline Systems* and/or *ABS Guide for Building and Classing Subsea Riser Systems*, and which are approved by the Committee will be classed and distinguished in the *Record* by the symbols **✕ A1 Offshore Installation** followed by the appropriate notation:

✕ A1 Offshore Installation – Hydrocarbon Processing

✕ A1 Offshore Installation – Hydrocarbon Production

✕ A1 Offshore Installation – Electric Generating Plant (electric generating plant – export load)

✕ A1 Offshore Installation – Undersea Pipeline

✕ A1 Offshore Installation – Chemical Processing

✕ A1 Offshore Installation – Metals/Ore Processing

3 Offshore Installations Not Built Under Survey

Offshore Installations which have not been built under the supervision of the ABS Surveyors, but which are submitted for classification, will be subject to a special classification survey. Where found satisfactory, and thereafter approved by the Classification Committee, they will be classed and distinguished in the *Record* in the manner as described as in 1-1-2/1, but the mark "✕" signifying the survey during construction will be omitted.

5 Classification Data

Data on offshore installations will be published in the *Record* as to the latitude and longitude of the location of the structure, structure type, structural dimensions and the depth of water at the site.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 3 Rules for Classification (*1 January 2008*)

1 Application of Rules

These Rules are applicable to offshore installations as defined in 3-1-1/1.13 and are generally intended to remain at a particular site for support of offshore facilities.

These Rules are applicable to those features of the system that are permanent in nature and can be verified by plan review, calculation, physical survey or other appropriate means. Any statement in the Rules regarding other features is to be considered as a guidance to the designer, builder, owner, et al.

PART

1

CHAPTER 1 Scope and Conditions of Classification

SECTION 4 Plans and Design Data to be Submitted

1 Submission of Site Condition Reports

As required in subsequent sections of these Rules, site condition reports are to be submitted. The principal purpose of these reports is to demonstrate that site conditions have been evaluated in establishing design criteria. Among the items to be discussed are:

- i) Environmental conditions of waves, winds, currents, tides, water depth, air and sea temperature and ice;
- ii) Seabed topography, stability, and pertinent geotechnical data; Seismic conditions;
- iii) Where appropriate, data established for a previous installation in the vicinity of the installation proposed for classification may be utilized if acceptable in the opinion of ABS.

3 Submission of Design Data and Calculations

Information is to be submitted for the offshore installation which describes the methods of design and analysis which were employed to establish its design. The estimated design service life of an offshore installation is also to be stated. Where model testing is used as a basis for a design, the applicability of the test results will depend on the demonstration of the adequacy of the methods employed, including enumeration of possible sources of error, limits of applicability, and methods of extrapolation to full scale data. Preferably, procedures are to be reviewed and agreed upon before model testing is done.

As required in subsequent sections, calculations are to be submitted to demonstrate the sufficiency of the proposed design. Such calculations are to be presented in a logical and well-referenced fashion employing a consistent system of units. Where the calculations are in the form of computer analysis, the submitted is to provide input and output data with computer generated plots for the structural model. A program description (not listings), user manuals, and the results of program verification sample problems may be required to be submitted.

5 Submission of Plans and Specifications

Plans or specifications depicting or describing the arrangements and details of the major items of the offshore installation are to be submitted for review or approval in a timely manner.

Where deemed appropriate, and when requested by the Owner, a schedule for information submittal and plan approval can be jointly established by the Owner and ABS. This schedule, which ABS will adhere to as far as reasonably possible, is to reflect the construction schedule and the complexity of the platform as it affects the time required for review of the submitted data.

7 Information Memorandum

An information memorandum on the offshore installation is to be prepared and submitted to ABS. ABS will review the contents of the memorandum to establish consistency with other data submitted for the purpose of obtaining classification. ABS will not review the contents of the memorandum for their accuracy or the features described in the memorandum for their adequacy.

An information memorandum is to contain, as appropriate to the installation, the following:

- i) Site plan indicating the general features at the site and the exact location of the installation
- ii) Environmental design criteria, including the recurrence interval used to assess environmental phenomena (see 3-1-2/5.1)
- iii) Plans showing the general arrangement of the offshore installation
- iv) Description of the safety and protective systems provided
- v) The number of personnel to be normally stationed at the installation
- vi) Listing of governmental authorities having cognizance over the installation
- vii) Listing of any novel features
- viii) Brief description of any monitoring proposed for use on the installation
- ix) Description of transportation and installation procedures

PART

2

Materials and Welding

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PART 2

CHAPTER 1 Materials

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PART

2

CHAPTER 1 Materials

SECTION 1 Structural Steels

1 General

1.1 Scope

This Section covers specifications for materials used for the construction of offshore steel structures. It is not intended for metals used in reinforced or prestressed concrete. (See Section 2-1-2.) All materials are to be suitable for intended service conditions, they are to be of good quality, defined by a recognized specification and free of injurious imperfections.

1.3 Material Selection

Materials used are required to exhibit satisfactory formability and weldability characteristics. As required, documentation is to be submitted to substantiate the applicability of a proposed steel. Reference can be made to 2-1-1/Tables 2 and 3 for ASTM and API steel grades and to Section 3-1-3 for guidance on the selection of ABS grades of steel.

When material other than steel is to be used as a structural material, documentation is to indicate the tensile, toughness, fatigue and corrosion characteristics of the proposed material.

1.5 Corrosion Control

Details of corrosion control systems (such as coatings, sacrificial anodes or impressed current systems) are to be submitted with adequate supporting data to show their suitability. Such information is to indicate the extent to which the possible existence of stress corrosion, corrosion fatigue, and galvanic corrosion due to dissimilar metals to be considered. Where the intended sea environment contains unusual contaminants, any special corrosive effects of such contaminants are also to be considered. Appropriate coatings are to be used to achieve satisfactory corrosion protection for miscellaneous parts such as bolts and nuts.

1.7 Toughness

Materials are to exhibit fracture toughness which is satisfactory for the intended application as supported by previous satisfactory service experience or appropriate toughness tests. Where the presence of ice is judged as a significant environmental factor, material selection may require special consideration.

1.9 Through Thickness Stress

In cases where principal loads, from either service or weld residual stresses, are imposed perpendicular to the surface of a structural member, the use of special steel with improved through thickness (Z-direction) properties may be required.

3 Steel Properties

3.1 General

Material specifications are to be submitted for review or approval. Due regard is to be given to established practices in the country in which material is produced and the purpose for which the material is intended.

3.3 Tensile Properties

In 2-1-1/Table 1, the designation Group I, II or III is used to categorize tensile properties.

3.5 Toughness

Appropriate supporting information or test data are to indicate that the toughness of the steels will be adequate for their intended application and minimum service temperature. Criteria indicative of adequate toughness are contained in 2-1-1/5.

3.7 Bolts and Nuts

Bolts and nuts are to have mechanical and corrosion characteristics comparable to the structural elements being joined and are to be manufactured and tested in accordance with recognized material standards.

5 Toughness Criteria for Steel Selection

5.1 General

When members are subjected to significant tensile stress, fracture toughness is to be considered in the selection of materials.

5.3 Steel Classification

Steels are to be classified as Groups I, II or III according to their tensile properties as listed in 2-1-1/Table 1. The yield strengths given in 2-1-1/Table 1 are provided only as a means of categorizing steels.

TABLE 1
Steel Tensile Properties

Group	Yield Strength f_y	
	ksi	MPa
I	$f_y < 40$	$f_y < 275$
II	$40 \leq f_y \leq 60$	$275 \leq f_y \leq 415$
III	$60 \leq f_y \leq 100$	$415 \leq f_y \leq 690$

Some of the typical ASTM and API steels belonging to the groups of 2-1-1/Table 1 are shown in 2-1-1/Tables 2 and 3. Steels other than those mentioned therein may be used, provided that their chemical composition, mechanical properties and weldability are similar to those listed.

TABLE 2
Structural Steel Plates and Shapes

Group	Specification and Grade	Yield Strength		Tensile Strength	
		ksi	MPa	ksi	MPa
I	ASTM A36-94 (to 2 in. thick)	36	250	58-80	400-550
	ASTM A131-94 Grade A (to 1/2 in. thick) (ABS Grade A)	34	235	58-75	400-515
	ASTM A285-90 Grade C (to 1/2 in. thick)	30	205	55-75	380-515
	ASTM A131-94 Grades B, D (ABS Grades B, D)	34	235	58-75	400-515
	ASTM A516-90 Grade 65	35	240	65-85	450-585
	ASTM A573-93a Grade 65	35	240	65-77	450-530
	ASTM A709-93a Grade 36T2	36	250	58-80	400-550
	ASTM A131-94 Grade E (ABS Grade E) (ABS Grades CS, E)	34	235	58-75	400-515
II	ASTM A572-94b Grade 42 (to 2 in. thick)	42	290	60 min.	415 min.
	ASTM A572-94b Grade 50 (to 1/2 in. thick*)	50	345	65 min.	450 min.
	ASTM A588-94 (to 2 in. thick)	50	345	70 min.	485 min.
	ASTM A709-93a Grades 50T2, 50T3	50	345	65 min.	450 min.
	ASTM A131-94 Grade AH32 (ABS Grade AH32)	46	315	68-85	470-585
	ASTM A131-94 Grade AH36 (ABS Grade AH36)	51	350	71-90	490-620
	API Spec 2H-Grade 42	42	290	62-80	425-550
	API Spec 2H-Grade 50 (to 2 1/2 in. thick)	50	345	70-90	485-620
	(over 2 1/2 in. thick)	47	325	70-90	485-620
	API Spec 2W-Grade 42 (to 1 in. thick)	42-67	290-460	62 min.	425 min.
	(over 1 in. thick)	42-62	290-430	62 min.	425 min.
	Grade 50 (to 1 in. thick)	50-75	345-515	65 min.	450 min.
	(over 1 in. thick)	50-70	345-485	65 min.	450 min.
	Grade 50T (to 1 in. thick)	50-80	345-550	70 min.	485 min.
	(over 1 in. thick)	50-75	345-515	70 min.	485 min.
	API Spec 2Y-Grade 42 (to 1 in. thick)	42-67	290-460	62 min.	425 min.
	(over 1 in. thick)	42-62	290-430	62 min.	425 min.
	Grade 50 (to 1 in. thick)	50-75	345-515	65 min.	450 min.
	(over 1 in. thick)	50-70	345-485	65 min.	450 min.
	Grade 50T (to 1 in. thick)	50-80	345-550	70 min.	485 min.
	(over 1 in. thick)	50-75	345-515	70 min.	485 min.
	ASTM A131-94 Grades DH32, EH32 (ABS Grades DH32, EH32)	46	315	68-85	470-585
	Grades DH36, EH36 (ABS Grades DH36, EH36)	51	350	71-90	490-620
	ASTM A537-91 Class 1 (to 2 1/2 in. thick)	50	345	70-90	485-620
	ASTM A633-94a Grade A	42	290	63-83	435-570
	Grades C, D	50	345	70-90	480-620
	ASTM A678-94a (80) Grade A	50	345	70-90	485-620
III	ASTM A537-91 Class 2	60	415	80-100	550-690
	ASTM A633-94a Grade E	60	415	80-100	550-690
	ASTM A678-94a (80) Grade B	60	415	80-100	550-690
	API Spec 2W-Grade 60 (to 1 in. thick)	60-90	415-620	75 min.	515 min.
	(over 1 in. thick)	60-85	415-585	75 min.	515 min.
	API Spec 2Y-Grade 60 (to 1 in. thick)	60-90	415-620	75 min.	515 min.
	(over 1 in. thick)	60-85	415-585	75 min.	515 min.
	ASTM A710-Grade A Class 3 (to 2 in. thick)	75	515	85 min.	585 min.
		65	450	75 min.	515 min.
		60	415	70 min.	485 min.

* To 2 in. Thick for Type 1, Fully Killed, Fine Grain Practice.

TABLE 3
Structural Steel Pipes

Group	Specification and Grade	Yield Strength		Tensile Strength	
		ksi	MPa	ksi	MPa
I	API 5L-Grade B	35	240	60 min.	415 min.
	ASTM A53-93a Grade B	35	240	60 min.	415 min.
	ASTM A135-93 Grade B	35	240	60 min.	415 min.
	ASTM A139-93a Grade B	35	240	60 min.	415 min.
	ASTM A381-93 Grade Y35	35	240	60 min.	415 min.
	ASTM A500-93 Grade A	33-39	230-270	45 min.	310 min.
	ASTM A501-93	36	250	58 min.	400 min.
	ASTM A106-94 Grade B	35	240	60 min.	415 min.
	ASTM A524-93 (strength varies with thickness)	30-35	205-240	55-85	380-585
II	API 5L95 Grade X42 (2% max. cold expansion)	42	290	60 min.	415 min.
	API 5L95 Grade X52 (2% max. cold expansion)	52	360	66 min.	455 min.
	ASTM A500-93 Grade B	42-46	290-320	58 min.	400 min.
	ASTM A618-93 Grade Ia, Ib & II (to C\w in. thick)	50	345	70 min.	485 min.
	API 5L95 Grade X52 (with SR5, SR6, or SR8)	52	360	66 min.	455 min.

5.5 Toughness Characteristics

Satisfactory toughness characteristics can be demonstrated by any one of the following.

- Demonstration of past successful application, under comparable conditions, of a steel, produced to a recognized standard (such as those of the ASTM, API or other recognized standard)
- Demonstration that a steel manufactured by a particular producer using a specific manufacturing process has minimum toughness levels representative of those listed herein
- Charpy impact testing in accordance with 2-1-1/Table 4

TABLE 4
Charpy Toughness Specification for Steels

Group	Section Size	Energy Absorption (Longitudinal)	
		Joules	ft-lb
I	6 mm < <i>t</i> < 19 mm (0.25 in. < <i>t</i> < 0.75 in.)	20	15
	<i>t</i> > 19 mm (0.75 in.)	27	20
II, III	<i>t</i> > 6 mm (0.25 in.)	34	25

The following notes apply to 2-1-1/Table 4:

- 1 Test Temperatures – The following applies for service temperatures down to –30°C (–22°F); for lower service temperatures, test requirements are to be specially considered.

- a) For structural members and joints whose performance is vital to the overall integrity of the structure and which experience an unusually severe combination of stress concentration, rapid loading, cold working, and restraint, the impact test guidelines of 2-1-1/Table 4 are to be met at test temperatures as given below:

Group	Test Temperature	Minimum Service Temperature (As determined by 2-1-1/7)
I, II	30°C (54°F) below Minimum Service Temperature	
III	–40°C (–40°F)	0°C (32°F)
	–50°C (–58°F)	–10°C (14°F)
	–50°C (–58°F)	–20°C (–4°F)
	–60°C (–76°F)	–30°C (–22°F)

- b) For structural members and joints which sustain significant tensile stress and whose fracture may pose a threat to the survival of the structure, the impact test guidelines of 2-1-1/Table 4 are to be met at test temperatures as given below:

Group	Test Temperature	Minimum Service Temperature (As determined by 2-1-1/7)
I, II	10°C (18°F) below Minimum Service Temperature	
III	–30°C (–22°F)	0°C (32°F)
	–40°C (–40°F)	–10°C (14°F)
	–40°C (–40°F)	–20°C (–4°F)
	–50°C (–58°F)	–30°C (–22°F)

- c) For primary structural members subjected to significant tensile stresses and whose usage warrants impact toughness testing, the impact test guidelines of 2-1-1/Table 4 are to be met at the following test temperatures:

Group	Test Temperature	Minimum Service Temperature (As determined by 2-1-1/7)
I, II	At Minimum Service Temperature	
III	Same as note 1b)	

- d) For structural members which have sufficient structural redundancy so that their fracture would not pose a threat to the survivability of the structure, the toughness criteria specified for c) above may be relaxed provided the materials used in such cases are appropriate for the loading conditions, loading rates, and temperatures encountered in service.

TABLE 4 (continued)
Charpy Toughness Specification for Steels

- 2 Impact tests are not necessary for section sizes below 6 mm (0.25 in.) in thickness.
- 3 Energy values in 2-1-1/Table 4 are minimum average values for full-size longitudinal specimens. Alternative toughness criteria which may be applied are:
 - *Under-sized Longitudinal Specimens:* Proportional reduction in 2-1-1/Table 4 energy values in accordance with ASTM A20 or equivalent
 - *Transverse Specimens:* $\frac{2}{3}$ of the energy values shown in 2-1-1/Table 4 but in no case less than 20 Joules (15 ft-lb)
 - *Longitudinal or Transverse Specimens:* Lateral expansion is not to be less than 0.5 mm (0.02 in.), or 0.38 mm (0.015 in.), respectively
 - Nil-ductility temperature (NDT) as determined by drop weight tests is to be 5°C (10°F) below the test temperature indicated in item 1 above
 - Other fracture toughness tests as appropriate.
- 4 The minimum number of specimens to be tested per heat is three. However, this number is to be increased in accordance with usage of the material (see ASTM A673 or equivalent).

7 Minimum Service Temperature

Minimum service temperature refers to the temperature of the material and is generally to be established in accordance with 2-1-1/7.1, 2-1-1/7.3, and 2-1-1/7.5 below. This temperature is to be based on meteorological data taken over a period of not less than 10 years for the lowest average daily temperature.

7.1 Material below the Splash Zone

For material below the splash zone (see 3-2-2/5.9), the service temperature is defined as 0°C (32°F). A higher service temperature may be used if adequate supporting data can be presented relative to the lowest average daily water temperature applicable to the depths involved.

7.3 Material within or above the Splash Zone

For material within or above the splash zone, the service temperature is the same as the lowest average daily atmospheric temperature. A higher service temperature may be used if the material above the waterline is warmed by adjacent sea water temperature or by auxiliary heating.

7.5 Special Conditions

In all cases where material temperature is reduced by localized cryogenic storage or other cooling conditions, such factors are to be taken into account in establishing minimum service temperature.

PART

2

CHAPTER 1 Materials

SECTION 2 Materials for Concrete Construction

1 General

1.1 Scope

This Section covers specifications for materials for concrete used in the construction of offshore platforms. It includes the metals used in reinforced or prestressed concrete. All materials are to be suitable for intended service conditions and are to be of good quality, defined by recognized specifications and free of injurious defects. Materials used in the construction of concrete structures are to be selected with due attention given to their strength and durability in the marine environment. Materials which do not conform to the requirements of this Section may be considered for approval upon presentation of sufficient evidence of satisfactory performance.

1.3 Zones

Particular attention is to be given in each of the following zones (see 3-2-2/5.9) to the considerations indicated:

- i) *Submerged Zone.* Chemical deterioration of the concrete, corrosion of the reinforcement and hardware, and abrasion of the concrete
- ii) *Splash Zone.* Freeze-thaw durability, corrosion of the reinforcement and hardware, chemical deterioration of the concrete, and fire hazards
- iii) *Ice Zone.* Freeze-thaw durability, corrosion of the reinforcement and hardware, chemical deterioration of the concrete, fire hazards, and abrasion of the concrete
- iv) *Atmospheric Zone.* Freeze-thaw durability, corrosion of reinforcement and hardware, and fire hazards

3 Cement

3.1 Type

Cement is to be equivalent to Types I or II Portland cement as specified by ASTM C150 or Portland-pozzolan cement as specified by ASTM C595. ASTM C150 Type III Portland cement may be specially approved for particular applications.

3.3 Tricalcium Aluminate

The tricalcium aluminate content of the cement is generally to be in the 5% to 10% range.

3.5 Oil Storage

For environments which contain detrimental sulfur bearing materials (such as where oil storage is planned and the oil is expected to contain sulfur compounds which are detrimental to concrete durability), the maximum content of tricalcium aluminate is to be at the lower end of the 5% to 10% range. Alternatively, pozzolans or pozzolans and fly ash may be added or a suitable coating employed to protect the concrete.

5 Water

5.1 Cleanliness

Water used in mixing concrete is to be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that may be deleterious to concrete or steel.

5.3 Nonpotable Water

If nonpotable water is proposed for use, the selection of proportions of materials in the concrete is to be based on test concrete mixes using water from the same source. The strength of mortar test cylinders made with nonpotable water is not to be less than 90% of the strength of similar cylinders made with potable water. Strength test comparisons are to include 7-day and 28-day strength data on mortars prepared and tested in accordance with recognized standards such as ASTM C109.

7 Chloride or Sulfide Content

Water for structural concrete or grout is not to contain more than 0.07% chlorides as Cl by weight of cement, nor more than 0.09% sulfates as SO_4 when tested by ASTM D512. Chlorides in mix water for prestressed concrete or grout are to be limited to 0.04% by weight of cement.

Total chloride content, as Cl, of the concrete prior to exposure is not to exceed 0.10% by weight of the cement for normal reinforced concrete and 0.06% by weight of cement for prestressed concrete.

9 Aggregates

9.1 General

Aggregates are to conform to the requirements of ASTM C330 or equivalent. Other aggregates may be used if there is supporting evidence that they produce concrete of satisfactory quality. When specially approved, lightweight aggregates similar to ASTM C330 may be used for conditions that do not pose durability problems.

9.3 Washing

Marine aggregates are to be washed with fresh water before use to remove chlorides and sulfates so that the total chloride and sulfate content of the concrete mix does not exceed the limits defined in 2-1-2/7.

9.5 Size

The maximum size of the aggregate is to be such that the concrete can be placed without voids. It is recommended that the maximum size of the aggregate not be larger than the smallest of the following:

- i) One-fifth of the narrowest dimension between sides of forms
- ii) One-third of the depth of slabs
- iii) Three-fourths of the minimum clear spacing between individual reinforcing bars, bundles of bars, prestressing tendons, or post-tensioning ducts

11 Admixtures

11.1 General

The admixture is to be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions. Admixtures containing chloride ions are not to be used if their use will produce a deleterious concentration of chloride ions in the mixing water.

11.3 Recognized Standards

Admixtures are to be in accordance with applicable recognized standards such as ASTM C260, ASTM C494, ASTM C618 or equivalents.

11.5 Pozzolan Content

Pozzolan or pozzolan and fly ash content is not to exceed 15% by weight of cement unless specially approved.

13 Steel Reinforcement

Steel reinforcement used in offshore concrete structures is to be suitable for its intended service and in accordance with recognized standards.

13.1 Reinforcement for Non-Prestressed Concrete

Non-prestressed reinforcement is to be in accordance with one of the following specifications or its equivalents:

- Deformed reinforcing bars and plain bars: ASTM A615
- Bar and rod mats: ASTM A184
- Plain wire for spiral reinforcement: ASTM A82, ASTM A704
- Welded plain wire fabric: ASTM A185
- Deformed wire: ASTM A496
- Welded deformed wire fabric: ASTM A497

13.3 Welded Reinforcement

Reinforcement which is to be welded is to have the properties needed to produce satisfactory welded connections. Welding is to be in accordance with recognized specifications such as the American Welding Society (AWS) D1.1, or is to be proven to produce connections of satisfactory quality.

13.5 Steel Reinforcement for Prestressed Concrete

Steel reinforcement for prestressed concrete is to be in accordance with one of the following specifications or equivalent.

- Seven-wire strand: ASTM A416
- Wire: ASTM A421

13.7 Other Materials

Other prestressing tendons may be approved upon presentation of evidence of satisfactory properties.

15 Concrete

The concrete is to be designed to provide sufficient strength and durability. A satisfactory method for quality control of concrete is to be used which is equivalent to ACI 318. Mixing, placing, and curing of concrete are to conform to recognized standards.

17 Water-Cement Ratios

Unless otherwise approved, water-cement ratios and 28-day compressive strengths of concrete for the three exposure zones are to be in accordance with 2-1-2/Table 1.

TABLE 1
W/C Ratios and Compressive Strengths

<i>Zone</i>	<i>Maximum W/C Ratio</i>	<i>Minimum 28-day Cylinder Compressive Strength</i>
Submerged	0.45	35 MPa (5000 psi)
Splash and Atmospheric	0.40 to 0.45*	35 MPa (5000 psi)

* Depending upon severity of exposure

19 Other Durability Requirements

19.1 Cement Content

Minimum cement content is to provide an adequate amount of paste for reinforcement protection and generally be not less than 355 kg/m³ (600 lb/yd³).

19.3 Freeze-Thaw Durability

When freeze-thaw durability is required, the concrete is to contain entrained air in accordance with a recognized standard such as ACI 211.1. Attention is to be paid to the appropriate pore distribution of the entrained air and the spacing between pores in the hardened concrete. The calculated spacing factors are not to exceed 0.25 mm (0.01 in.).

19.5 Scouring

When severe scouring action is expected, the coarse aggregate is to be as hard as the material causing the abrasion, the sand content of the concrete mix is to be kept as low as possible, and air entrainment is to be limited to the minimum appropriate to the application.

21 Grout for Bonded Tendons

21.1 General

Grout for bonded tendons is to conform to ACI 318 or equivalent.

21.3 Chlorides and Sulfates

Grout is not to contain chlorides or sulfates in amounts which are detrimental to the structure. Limitations are included in 2-1-2/7.

21.5 Contents

Grout is to consist of Portland cement and potable water, or Portland cement, sand, and potable water. Admixtures may be used only after sufficient testing to indicate that their use is beneficial and that they are free of harmful quantities of chlorides, nitrates, sulfides, sulfates or any other material which has been shown to be detrimental to the steel or grout.

21.7 Sand

Sand, if used, is to conform to ASTM C144 or equivalent, except that gradation is to be modified as necessary to obtain increased workability.

21.9 Preparation

Proportions of grouting materials are to be based on results of tests on fresh and hardened grout prior to beginning work. The water content is to be the minimum necessary for proper placement but in no case more than 50% of the content of cement by weight. Grout is to be properly mixed and screened.

21.11 Temperature

Temperature of members at the time of grouting is to be above 10°C (50°F) and is to be maintained at this temperature for at least 48 hours.

PART
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CHAPTER 2 Welding and Fabrication

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PART

2

CHAPTER 2 Welding and Fabrication

SECTION 1 Welding

1 Requirements

The requirements for welding and fabrication are contained in Chapter 4 of the separate, generic ABS *Rules for Materials and Welding (Part 2)*.

Additional welding requirements specific to offshore installations are contained in the following Sections of this Chapter. Requirements for the design of fillet welds are given in Section 3-2-7.

3 Inspection of Welds

3.1 General

Inspection of welded joints in important locations is to be carried out preferably by established nondestructive test methods such as radiographic, ultrasonic, magnetic-particle or dye-penetrant inspection. NDE should be carried out in accordance with ABS's separately issued *Guide for Nondestructive Inspection of Hull Welds*. An approved acceptance criterion is to be used in evaluating radiographs and ultrasonic indications (see also 2-2-1/3.5).

Radiographic or ultrasonic inspections, or both, are to be used when the overall soundness of the weld cross section is to be evaluated.

Magnetic-particle or dye-penetrant inspection may be used when investigating the outer surface of welds, as a check of intermediate weld passes such as root passes, and to check back chipped, ground or gouged joints prior to depositing subsequent passes. Surface inspection of important tee or corner joints in critical locations, using an approved magnetic-particle or dye-penetrant method, is to be conducted to the satisfaction of the Surveyor.

Some steels, especially higher-strength steels, may be susceptible to delayed cracking. When welding these materials, the final nondestructive testing is to be delayed for a suitable period to permit detection of such defects.

Weld run-on or run-off tabs may be used where practicable and these may be sectioned for examination.

The practice of taking weld plugs or samples by machining or cutting from the welded structure is not recommended and is to be used only in the absence of other suitable inspection methods. When such weld plugs or samples are removed from the welded structure, the holes or cavities thus formed are to be properly prepared and welded, using a suitable welding procedure as established for the original joint.

3.3 Extent of Inspection of Welds

3.3.1 General

The minimum extent of nondestructive testing to be conducted is indicated in 2-2-1/3.3.4 or 2-2-1/3.3.5 below. The distribution of inspected welds is to be based on the classification of application of the welds, as mentioned in 2-2-1/3.3.3, and the variety of weld sizes used in the structure.

Nondestructive testing is generally to be carried out after all forming and postweld heat treatment, and procedures are to be adequate to detect delayed cracking.

Welds which are inaccessible or difficult to inspect in service are to be subjected to increased levels of nondestructive inspection.