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Petroleum and natural gas industries — Fixed steel offshore structures

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Preface

This Standard was prepared by the Standards Australia Committee ME-092, Materials, equipment, structures and related services for petroleum, petrochemical and natural gas industries.

The objective of this document is to specify requirements and provides recommendations applicable to the following types of fixed steel offshore structures for the petroleum and natural gas industries:

- (a) Caissons, free-standing and braced.
- (b) Jackets.
- (c) Monotowers.
- (d) Towers.

In addition, it is applicable to compliant bottom founded structures, steel gravity structures, jack-ups, other bottom founded structures and other structures related to offshore structures (such as underwater oil storage tanks, bridges and connecting structures).

This document contains requirements for planning and engineering of the design, fabrication, transportation and installation of new structures as well as, if relevant, their future removal.

Specific requirements for the design of fixed steel offshore structures in arctic environments are presented in ISO 19906. Requirements for topsides structures are presented in ISO 19901-3; for marine operations in, ISO 19901-6; for structural integrity management in ISO 19901-9, and for the site-specific assessment of jack-ups, in ISO 19905-1.

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The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

Contents

Preface	ii
Foreword	xiii
Introduction	xvi
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols	9
5 Abbreviated terms	12
6 Overall considerations	14
6.1 Types of fixed steel offshore structure	14
6.1.1 General	14
6.1.2 Jackets	15
6.1.3 Towers	15
6.1.4 Jack-ups	15
6.2 Planning	16
6.2.1 General	16
6.2.2 Hazards	16
6.2.3 Designing for hazards	17
6.2.4 Design situations and criteria	17
6.2.5 Design for inspection and maintenance	17
6.2.6 Foundations and active geological processes	18
6.2.7 Regulations	18
6.3 Service and operational considerations	18
6.3.1 General considerations	18
6.3.2 Water depth	18
6.3.3 Structural configuration	18
6.3.4 Access and auxiliary systems	19
6.4 Safety considerations	19
6.5 Environmental considerations	19
6.5.1 General	19
6.5.2 Selection of design metocean parameters and action factors	19
6.6 Exposure levels	20
6.7 Assessment of existing structures	20
6.8 Structure reuse	21
7 General design requirements	21
7.1 General	21
7.2 Material properties for steel	21
7.3 Incorporating limit states	21
7.4 Determining design situations	22
7.5 Structural modelling and analysis	22
7.6 Design for pre-service and removal situations	22
7.7 Design for the in-place situation	23
7.8 Determination of component resistances	23
7.8.1 General	23
7.8.2 Physical testing to derive resistances	23
7.8.3 Resistances derived from computer simulations validated by physical testing	23
7.8.4 Resistances derived from computer simulations validated against design formulae	23
7.8.5 Resistances derived from unvalidated computer simulations	23
7.9 Strength and stability checks	24
7.9.1 Action and resistance factors	24

7.9.2	Strength and stability equations	24
7.9.3	Unfactored actions	24
7.10	Robustness	24
7.10.1	General	24
7.10.2	Damage tolerance	25
7.11	Reserve strength	25
7.11.1	New structures	25
7.11.2	Existing structures	26
7.12	Indirect actions	26
7.13	Structural reliability analysis	26
8	Actions for pre-service and removal situations	27
8.1	General	27
8.1.1	Coverage	27
8.1.2	Design situations	27
8.1.3	Actions	27
8.2	General requirements	28
8.2.1	Weight control	28
8.2.2	Dynamic effects	28
8.2.3	Action effects	28
8.3	Onshore lifting	29
8.3.1	General	29
8.3.2	Dynamic effects	30
8.3.3	Effect of tolerances	30
8.3.4	Multi-crane lift	31
8.3.5	Local factor	31
8.3.6	Member and joint strengths	31
8.3.7	Lifting attachments	31
8.3.8	Slings, shackles and fittings	32
8.4	Fabrication	32
8.5	Loadout	32
8.5.1	Direct lift	32
8.5.2	Horizontal movement onto vessel	32
8.5.3	Self-floating structures	33
8.6	Transportation	33
8.6.1	General	33
8.6.2	Metocean conditions	33
8.6.3	Determination of actions	33
8.6.4	Other considerations	34
8.7	Installation	34
8.7.1	Lifted structures	34
8.7.2	Launched structures	34
8.7.3	Crane assisted uprighting of structures	34
8.7.4	Submergence pressures	34
8.7.5	Member flooding	35
8.7.6	Actions on the foundation during installation	35
9	Actions to in-place situations	35
9.1	General	35
9.2	Permanent actions (G) and variable actions (Q)	36
9.2.1	Permanent action 1, G_1	36
9.2.2	Permanent action 2, G_2	36
9.2.3	Variable action 1, Q_1	36
9.2.4	Variable action 2, Q_2	36
9.2.5	Unintentional flooding	37
9.2.6	Position and range of permanent and variable actions	37
9.2.7	Carry down factors	37
9.2.8	Representation of actions from topsides	37
9.2.9	Weight control	37

9.3	Extreme metocean actions	37
9.3.1	General	37
9.3.2	Notation	38
9.4	Extreme quasi-static action due to wind, waves and current (E_e)	38
9.4.1	Procedure for determining E_e	38
9.4.2	Direction of extreme wind, waves and current	39
9.4.3	Extreme global actions	39
9.4.4	Extreme local actions and action effects	40
9.4.5	Vortex induced vibrations (VIV)	40
9.5	Extreme quasi-static action caused by waves only (E_{we}) or by waves and currents (E_{wce})	40
9.5.1	Procedure for determining E_{we} and E_{wce}	40
9.5.2	Models for hydrodynamic actions	42
9.5.3	Hydrodynamic models for appurtenances	45
9.6	Actions caused by current	45
9.7	Actions caused by wind	46
9.7.1	General	46
9.7.2	Determining actions caused by wind	46
9.7.3	Wind actions determined from models	47
9.8	Equivalent quasi-static action representing dynamic response caused by extreme wave conditions	47
9.8.1	General	47
9.8.2	Equivalent quasi-static action (D_e) representing the dynamic response	48
9.8.3	Global dynamic analysis in waves	48
9.9	Factored actions	49
9.9.1	General	49
9.9.2	Factored permanent and variable actions	49
9.9.3	Factored extreme metocean actions	50
9.10	Design situations	50
9.10.1	General considerations on the ultimate limit state	50
9.10.2	Demonstrating sufficient RSR under metocean actions	51
9.10.3	Partial factor design	51
9.11	Local hydrodynamic actions	52
10	Accidental and abnormal situations	53
10.1	General	53
10.1.1	Treatment of ALS events	53
10.1.2	Accidental events	53
10.1.3	Abnormal environmental events	54
10.2	Vessel collisions	54
10.2.1	General	54
10.2.2	Collision events	54
10.2.3	Collision process	55
10.3	Dropped objects	55
10.4	Fires and explosions	55
10.5	Abnormal environmental actions	56
10.6	Assessment of structures following damage	56
11	Seismic design considerations	56
11.1	General	56
11.2	Seismic design procedure	57
11.3	Seismic reserve capacity factor	57
11.4	Recommendations for ductile design	58
11.5	ELE requirements	59
11.5.1	Partial action factors	59
11.5.2	ELE structural and foundation modelling	59
11.6	ALE requirements	60
11.6.1	General	60
11.6.2	ALE structural and foundation modelling	61

11.6.3	Non-linear static pushover analysis.....	61
11.6.4	Time-history analysis.....	63
12	Structural modelling and analysis.....	63
12.1	Purpose of analysis.....	63
12.2	Analysis principles.....	63
12.2.1	Extent of analysis.....	63
12.2.2	Calculation methods.....	64
12.3	Modelling.....	64
12.3.1	General.....	64
12.3.2	Level of accuracy.....	64
12.3.3	Geometrical definition for framed structures.....	64
12.3.4	Modelling of material properties.....	67
12.3.5	Topsides structure modelling.....	67
12.3.6	Appurtenances.....	68
12.3.7	Soil-structure interaction.....	68
12.3.8	Other support conditions.....	69
12.3.9	Local analysis structural models.....	70
12.3.10	Actions.....	70
12.3.11	Mass simulation.....	71
12.3.12	Damping.....	71
12.4	Analysis requirements.....	71
12.4.1	General.....	71
12.4.2	Fabrication.....	73
12.4.3	Other pre-service and removal situations.....	73
12.4.4	In-place situations.....	75
12.5	Types of analysis.....	77
12.5.1	Natural frequency analysis.....	77
12.5.2	Dynamically responding structures.....	77
12.5.3	Static and quasi-static linear analysis.....	78
12.5.4	Static ultimate strength analysis.....	78
12.5.5	Dynamic linear analysis.....	78
12.5.6	Dynamic ultimate strength analysis.....	79
12.6	Non-linear analysis.....	79
12.6.1	General.....	79
12.6.2	Geometry modelling.....	79
12.6.3	Component strength.....	80
12.6.4	Models for member strength.....	80
12.6.5	Models for joint strength.....	80
12.6.6	Ductility limits.....	80
12.6.7	Yield strength of structural steel.....	81
12.6.8	Models for foundation strength.....	81
12.6.9	Investigating non-linear behaviour.....	81
13	Strength of tubular members.....	82
13.1	General.....	82
13.2	Tubular members subjected to tension, compression, bending, shear, torsion or hydrostatic pressure.....	83
13.2.1	General.....	83
13.2.2	Axial tension.....	84
13.2.3	Axial compression.....	84
13.2.4	Bending.....	86
13.2.5	Shear.....	88
13.2.6	Hydrostatic pressure.....	89
13.3	Tubular members subjected to combined forces without hydrostatic pressure.....	92
13.3.1	General.....	92
13.3.2	Axial tension and bending.....	92
13.3.3	Axial compression and bending.....	93
13.3.4	Axial tension or compression, bending, shear and torsion.....	94

13.3.5	Piles.....	96
13.4	Tubular members subjected to combined forces with hydrostatic pressure.....	96
13.4.1	General.....	96
13.4.2	Axial tension, bending and hydrostatic pressure.....	97
13.4.3	Axial compression, bending and hydrostatic pressure.....	98
13.4.4	Axial tension or compression, bending, hydrostatic pressure, shear and torsion.....	99
13.5	Effective lengths and moment reduction factors.....	100
13.6	Conical transitions.....	101
13.6.1	General.....	101
13.6.2	Design stresses.....	101
13.6.3	Strength requirements without external hydrostatic pressure.....	104
13.6.4	Strength requirements with external hydrostatic pressure.....	109
13.6.5	Ring design.....	110
13.7	Dented tubular members.....	112
13.7.1	General.....	112
13.7.2	Dented tubular members subjected to tension, compression, bending or shear.....	112
13.7.3	Dented tubular members subjected to combined forces.....	119
13.8	Corroded tubular members.....	122
13.9	Grouted tubular members.....	122
13.9.1	General.....	122
13.9.2	Grouted tubular members subjected to tension, compression or bending.....	123
13.9.3	Grouted tubular members subjected to combined forces.....	126
14	Strength of tubular joints.....	128
14.1	General.....	128
14.2	Design considerations.....	129
14.2.1	Materials.....	129
14.2.2	Design forces and joint flexibility.....	130
14.2.3	Minimum joint strength.....	130
14.2.4	Weld strength.....	130
14.2.5	Joint classification.....	130
14.2.6	Detailing practice.....	133
14.3	Simple tubular joints.....	135
14.3.1	General.....	135
14.3.2	Basic joint strength.....	136
14.3.3	Strength factor, Q_u	137
14.3.4	Chord force factor, Q_f	138
14.3.5	Effect of chord can length on joint strength.....	139
14.3.6	Strength check.....	141
14.4	Overlapping joints.....	141
14.5	Combed joints.....	141
14.6	Ring stiffened joints.....	142
14.7	Other joint types.....	142
14.8	Damaged joints.....	142
14.9	Non-circular joints.....	143
14.10	Cast joints.....	143
15	Strength and fatigue resistance of other structural components.....	143
15.1	Grouted connections.....	143
15.1.1	General.....	143
15.1.2	Detailing requirements.....	145
15.1.3	Axial force.....	145
15.1.4	Reaction force from horizontal shear force and bending moment in piles.....	145
15.1.5	Interface transfer stress.....	146
15.1.6	Interface transfer strength.....	147
15.1.7	Strength check.....	150
15.1.8	Fatigue assessment.....	150

15.2	Mechanical connections	151
15.2.1	Types of mechanical connectors	151
15.2.2	Design requirements	151
15.2.3	Actions and forces on the connector	152
15.2.4	Resistance of the connector	152
15.2.5	Strength criteria	152
15.2.6	Fatigue criteria	153
15.2.7	Stress analysis validation	153
15.2.8	Threaded fasteners	153
15.2.9	Swaged connections	155
15.3	Clamps for strengthening and repair	156
15.3.1	General	156
15.3.2	Split sleeve clamps	156
15.3.3	Prestressed clamps	156
15.3.4	Forces on clamps	156
15.3.5	Clamp design	157
15.3.6	General requirements for bolted clamps	158
15.3.7	Bolting considerations	159
16	Fatigue	159
16.1	General	159
16.1.1	Applicability	159
16.1.2	The fatigue process	160
16.1.3	Fatigue assessment by analysis using S–N data	160
16.1.4	Fatigue assessment by analysis using fracture mechanics methods	160
16.1.5	Fatigue assessment by other methods	160
16.2	General requirements	161
16.2.1	Applicability	161
16.2.2	Fatigue crack initiation and crack propagation	161
16.2.3	Sources of variable stresses causing fatigue	161
16.2.4	Design service life and fatigue life	162
16.2.5	The nature of fatigue damage	162
16.2.6	Characterization of the stress range data governing fatigue	162
16.2.7	The long-term stress range history	162
16.2.8	Partial action and resistance factors	163
16.2.9	Fatigue resistance	163
16.2.10	Fatigue damage calculation	163
16.2.11	Weld improvement techniques	163
16.3	Description of the long-term wave environment	163
16.3.1	General	163
16.3.2	Wave scatter diagram	164
16.3.3	Mean wave directions	164
16.3.4	Wave frequency spectra	164
16.3.5	Wave directional spreading function	165
16.3.6	Periodic waves	165
16.3.7	Long-term distribution of individual wave heights	165
16.3.8	Current	165
16.3.9	Wind	165
16.3.10	Water depth	165
16.3.11	Marine growth	165
16.4	Performing the global stress analyses	165
16.4.1	General	165
16.4.2	Actions caused by waves	166
16.4.3	Quasi-static analyses	167
16.4.4	Dynamic analyses	168
16.5	Characterization of the stress range data governing fatigue	169
16.6	The long-term local stress range history	170
16.6.1	General	170
16.6.2	Probabilistic determination using spectral analysis methods	170

16.6.3	Deterministic determination using individual periodic waves	170
16.6.4	Approximate determination using simplified methods	171
16.7	Determining the long-term stress range distribution by spectral analysis	171
16.7.1	General	171
16.7.2	Stress transfer functions	172
16.7.3	Short-term stress range statistics	173
16.7.4	Long-term stress range statistics	173
16.8	Determining the long-term stress range distribution by deterministic analysis	175
16.8.1	General	175
16.8.2	Wave height selection	175
16.8.3	Wave period selection	175
16.8.4	Long-term stress range distribution	175
16.9	Determining the long-term stress range distribution by approximate methods	175
16.10	Geometric stress ranges	176
16.10.1	General	176
16.10.2	Stress concentration factors for tubular joints	176
16.11	Fatigue resistance of the material	178
16.11.1	Basic S–N curves	178
16.11.2	High strength steel	179
16.11.3	Cast joints	179
16.11.4	Thickness effect	179
16.12	Fatigue assessment	180
16.12.1	Cumulative damage and fatigue life	180
16.12.2	Fatigue damage design factors	180
16.12.3	Local experience factor	181
16.13	Other causes of fatigue damage than wave action	181
16.13.1	General	181
16.13.2	Vortex induced vibrations	181
16.13.3	Wind induced vibrations	181
16.13.4	Transportation	181
16.13.5	Installation	181
16.13.6	Risers	182
16.14	Further design considerations	182
16.14.1	General	182
16.14.2	Conductors, caissons and risers	182
16.14.3	Miscellaneous non-load carrying attachments	182
16.14.4	Miscellaneous load carrying attachments	182
16.14.5	Conical transitions	183
16.14.6	Members in the splash zone	183
16.14.7	Topsides structure	183
16.14.8	Inspection strategy	183
16.15	Fracture mechanics methods	183
16.15.1	General	183
16.15.2	Fracture assessment	184
16.15.3	Fatigue crack growth law	184
16.15.4	Stress intensity factors	185
16.15.5	Fatigue stress ranges	185
16.15.6	Castings	185
16.16	Fatigue performance improvement of existing components	185
17	Foundation design	185
17.1	General	185
17.2	Design of pile foundations	186
17.3	Pile wall thickness	187
17.3.1	General	187
17.3.2	Pile stresses	187
17.3.3	Pile design checks	188
17.3.4	Check for design situation due to weight of hammer during hammer placement	188

17.3.5	Stresses during driving.....	189
17.3.6	Minimum wall thickness.....	189
17.3.7	Allowance for underdrive and overdrive.....	189
17.3.8	Driving shoe.....	189
17.3.9	Driving head.....	190
17.4	Length of pile sections.....	190
17.5	Shallow foundations.....	190
17.5.1	General.....	190
17.5.2	Stability of shallow foundations.....	191
18	Corrosion control.....	191
18.1	General.....	191
18.2	Corrosion zones and environmental parameters affecting corrosivity.....	191
18.3	Forms of corrosion, associated corrosion rates and corrosion damage.....	192
18.4	Design of corrosion control.....	193
18.4.1	General.....	193
18.4.2	Considerations in design of corrosion control.....	193
18.4.3	Coatings, linings and wrappings.....	193
18.4.4	Cathodic protection.....	194
18.4.5	Corrosion resistant materials.....	197
18.4.6	Corrosion allowance.....	197
18.5	Fabrication and installation of corrosion control.....	197
18.5.1	General.....	197
18.5.2	Coatings and linings.....	197
18.5.3	Cathodic protection.....	197
18.5.4	Corrosion resistant materials.....	198
18.6	In-service inspection, monitoring and maintenance of corrosion control.....	198
18.6.1	General.....	198
18.6.2	Coatings and linings.....	198
18.6.3	Cathodic protection.....	198
18.6.4	Corrosion resistant materials.....	199
19	Materials.....	199
19.1	General.....	199
19.2	Lowest anticipated service temperature.....	200
19.3	Chemical composition.....	200
19.3.1	General.....	200
19.3.2	Carbon equivalent.....	201
19.3.3	Modified carbon equivalent.....	201
19.4	Strength, toughness and other considerations.....	201
19.4.1	Yield strength.....	201
19.4.2	Toughness.....	201
19.5	Material category approach.....	202
19.5.1	Steel selection philosophy.....	202
19.5.2	Material characterization.....	202
19.5.3	Material selection criteria.....	202
19.5.4	Selection process.....	203
19.5.5	Steel strength groups.....	203
19.5.6	Toughness class.....	204
19.5.7	Applicable steels.....	205
19.6	Design class approach.....	205
19.6.1	General.....	205
19.6.2	DC component classification.....	205
19.6.3	Materials.....	206
19.6.4	Applicable steels.....	208
19.7	Cement grout.....	208
19.7.1	Grout materials.....	208
19.7.2	Onshore grout trial.....	208
19.7.3	Offshore grout trial.....	209

19.7.4	Offshore quality control.....	209
20	Welding, weld inspection and fabrication.....	209
20.1	General.....	209
20.2	Welding.....	210
20.2.1	Selected generic welding and fabrication standards.....	210
20.2.2	Weld metal and HAZ properties.....	212
20.2.3	Tubular T-, Y- and K-joints.....	215
20.3	Inspection.....	215
20.4	Fabrication.....	215
20.4.1	General.....	215
20.4.2	Weld requirements.....	215
20.4.3	Forming.....	217
20.4.4	Fabrication tolerances.....	218
20.4.5	Grouted connections.....	218
21	Quality control, quality assurance and documentation.....	219
21.1	General.....	219
21.2	Quality management system.....	219
21.3	Quality control plan.....	220
21.3.1	General.....	220
21.3.2	Inspector qualifications.....	220
21.3.3	NDT personnel qualifications.....	220
21.3.4	Inspection of materials.....	221
21.3.5	Inspection of fabrication.....	221
21.3.6	Inspection of welding.....	221
21.4	Documentation.....	221
21.4.1	General.....	221
21.4.2	Calculations.....	222
21.4.3	Weight and centre of gravity reports.....	222
21.4.4	Fabrication inspection documentation.....	222
21.5	Drawings and specifications.....	222
22	Loadout, transportation and installation.....	223
22.1	General.....	223
22.1.1	Planning.....	223
22.1.2	Records and documentation.....	223
22.1.3	Actions and required resistance.....	223
22.1.4	Temporary bracing and rigging.....	224
22.2	Loadout and transportation.....	224
22.2.1	General.....	224
22.2.2	Loadout.....	224
22.2.3	Cargo and launch vessels.....	224
22.2.4	Towing vessels.....	225
22.2.5	Actions on the platform components.....	225
22.2.6	Buoyancy and flooding systems.....	225
22.3	Transfer of the structure from the transport vessel into the water.....	226
22.3.1	General.....	226
22.3.2	Lifting operations.....	226
22.3.3	Launching.....	226
22.4	Placement on the sea floor and assembly of the structure.....	227
22.4.1	General.....	227
22.4.2	Safety of navigation.....	227
22.4.3	Stationkeeping.....	227
22.4.4	Positioning of the structure.....	227
22.5	Pile installation.....	229
22.5.1	General.....	229
22.5.2	Stabbing guides.....	229
22.5.3	Lifting methods.....	229
22.5.4	Field welds.....	229

22.5.5	Driveability studies.....	229
22.5.6	Drilled and grouted piles.....	229
22.5.7	Grouting pile-to-sleeve connections and grouted repairs.....	229
22.5.8	Pile installation records.....	229
22.6	Installation of conductors.....	230
22.7	Topsides installation.....	230
22.7.1	General.....	230
22.7.2	Alignment and tolerances.....	230
22.7.3	Securing topsides.....	230
22.8	Grounding of installation welding equipment.....	230
22.8.1	General.....	230
22.8.2	Welding equipment.....	230
22.8.3	Monitoring remote ground efficiency.....	231
Annex A	(informative) Additional information and guidance.....	232
Annex B	(normative) Weld CTOD testing procedures.....	471
Annex C	(informative) Material category approach.....	477
Annex D	(informative) Design class approach.....	482
Annex E	(informative) Welding and weld inspection requirements — Material category approach.....	485
Annex F	(informative) Welding and weld inspection requirements – Design class approach.....	489
Annex G	(normative) Fabrication tolerances.....	496
Annex H	(informative) Regional information.....	512
Bibliography	517

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

This second edition cancels and replaces the first edition (ISO 19902:2007), which has been technically revised. It also incorporates the Amendment ISO 19902:2007/Amd.1:2013. The main changes compared to the previous edition are as follows:

- duplication of symbols has largely been eliminated (see [Clause 4](#));
- use of metocean versus environmental has been rationalized. Metocean now refers to wind, wave and current actions only while environmental encompasses metocean, ice and seismic;
- high strength steel: applicable specified minimum yield strength increased to 800 MPa but only with respect to non-material requirements;
- hazards and designing for hazards moved from [10.1.1](#) and [10.1.2](#), respectively, to [6.2.2](#) and [6.2.3](#), respectively;
- deck elevation ([6.3.3.2](#)) expanded to include air gap plus need to consider crest levels 15 % higher than calculated values;
- exposure levels ([6.6](#)) are addressed in ISO 19900 so text modified accordingly;
- damage tolerance now more appropriately addressed in [7.10.2](#) rather than 10.1.6.1;
- reserve strength ratio ([7.11.1](#)): detailed procedure introduced because of general lack of adequate, appropriate documentation;
- structural reliability analysis ([7.13](#)): text reordered and supplemented by text from completely rewritten [A.9.9.3.3](#);

- onshore lifting ([8.3](#)): because offshore lifting is now addressed in ISO 19901-6, the text and tabulated information on DAFs have been modified accordingly;
- multi-crane lifts ([8.3.4](#)): for consistency with ISO 19901-6, now considered in place of dual lifts;
- gravity load partial action factors for extreme conditions reduced from 1.1 to 1.0 ([Table 9.10-1](#) and [Table 8.2-1](#));
- clarified that for abnormal design situations, verification is required even if wave-in-deck events do not occur to ensure that the appropriate robustness requirement is realized;
- ELE structural and foundation modelling: new first paragraph added in response to questions to Seismic Panel (responsible for ISO 19901-2) regarding the appropriate weight of personnel to consider during an event;
- tubular member diameter to thickness ratio non-dimensionalized ([13.1](#));
- shear and torsion now included in all tubular member strength formulae including those addressing hydrostatic pressure;
- tubular member strength formulae for combined axial and bending loading now of cosine interaction form instead of previously adopted linear interaction;
- formulae ([13.6-2](#)) and ([13.6-3](#)) relating to conical transitions corrected;
- tubular joint strength formulae nearly all changed through adoption of the API RP 2A-WSD 21st Edition Supplement 2 (October 2005) tubular joint formulae supplemented by some limited non-linear FEA;
- grouted connections: pile outer diameter limited ([15.1.5.2](#));
- use of HSS in fatigue applications: warning re possible hydrogen embrittlement when yield strength exceeds 700 MPa ([16.11.2](#));
- fatigue damage design factors: effect of considering life cycle ([16.12.2](#));
- [Clause 17](#): detailed pile design requirements moved to ISO 19901-4 so no longer addressed;
- [Clause 19](#): expanded to include more detailed requirements for Design class approach;
- [Clause 20](#): expanded to include more detailed requirements for Design class approach;
- [Clause 21](#): some requirements for Design class approach added to [Tables 21.2-1](#) and [21.4-1](#) (previously 21.7-1);
- particular standards identified for NDT personnel qualification ([21.3.3](#));
- [Clause 21](#): existing [21.4](#) to 21.6 moved to ISO 19901-6;
- [Clause 22](#): reference to ISO 19901-6 added where appropriate. Requirements for flotation ([22.3.2.4](#)) and crane barges ([22.3.2.5](#)) combined ([22.3.3.4](#));
- Clauses 23 to 25 (and A.23 to A.25) deleted because ISO 19901-9 *Structural integrity management* approved;
- [Annex A](#) modified to accommodate above changes to normative text as appropriate;
- [Table C.1](#): extra strength groups for chord cans and padeyes;
- [Table C.4](#) enlarged considerably;
- [Annex D](#) completely rewritten;
- E.3: 100 % CVI now required for all welding;

- [Annex F](#): substantially rewritten and expanded. Now important to consider whether LAST is $\geq -10^{\circ}\text{C}$ or $< -10^{\circ}\text{C}$;
- new [Table F.5](#) and [Figure F.1](#) similar to existing requirements in Table D.3 and [Figure D.1](#), now deleted from [Annex D](#);
- new [Table F.6](#) addressing subsea structures whereas [Table F.5](#) only concerns jacket structures;
- minimum RSR requirement added for North West Europe ([H.2.3.1](#));
- [H.3.3.2](#) Canadian welding references revised;
- US Customary units have been deleted;
- a number of figures have been corrected.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The International Standards on offshore structures prepared by TC 67/SC 7 (i.e. ISO 19900, the ISO 19901 series, ISO 19902, ISO 19903, ISO 19904-1, the ISO 19905 series, ISO 19906) constitute a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum and natural gas industries worldwide. Through their application, the intention is to achieve reliability levels appropriate for manned and unmanned offshore structures, whatever the type of structure and the nature or combination of the materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of all offshore structural systems.

These documents applicable to the various types of offshore structure are intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgment is therefore crucial in the use of these documents.

[Annex A](#) provides background to and guidance on the use of this document and should be read in conjunction with the main body of this document. The clause numbering in [Annex A](#) is the same as in the normative text to facilitate cross-referencing.

Materials, welding and weld inspection requirements can be based either on a “material category” or on a “design class” approach, as discussed in [Clauses 19](#) and [20](#). If the material category approach is used, see the corresponding provisions of [Annexes C](#) and [E](#); if the design class approach is used, see the corresponding provisions of [Annexes D](#) and [F](#).

[Annex G](#) gives requirements on fabrication tolerances.

Regional information on the application of the document to certain specific offshore areas is provided in [Annex H](#).

To meet certain needs of industry for linking software to specific elements in this document, a special numbering system has been permitted for figures, tables, formulae and bibliographic references.

Australian Standard[®]

Petroleum and natural gas industries — Fixed steel offshore structures

1 Scope

This document specifies requirements and provides recommendations applicable to the following types of fixed steel offshore structures for the petroleum and natural gas industries:

- caissons, free-standing and braced;
- jackets;
- monotowers;
- towers.

In addition, it is applicable to compliant bottom founded structures, steel gravity structures, jack-ups, other bottom founded structures and other structures related to offshore structures (such as underwater oil storage tanks, bridges and connecting structures).

This document contains requirements for planning and engineering of the design, fabrication, transportation and installation of new structures as well as, if relevant, their future removal.

NOTE 1 Specific requirements for the design of fixed steel offshore structures in arctic environments are presented in ISO 19906.

NOTE 2 Requirements for topsides structures are presented in ISO 19901-3; for marine operations in, ISO 19901-6; for structural integrity management, in ISO 19901-9 and for the site-specific assessment of jack-ups, in ISO 19905-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel*

ISO 10414-1, *Petroleum and natural gas industries — Field testing of drilling fluids — Part 1: Water-based fluids*

ISO 12135, *Metallic materials — Unified method of test for the determination of quasistatic fracture toughness*

ISO 15653, *Metallic materials — Method of test for the determination of quasistatic fracture toughness of welds*

ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations*

ISO 19901-2, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria*

ISO 19901-3, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 3: Topsides structure*

ISO 19901-4, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations*