

DIN EN ISO 13628-16

ICS 75.180.10

Einsprüche bis 2010-07-24

Entwurf

**Erdöl- und Erdgasindustrie –
Auslegung und Betrieb von Unterwasser-Fördersystemen –
Teil 16: Anforderungen an Zusatzausrüstungen von flexiblen
Rohrleitungssystemen (ISO/DIS 13628-16:2010);
Englische Fassung prEN ISO 13628-16:2010**

Petroleum and natural gas industries –
Design and operation of subsea production systems –
Part 16: Specification for flexible pipe ancillary equipment (ISO/DIS 13628-16:2010);
English version prEN ISO 13628-16:2010

Industries du pétrole et du gaz naturel –
Conception et exploitation des systèmes de production immergés –
Partie 16: Spécification pour accessoires de canalisations flexibles
(ISO/DIS 13628-16:2010);
Version anglaise prEN ISO 13628-16:2010

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2010-05-24 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an noeg@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.din.de/stellungnahme abgerufen werden;
- oder in Papierform an den Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN, 10772 Berlin (Hausanschrift: Burggrafenstr. 6, 10787 Berlin).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevante Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 327 Seiten

Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Dieses Dokument (prEN ISO 13628-16:2010) wurde vom ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“, Subkomitee SC 4 „Drilling and production equipment“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat AFNOR, Frankreich) erarbeitet

Für Deutschland hat hieran der Arbeitskreis NA 109-00-01-04 AK „Bohr- und Fördereinrichtungen — Spiegelausschuss zu ISO/TC 67/SC 4“ im Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) des DIN Deutsches Institut für Normung e. V. mitgearbeitet.

Diese europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung der ISO Norm.

Für die in diesem Dokument zitierten Internationalen Normen wird im Folgenden auf die entsprechenden Deutschen Normen hingewiesen:

ISO 34-1	siehe	DIN ISO 34-1
ISO 62	siehe	DIN EN ISO 62
ISO 75-1	siehe	DIN EN ISO 75-1
ISO 75-2	siehe	DIN EN ISO 75-2
ISO 178	siehe	DIN EN ISO 178
ISO 179-1	siehe	DIN EN ISO 179-1
ISO 179-2	siehe	DIN EN ISO 179-2
ISO 180	siehe	DIN EN ISO 180
ISO 527-1	siehe	DIN EN ISO 527-1
ISO 527-2	siehe	DIN EN ISO 527-2
ISO 604	siehe	DIN EN ISO 604
ISO 868	siehe	DIN EN ISO 868
ISO 1183 (all parts)	siehe	DIN EN ISO 1183 (alle Teile)
ISO 1431-1	siehe	DIN ISO 1431-1
ISO 1827	siehe	DIN ISO 1827
ISO 7784-2	siehe	DIN EN ISO 7784-2
ISO 10423	siehe	DIN EN ISO 10423
ISO 10474	siehe	DIN EN 10204

ISO 13628-2	siehe	DIN EN ISO 13628-2
ISO 13628-4	siehe	DIN EN ISO 13628-4
ISO 13628-11	siehe	DIN EN ISO 13628-11
ISO 19902	siehe	DIN EN ISO 19902

ISO 13628 *Petroleum and natural gas industries — Design and operation of subsea production systems* besteht aus den folgenden Teilen:

- *Part 1: General requirements and recommendations*
- *Part 2: Unbonded flexible pipe systems for subsea and marine applications*
- *Part 3: Through flowtime (TFL) systems*
- *Part 4: Subsea wellhead and tree equipment*
- *Part 5: Subsea umbilicals*
- *Part 6: Subsea production control systems*
- *Part 7: Completion/workover riser systems*
- *Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems*
- *Part 9: Remotely Operated Tools (ROT) intervention systems*
- *Part 10: Specification for bonded flexible pipe*
- *Part 11: Flexible pipe systems for subsea and marine applications*
- *Part 16: Specification for flexible pipe ancillary equipment*
- *Part 17: Recommended practice for flexible pipe ancillary equipment*

Nationaler Anhang NA (informativ)

Begriffe, Definitionen und Abkürzungen

Folgende Begriffe, Definitionen und Abkürzungen werden in der Norm verwendet:

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach ISO 13628-2, ISO 13628-11 und die folgenden Begriffe. Für die nähere Beschreibung und Zusatzangaben siehe ISO 13628-17, Abschnitt 4.

3.1.1

Ausnahmelast

Last, die durch ein außergewöhnliches Ereignis verursacht wird

3.1.2

Ankerfuß

Konstruktion, die dazu dient, ein Ende eines Halteseils am Meeresboden zu befestigen

3.1.3

Zusatzbauteil

Bauteil, das mit dem flexiblen Rohrleitungssystem verbunden ist, um eine oder mehrere der folgenden Funktionen zu übernehmen:

- a) um das Verhalten des flexiblen Rohrleitungssystems zu steuern;
- b) um einen baulichen Übergang zwischen dem flexiblen Rohrleitungssystem und benachbarten Konstruktionen herzustellen;
- c) um weitere Anlagen mit dem flexiblen Rohrleitungssystem zu verbinden;
- d) um das flexible Rohrleitungssystem zu schützen oder zu reparieren;
- e) um eine Abdichtung über die Länge des flexiblen Rohrleitungssystems zu erreichen.

3.1.4

Audit

vom Käufer durchgeführte dokumentierte Untersuchung, um zu verifizieren, dass die geltenden Anforderungen umgesetzt wurden

3.1.5

Ballastmodul

nicht schwimmfähiges Bauteil, das an einzelnen Punkten entlang einer Länge des flexiblen Rohrleitungssystems verwendet wird, um dieses mit zusätzlichem Gewicht zu beschweren

3.1.6

Versteifungsring

Vorrichtung, um mechanischen Schutz für das flexible Rohrleitungssystem zu erreichen

3.1.7

Charge

Menge eines Produkts, die während eines Arbeitsvorgangs hergestellt wurde

3.1.8**Krümmungsbegrenzer-Element**

Teil eines Krümmungsbegrenzers, wobei mehrere dieser Teile in Reihe miteinander verbunden werden, um die gesamte Länge des Krümmungsbegrenzers zu bilden

3.1.9**Basis der Biegeversteifung**

Fläche der Schnittstellenkonstruktion auf der Seite der Tragkonstruktion, an der die Biegeversteifung beginnt

3.1.10**Biegeversteifungs-Körper**

Polymerteil einer Biegeversteifung, das dem flexiblen Rohrleitungssystem zusätzliche Steifigkeit verleiht, um dessen Überbiegung zu verhindern

ANMERKUNG 1 In Bild 1 ist der Körper der Biegeversteifung für eine bestimmte Biegeversteifungs-Anordnung dargestellt.

ANMERKUNG 2 Biegeversteifungs-Kappen enthalten oft das Vatterteil des Biegeversteifungsmechanismus und die trichterförmigen Kabeleinführungen das Mutterteil.

3.1.11**Biegeversteifungs-Kappe**

Bauteil bei einigen Biegeversteifungskonstruktionen, das aus einem zylindrischen Metallgehäuse besteht, das außen an einem Teil der Länge der Biegeversteifung in unmittelbarer Nähe zur Basis der Biegeversteifung angebracht ist

ANMERKUNG In Bild 1 ist ein Beispiel für eine Biegeversteifungs-Kappe für eine bestimmte Biegeversteifungs-anordnung dargestellt.

3.1.12**Biegeversteifungs-Verbindungsmechanismus**

eine Konstruktion oder ein Mechanismus, die/der eine Biegeversteifung mit einer Tragkonstruktion so verbindet, dass die Biegekraft von der Biegeversteifung auf die Tragkonstruktion übertragen werden kann

3.1.13**Biegeversteifungs-Schutzauskleidung**

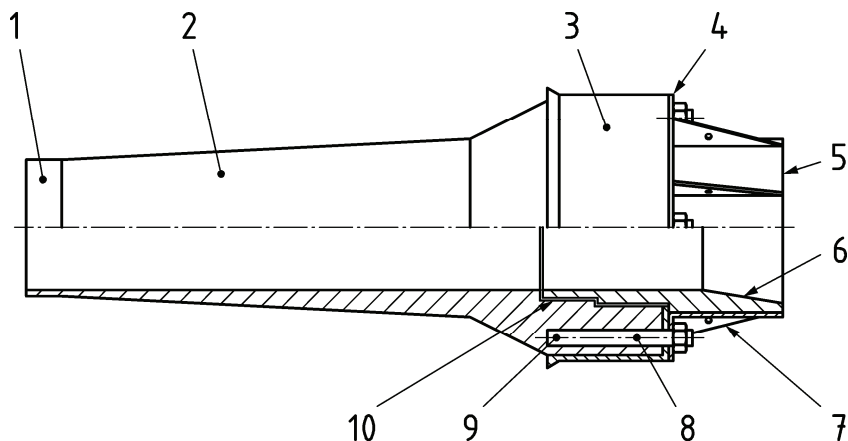
Polymerhülse, die intern die Aussparung eines Anschlussteils in einer Schnittstellenkonstruktion umhüllt, um einen Kontakt zwischen dem Außenmantel der flexiblen Rohrleitung und den Metallteilen der Schnittstellenkonstruktion zu verhindern

ANMERKUNG In Bild 1 ist ein Beispiel für eine Biegeversteifungs-Schutzauskleidung für eine bestimmte Biegeversteifungsanordnung dargestellt.

3.1.14**Spitze der Biegeversteifung**

das der Basis gegenüberliegende Ende des Biegeversteifungs-Körpers

ANMERKUNG In Bild 1 ist ein Beispiel für die Spitze der Biegeversteifung für eine bestimmte Biegeversteifungsanordnung dargestellt.



Legende

- 1 Schnittstellenkonstruktion
- 2 verstärkte Konstruktion
- 3 Gewindebolzen
- 4 Rippen
- 5 aufgeweiteter Liner
- 6 Aufbau
- 7 Flansch
- 8 Kappe
- 9 Körper
- 10 Spitze

Bild 1 — Beispiel einer Schutzrohr-Biegeversteifung

3.1.15

Biegespannung

Teil der Primärspannung proportional zur Distanz vom Schwerpunkt eines Querschnitts, ausschließlich der Auswirkungen von Diskontinuitäten und Spannungskonzentrationen

[API RP 2RD]

3.1.16

Schaumstoff

Polymerschaum, der weder Mikrokugeln noch Makrokugeln enthält

3.1.17

Verbindungsgurt (en: bridle)

lasttragende Konstruktion, die den Übergang zwischen einer Unterwasserboje und deren Halteseilen bildet

3.1.18

Auftriebselement

Teil eines Auftriebsmoduls oder einiger Unterwasserbojen, das dem Modul oder der Boje Auftrieb gibt

ANMERKUNG Das Auftriebselement besteht aus einem schwimmfähigen Material, das eine schützende Außenhaut aufweisen kann. Es umfasst keine Schwimm tanks.

3.1.19

Auftriebsmodul

diskretes Bauteil, das aus einem Auftriebselement, einer Innenklemme sowie jeglichen Befestigungsmitteln besteht, die für die Lagesicherung dieser Bauteile erforderlich sind; es wird zum Auftrieb von flexiblen Rohrleitungen verwendet, indem eine Reihe solcher Bauteile entlang der Rohrlänge befestigt werden

3.1.20**Schwimmtank**

Bauteil einiger Unterwasserbojen, das aus einem gasgefüllten Druckbehälter besteht, wobei der Druck dem Umgebungsdruck entspricht oder höher als dieser ist und auf diese Weise der Boje Auftrieb gibt

3.1.21**chemische Alterung**

Degradation eines Werkstoffs im Zeitablauf infolge der Exposition gegenüber Chemikalien, die durch Veränderungen auf molekularer Ebene verursacht wird

3.1.22**Chinesischer Finger**

während der Installation des flexiblen Rohrleitungssystems verwendete Einrichtung, die aus einem Maschengewebe besteht, mit dessen Hilfe die flexible Rohrleitung an ihrem Außenmantel gegriffen wird

ANMERKUNG Das Maschengewebe ist so konfiguriert, dass dessen Griff mit steigender Last immer fester wird.

3.1.23**Klemmkörper**

Teil einer Klemme, der Flächenberührung mit dem Außenmantel des flexiblen Rohrleitungssystems hat

3.1.24**Klemmen-Innenauskleidung**

Teil einiger Klemmkörper, das aus einem elastischen Auskleidungsmaterial besteht, das Kontakt zum Außenmantel der flexiblen Rohrleitung hat und Anpassungen an verschiedene Außendurchmesser der flexiblen Rohrleitung ermöglicht

3.1.25**Verbundwerkstoff**

Kombination aus einem Polymerwerkstoff und einem Verstärkungsmaterial, das die Eigenschaften des Polymers verbessert

3.1.26**gemischter syntaktischer Schaum**

Verbundwerkstoff, der aus einer Polymermatrix besteht, die sowohl Mikrokugeln als auch Makrokugeln enthält

3.1.27**Verbinder**

Einrichtung, die dazu dient, eine dichte bauliche Verbindung zwischen dem Anschlussteil und der angrenzenden Rohrleitung herzustellen

ANMERKUNG Er umfasst keine Anschlussteile des flexiblen Rohrleitungssystems.

3.1.28**Scheiteldruckfestigkeit**

maximale, örtlich begrenzte, radiale Druckbelastung, der ein flexibles Rohrleitungssystem standhalten kann

3.1.29**Schließradius unter Last**

Radius eines Krümmungsbegrenzers während des Schließens bei Belastung

3.1.30**Verifizierungsbericht über die Konstruktionsmethodik**

Bewertungsbericht, der zum Zeitpunkt der Erstbegutachtung von einer unabhängigen Verifizierungsstelle für einen bestimmten Hersteller verfasst wird und die Eignung und die entsprechenden Grenzen der Konstruktionsmethodik des Herstellers bestätigt

ANMERKUNG Der Verifizierungsbericht über die Konstruktionsmethodik kann gelegentliche Änderungen oder Überarbeitungen enthalten, um Erweiterungen von bisherigen Grenzen oder Überarbeitungen von Methodiken zu berücksichtigen.

3.1.31

Verifizierung der Konstruktion

Prozess der Erprobung der Konstruktion mittels Prüfung

3.1.32

tauchergestützte Schutzrohrabdichtung

Schutzrohrabdichtung, die zur Herstellung einer Unterstützung durch Taucher bedarf

ANMERKUNG Sie kann eine Klemmvorrichtung aufweisen.

3.1.33

taucherlose Schutzrohrabdichtung

Schutzrohrabdichtung, die keiner Unterstützung durch Taucher bedarf

ANMERKUNG Die Abdichtung erfolgt dadurch, dass sie in ein Schutzrohr gezogen wird. Eine Klemmvorrichtung wirkt den Einzugskräften entgegen.

3.1.34

Trockenreparatur

Reparatur eines flexiblen Rohrleitungssystems, das aus dem Wasser geborgen wurde

3.1.35

dynamischer Krümmungsbegrenzer

Konstruktionsweise, bei der eine zeitweilige Sperrung zwischen Krümmungsbegrenzer-Elementen erfolgt, die durch äußere Kräfte, wie beispielsweise Wellen und augenblickliche Umwelteinwirkungen ausgelöst wird

3.1.36

an die Schnittstellenkonstruktion angrenzendes Anschlussteil

Biegeversteifungs-Schnittstellenkonstruktion, bei der sich das Anschlussteil innerhalb der Schnittstellenkonstruktion befindet

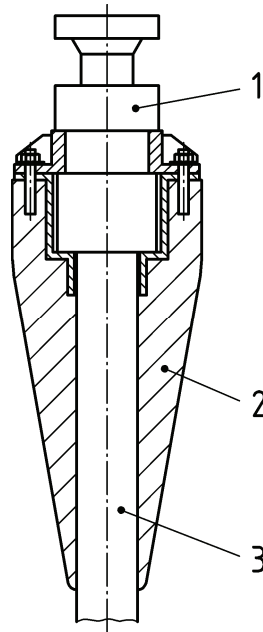
ANMERKUNG In Bild 2 ist ein Beispiel für ein an die Schnittstellenkonstruktion angrenzendes Anschlussteil dargestellt.

3.1.37

außerhalb der Schnittstellenkonstruktion befindliches Anschlussteil

Biegeversteifungs-Schnittstellenkonstruktion, bei der sich das Anschlussteil außerhalb der Schnittstellenkonstruktion befindet

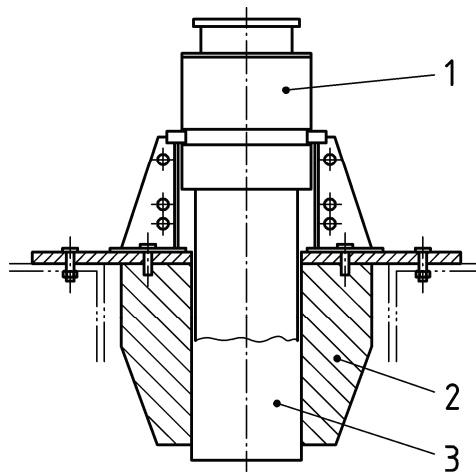
ANMERKUNG In Bild 3 ist ein Beispiel für ein außerhalb der Schnittstellenkonstruktion befindliches Anschlussteil dargestellt.



Legende

- 1 Anschlussteil
- 2 Biegeversteifung
- 3 flexibles Rohrleitungssystem

Bild 2 — Beispiel für ein an die Schnittstellenkonstruktion angrenzendes Anschlussteil einer Biegeversteifung



Legende

- 1 Anschlussteil
- 2 Biegeversteifung
- 3 flexibles Rohrleitungssystem

Bild 3 — Beispiel für ein außerhalb der Schnittstellenkonstruktion befindliches Anschlussteil einer Biegeversteifung

3.1.38

Umwelteinwirkung

Beanspruchung, die durch äußere Umweltparameter verursacht wird

3.1.39

End-Nettoauftrieb

Nettoauftrieb am Ende der Lebensdauer

3.1.40

Brandschutz

Materialschicht, die im Brandfall für eine festgelegte Zeitdauer einen passiven Brandschutz für das flexible Rohrleitungssystem bietet

3.1.41

flexibles Rohrleitungssystem

Fluidfördersystem, bei dem die flexible Rohrleitung das Hauptbauteil darstellt und das Zusatzbauteile umfasst, die unmittelbar oder mittelbar mit der Rohrleitung verbunden sind

3.1.42

flexibler Anschluss an das Riser-Verankerungssystem

Bauteil eines Riser-Verankerungssystems, das den Übergang zwischen der flexiblen Rohrleitung und der Konstruktion der Riser-Verankerung bildet

3.1.43

lastfreier Schließradius

Radius eines Krümmungsbegrenzers während des Schließens ohne Lasteinwirkung

3.1.44

funktionsbedingte Belastungen

sämtliche Belastungen der Zusatzausrüstungen während des Betriebs

3.1.45

Abreiben

allmähliche Entfernung des Werkstoffs von einer Oberfläche infolge der sich dauernd wiederholenden Relativbewegung an einer benachbarten Oberfläche

3.1.46

Rinne

Teil eines Unterwasserbogens, auf dem die flexible Rohrleitung ruht und in dem sie eingespannt sein kann

3.1.47

Wärmeformbeständigkeitstemperatur

Temperatur, bei der ein Probekörper aufgrund einer aufgetragenen Last in einem festgelegten Ausmaß verformt wird

3.1.48

Hochleistungsauftrieb

Auftriebslänge einer flexiblen Rohrleitung mit einem relativ hohen Nettoauftrieb je Längeneinheit

3.1.49

Hybrid-Krümmungsbegrenzer

Krümmungsbegrenzer mit einer Kombination aus Polymer- und Metallelementen

3.1.50

Wasserstoffversprödung

Festigkeitsabfall von metallischen Werkstoffen infolge der Verbindung mit einem CP-System

3.1.51**Hysterese**

Biegeverhalten eines flexiblen Rohrleitungssystems, das durch eine Änderung der Biegesteifigkeit charakterisiert ist, beobachtbar in der Momenten-Krümmungs-Beziehung, wenn die Reibung der Zugbewehrungen der flexiblen Rohrleitung überwunden ist und der Beitrag der Polymerschichten zur Biegesteifigkeit überwiegt

ANMERKUNG Wenn sich die Krümmungsrichtung ändert, nimmt die Steifigkeit infolge von Reibung solange zu, bis sie überwunden ist. Die Momenten-Krümmungs-Beziehung ähnelt einem elastisch-plastischen Verhalten und bildet, bei normaler zyklischer Biegung, eine geschlossene Schleife.

3.1.52**Schutzrohrabdichtung**

Einrichtung, die die flexible Rohrleitung umgibt und für eine druckfeste Abdichtung in einem Schutzrohr sorgt, damit ein korrosionsinhibierendes Fluid darin enthalten sein kann

3.1.53**unabhängige Verifizierungsstelle**

vom Hersteller ausgewählte unabhängige Partei oder Gruppe, bei der es sich um den Käufer handeln kann, die die angegebenen Methodiken oder das Leistungsvermögen auf Grundlage von Fachliteratur, Analysen, Prüfergebnisse und weiterer vom Hersteller zur Verfügung gestellter Informationen verifizieren kann

ANMERKUNG Die unabhängige Verifizierungsstelle ist außerdem aufgefordert, einige Messungen und Prüfungen zur Materialqualifizierung zu beglaubigen.

3.1.54**Anfangs-Nettoauftrieb**

Nettoauftrieb vor dem Eintauchen in Meerwasser

3.1.55**Installation**

Einbau der Zusatzausrüstungen in das flexible Rohrleitungssystem

ANMERKUNG Dieser Begriff bezieht sich nicht auf die Installation der flexiblen Rohrleitung, sofern es nicht eigens angegeben ist.

3.1.56**Schnittstellenkonstruktion**

Konstruktion, die Lasten von einer Biegeversteifung oder einem Krümmungsbegrenzer auf die Anschlusskonstruktion überträgt

3.1.57**interner Klemmbügel**

Bauteil einiger Auftriebsmodule, das den internen Klemmkörper an der flexiblen Rohrleitung befestigt

ANMERKUNG Der interne Klemmbügel ist im Innern des Auftriebselements angeordnet.

3.1.58**Schutzrohr-Biegeversteifung**

Biegeversteifung, die an der Oberwerk-Verbindung einer flexiblen Rohrleitung angebracht ist, die am Schiff bzw. an der Plattform mittels eines Schutzrohrs aufgehängt ist

ANMERKUNG In Bild 1 ist ein Beispiel für eine Schutzrohr-Biegeversteifung dargestellt.

3.1.59**Umsetzbügel**

Anschlussstelle bei einer Konstruktion, die zum Ankoppeln von Hubgerät dient

3.1.60

Lastübertragungseinrichtung

Einrichtung, die zur Übertragung der Lasten vom Anschlussteil der flexiblen Rohrleitung oder der Schnittstellenkonstruktion der Krümmungsbegrenzungsvorrichtung auf die Oberwerkkonstruktionen dient, aber keine drucktragende Funktion hat

3.1.61

Sperrung

Verschließen einzelner Krümmungsbegrenzer-Elemente

3.1.62

Kleinleistungsauftrieb

Auftriebslänge einer flexiblen Rohrleitung mit einem relativ geringen Nettoauftrieb je Längeneinheit

3.1.63

untere Trosse

Länge der flexiblen Rohrleitung zwischen dem Riser-Verankerungssystem und der Unterwasserboje

3.1.64

Makrokugel

Kugel aus Keramik, Polymer oder Verbundwerkstoff mit einem Durchmesser von mehr als 1 mm, die Bestandteil von gemischten syntaktischen Schäumen ist

3.1.65

Hersteller

für die Anwendung des vorliegenden Teils der ISO 13628 der Hersteller der Zusatzausrüstungen

3.1.66

mechanische Schutzeinrichtung

Materialschicht, die eine vorgegebene Länge einer flexiblen Rohrleitung umschließt, um sie gegen Abrieb und Stoßbelastungen zu schützen oder um einen Abstand zwischen der flexiblen Rohrleitung und anderen Unterwasserleitungen zu schaffen

3.1.67

Membranspannung

σ_m

Mittelwert der Spannung in Richtung der Dicke eines festen Abschnitts, ausschließlich der Auswirkungen von Diskontinuitäten und Spannungskonzentrationen

BEISPIEL Die allgemeine primäre Membranspannung in einer nur auf Zug belasteten Rohrleitung entspricht der Spannung dividiert durch die Querschnittsfläche. σ_m kann die globale Biegung umfassen, wie im Fall einer einfachen, durch ein Biegemoment belasteten Rohrleitung.

[API RP 2RD]

3.1.68

Mikrokugel

Kugel aus Keramik, Polymer oder Verbundwerkstoff mit einem Durchmesser zwischen 1 μm und 1 000 μm , die Bestandteil von syntaktischen und gemischten syntaktischen Schäumen ist

3.1.69

Gemisch

besondere Mischung von Bestandteilen aus Polymer-Werkstoff

3.1.70

Modulelement

Teil eines Auftriebs- oder Ballastmoduls, das dem Modul Auftrieb oder zusätzliches Gewicht verleiht

ANMERKUNG Das Modulelement umfasst keine Schwimm tanks.

3.1.71**Nettoauftrieb**

resultierender Auftrieb unter Berücksichtigung sämtlicher schwimmfähiger und nicht-schwimmfähiger Bauteile in einer Unterwasserboje oder einem Auftriebsmodul

3.1.72**Überbord-Transportschacht**

am Rand des Schiffes angeordnete bogenförmige Konstruktion, die als Installationshilfe für die flexible Rohrleitung dient

3.1.73**oxidative Alterung**

Abbau eines Werkstoffs im Zeitverlauf aufgrund der Exposition gegenüber Sauerstoff, der durch Veränderungen auf molekularer Ebene verursacht wird

3.1.74**passiver Brandschutz**

Beschichtung, Verkleidung oder freistehende Schutzeinrichtung, die im Brandfall einen thermischen Schutz bietet und weder manueller, mechanischer noch anderer Mittel zur Auslösung, Auffüllung oder zum Unterhalt bedarf

[DNV OS-D301]

3.1.75**dauerhafte Zusatzausrüstung**

Zusatzausrüstung, die während der gesamten Lebensdauer der flexiblen Rohrleitung eingesetzt wird

3.1.76**dauerhafte Biegeversteifung**

Biegeversteifung, die während der gesamten Lebensdauer der flexiblen Rohrleitung eingesetzt wird

3.1.77**Huckepack-Klemme**

Abstandhalter in einem Huckepack-System, der am Stützrohr und an der gestützten Rohrleitung befestigt wird und keine Relativbewegung der gestützten Rohrleitung zulässt

3.1.78**Huckepack-Führung**

Abstandhalter in einem Huckepack-System, der am Stützrohr befestigt ist und eine Relativbewegung der gestützten Rohrleitung zulässt

3.1.79**Einzugskopf**

Vorrichtung, die während der Installation einer flexiblen Rohrleitung eingesetzt wird und dazu dient, das Anschlussstück der flexiblen Rohrleitung mit einem Einzugsdraht zu verbinden; sie ist so konstruiert, dass sie mit dem Anschlussstück verbunden werden kann und einen Anschluss zum Ankoppeln von Hubgerät aufweist

3.1.80**Käufer**

Anbieter eines flexiblen Rohrleitungssystems, der gegenüber dem Hersteller von Zusatzausrüstungen als Käufer auftritt

3.1.81**Rohstoff-Lieferant**

Lieferant von Rohstoffen für jegliche Bauteile einer Einheit der Zusatzausrüstung

3.1.82

Reaktionsring

Schnittstellenkonstruktion des Krümmungsbegrenzers, die aus einer zweiteiligen Schalenkonfiguration besteht, die das Anschlussstück der flexiblen Rohrleitung umspannt

3.1.83

Reaktionsflansch

Schnittstellenkonstruktion des Krümmungsbegrenzers, die aus einer zweiteiligen Flanschanordnung besteht, die direkt mit der Tragkonstruktion verbunden ist, über der ein Krümmungsbegrenzer-Element angeordnet ist

3.1.84

Reparaturklemme

Klemme, die über einem beschädigten Bereich einer flexiblen Rohrleitung angeordnet ist und dazu dient, einen solchen Bereich zu reparieren

3.1.85

Riser-Verankerungssystem

auf dem Meeresboden angeordnete Konstruktion, die dazu dient eine bauliche und druckdichte Verbindung zwischen einer flexiblen Steigleitung und einer Förderleitung herzustellen

ANMERKUNG Das Riser-Verankerungssystem kann ein Pipeline-Endabschlussstück (PLET) oder ein Pipeline-Endverteilerstück (PLEM) sein.

3.1.86

Verbindung am Meeresboden

Verbindung zwischen dem Anschlussstück der flexiblen Steigleitung (riser) und dem Riser-Verankerungssystem

3.1.87

Dichtelement

Teil einer Schutzrohrabdichtung, das für die Abdichtung sorgt

3.1.88

Sekantenmodul

Steigung der Geraden, die vom Ausgangspunkt im Spannungs-Dehnungs-Diagramm durch einen Punkt im gleichen Diagramm gezogen wird, der einer bestimmten Dehnung entspricht

3.1.89

Sekundärspannung

jegliche Normal- oder Schubspannung, die sich aufgrund einer Materialeinschränkung entwickelt

ANMERKUNG Diese Spannungsart ist selbstbegrenzend, d. h. lokales Fließen kann die Bedingungen korrigieren, die die Spannung verursachen, und eine einzige Lastaufbringung führt nicht zu einem Versagen.

[API RP 2RD]

3.1.90

Abbindezeit

Zeitdauer, die Bauteile aus Polymer- oder Verbundwerkstoffen in einer Form verbleiben müssen, bevor diese entnommen werden können

3.1.91

Strecklast

plötzlich auftretende Last, die an einem schlaffen Halteseil angreift und zu einer dynamischen Verstärkung führt, die ein Vielfaches der aufgebrachten Zugspannung beträgt

3.1.92**Abstandhalter**

diskretes Bauteil, von dem mehrere in Reihe dazu verwendet werden, eine oder mehrere gestützte Rohrleitungen über eine vorgegebenen Länge an einem Stützrohr zu befestigen

3.1.93**Unterwasserbojen-Rahmen**

Bauteil einer Unterwasserboje. Es umfasst die Rinnen, die Gehäuse für Klemmen und Schwimm tanks oder Auftriebs Elemente sowie Anschlussstellen für Halteseil-Beschläge

3.1.94**Tragkonstruktion**

Konstruktion, die die Lasten einer flexiblen Rohrleitung oder einer Krümmungsbegrenzungsvorrichtung trägt und sie entweder zum Oberwerk, zum Meeresboden oder auf eine Zwischenverbindung überträgt

3.1.95**gestützte Rohrleitung**

Rohrleitung, die mit Hilfe einer Reihe von Huckepack-Klemmen oder –Führungen über eine vorgegebene Länge an einem Stützrohr befestigt ist

ANMERKUNG Eine gestützte Rohrleitung kann eine flexible Rohrleitung sein.

3.1.96**Stützrohr**

Rohrleitung, die mit Hilfe einer Reihe von Huckepack-Klemmen oder –Führungen eine oder mehrere Rohrleitungen über einer vorgegebene Länge stützt

ANMERKUNG Ein Stützrohr kann eine flexible Rohrleitung sein.

3.1.97**syntaktischer Schaum**

Verbundwerkstoff, der aus einer Polymermatrix besteht, die nur Mikrokugeln enthält

3.1.98**Eigentümer der Anlage**

Käufer eines flexiblen Rohrleitungssystems von einem Anbieter eines flexiblen Rohrleitungssystems

3.1.99**Reißfestigkeit**

Kraft, die erforderlich ist, um eine Probe des Werkstoffs (gekerbt oder ungekerbt) unter festgelegten Bedingungen zu zerreißen

3.1.100**provisorische Biegeversteifung**

Biegeversteifung, die während der Installation einer flexiblen Rohrleitung, zu deren Handhabung oder bei anderen Tätigkeiten, nicht jedoch während des Betriebes, erforderlich ist, um die Anforderungen an die Funktionstüchtigkeit zu erfüllen

3.1.101**Halteseil**

Kette oder Seil zur Befestigung einer flexiblen Rohrleitung oder einer Unterwasserboje an einer Halteseil-Verankerung, einschließlich der an jedem Endabschluss erforderlichen Verbindungstechnik

3.1.102**Halteseil-Verankerung**

Konstruktion, die ein Halteseil oder einer Gruppe von Halteseilen am Meeresboden verankert, einschließlich Halteseil-Anschlussstellen und Umsetzbügel

3.1.103

thermische Alterung

Degradation eines Werkstoffs im Zeitablauf infolge von Temperatur, die durch Veränderungen auf molekularer Ebene verursacht wird

3.1.104

Temperaturschock

Exposition gegenüber einer großen Temperaturschwankung innerhalb einer kurzen Zeitdauer

3.1.105

Träger

Bauteil, das aus mehreren einzelnen, schmalen Teilen zusammengeschweißt oder -geschraubt und so gestaltet ist, dass es Dehnungs- und Stauchungskräfte aufnimmt, wobei die gesamte Konstruktion als ein Träger agiert

3.1.106

Oberwerk-Verbindung

Verbindung zwischen dem Anschlussteil der flexiblen Rohrleitung und der Plattform

3.1.107

obere Trosse

Länge der flexiblen Rohrleitung zwischen der Plattform und der Unterwasserboje

3.1.108

Unterwasser-Reparatur

Reparatur einer flexiblen Rohrleitung vor Ort

3.2 Symbole und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden Symbole und Abkürzungen.

C_a zulässiger Spannungsfaktor
 $C_a = 0,67$

ANMERKUNG 1 Siehe API RP 2RD.

C_f Auslegungsfaktor

ANMERKUNG 2 Siehe API RP 2RD.

σ_b Biegespannung

σ_m Membranspannung

σ_q Sekundärspannung

σ_{sc} Spannung bei einer bestimmten Tragfähigkeit

$(\sigma_x)_e$ Von-Mises-Spannungskomponente für σ_x

BEISPIEL $(\sigma_b)_e$ ist die Von-Mises-Membranspannung.

AISI American Iron and Steel Institute

API American Petroleum Institute

AWS American Welding Society

BV Bureau Veritas

CP Korrosionsschutz

DIN	Deutsches Institut für Normung e.V.
DnV	Det norske Veritas
EMMUA	Engineering Equipment & Materials Users' Association
EPDM	Ethylen-Propylen-Dien-Terpolymer
FAT	Werksabnahme
FEA	Finite-Elemente-Analyse
GVI	Allgemeine Sichtprüfung
HMPE	Hochmodul-Polyethylen
IAPSO	International Association for Physical Sciences of the Ocean
MBL	Mindestbruchkraft
MBR	Mindest-Biegeradius
MBS	Mindestbruchfestigkeit
MWL	Mittelwasserlinie
N/A	Nicht zutreffend
NDE	Zerstörungsfreie Untersuchung
PCD	Teilkreisdurchmesser
PLEM	Pipeline-Endverteilerstück
PLET	Pipeline-Endabschlussstück
ROV	Ferngelenktes Fahrzeug
SBR	Styrol-Butadien-Kautschuk
SWL	Zulässige Betriebslast
UKOOA	United Kingdom Offshore Operators Association
UV	ultraviolett
VIV	wirbelinduzierte Schwingung

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN ISO 34-1, *Elastomere oder thermoplastische Elastomere — Bestimmung des Weiterreißwiderstandes — Teil 1: Streifen-, winkel- und bogenförmige Probekörper*

DIN ISO 1431-1, *Elastomere oder thermoplastische Elastomere — Widerstand gegen Ozonrissbildung — Teil 1: Statische und dynamische Prüfung*

DIN EN 10204, *Metallische Erzeugnisse — Arten von Prüfbescheinigungen*

DIN EN ISO 62, *Kunststoffe — Bestimmung der Wasseraufnahme*

DIN EN ISO 75-1, *Kunststoffe — Bestimmung der Wärmeformbeständigkeitstemperatur — Teil 1: Allgemeines Prüfverfahren*

DIN EN ISO 75-2, *Kunststoffe — Bestimmung der Wärmeformbeständigkeitstemperatur — Teil 2: Kunststoffe und Hartgummi*

DIN EN ISO 178, *Kunststoffe — Bestimmung der Biegeeigenschaften*

DIN EN ISO 179-1, *Kunststoffe — Bestimmung der Charpy-Schlageigenschaften — Teil 1: Nicht instrumentierte Schlagzähigkeitsprüfung*

DIN EN ISO 179-2, *Kunststoffe — Bestimmung der Charpy-Schlageigenschaften — Teil 2: Instrumentierte Schlagzähigkeitsprüfung*

DIN EN ISO 180, *Kunststoffe — Bestimmung der Izod-Schlagzähigkeit*

DIN EN ISO 527-1, *Kunststoffe — Bestimmung der Zugeigenschaften — Teil 1: Allgemeine Grundsätze*

DIN EN ISO 527-2, *Kunststoffe — Bestimmung der Zugeigenschaften — Teil 2: Prüfbedingungen für Form- und Extrusionsmassen*

DIN EN ISO 604, *Kunststoffe — Bestimmung von Druckeigenschaften*

DIN EN ISO 868, *Kunststoffe und Hartgummi — Bestimmung der Eindruckhärte mit einem Durometer (Shore-Härte)*

DIN EN ISO 1183, *Kunststoffe - Verfahren zur Bestimmung der Dichte von nicht verschäumten Kunststoffen*

DIN ISO 1827, *Elastomere oder thermoplastische Elastomere — Bestimmung des Schubmoduls oder der Haftung zu starren Platten — Quadrupel-Schermethode*

DIN EN ISO 7784-2, *Beschichtungsstoffe — Bestimmung des Abriebwiderstandes — Teil 2: Verfahren mit rotierendem Gummireibrad*

EN ISO 10423, *Erdöl- und Erdgasindustrie — Bohr- und Förderausrüstung — Bohrlochkopf- und Eruptionskreuz-Ausrüstung*

DIN EN ISO 13628-2, *Erdöl- und Erdgasindustrie — Auslegung und Betrieb von Unterwasser-Fördersystemen — Teil 2: Flexible Rohrleitungssysteme mit unverbundenen Auskleidungen für Unterwasser- und meeres technische Anwendungen*

DIN EN ISO 13628-4, *Erdöl- und Erdgasindustrien — Konstruktion und Betrieb von Unterwasser-Produk tions systemen — Teil 4: Bohrlochkopf- und E-Kreuz-Ausrüstungen für den Unterwassereinsatz*

DIN EN ISO 13628-11, *Erdöl- und Erdgasindustrie — Auslegung und Betrieb von Unterwasser-Produk tions systemen — Teil 11: Flexible Rohrleitungssysteme für Unterwasser- und meeres technische Anwendung*

DIN EN ISO 19902, *Erdöl- und Erdgasindustrie — Gegründete Stahlplattformen*

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English Version

**Petroleum and natural gas industries —
Design and operation of subsea production systems —
Part 16: Specification for flexible pipe ancillary equipment
(ISO/DIS 13628-16:2010)**

Industries du pétrole et du gaz naturel —
Conception et exploitation des systèmes de production
immersés —
Partie 16: Spécification pour accessoires de canalisations
flexibles (ISO/DIS 13628-16:2010)

Erdöl- und Erdgasindustrie —
Auslegung und Betrieb von Unterwasser-Fördersystemen —
Teil 16: Anforderungen von Zusatzausrüstungen von flexiblen
Rohrleitungssystemen (ISO/DIS 13628-16:2010)

This draft European Standard is submitted to CEN members for parallel enquiry. It has been drawn up by the Technical Committee CEN/TC 12.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

	Page
Foreword.....	6
Introduction	7
1 Scope	7
2 Normative references	8
3 Terms, definitions, symbols and abbreviated terms.....	11
3.1 Terms and definitions	11
3.2 Symbols and abbreviated terms	21
4 General requirements.....	23
4.1 Introduction	23
4.2 Functional requirements	23
4.3 Design requirements	26
4.4 Material requirements	34
4.5 Manufacturing requirements	39
4.6 Documentation.....	42
4.7 Factory acceptance tests.....	45
4.8 Marking and packaging	46
5 Bend stiffeners.....	46
5.1 Applicability.....	46
5.2 Functional requirements	47
5.3 Design requirements	49
5.4 Material requirements	54
5.5 Manufacturing requirements	55
5.6 Documentation.....	57
5.7 Factory acceptance tests	58
5.8 Marking	59
6 Bend restrictors	59
6.1 Applicability.....	59
6.2 Functional requirements	59
6.3 Design requirements	62
6.4 Material requirements	66
6.5 Manufacturing requirements	67
6.6 Documentation.....	68
6.7 Factory acceptance tests	70
6.8 Marking and packaging	71
7 Bellmouths	72
7.1 Applicability.....	72
7.2 Functional requirements	72
7.3 Design requirements	74
7.4 Material requirements	75
7.5 Manufacturing requirements	77
7.6 Documentation.....	77
7.7 Factory acceptance tests	78
7.8 Marking	79
8 Buoyancy and ballast modules	79
8.1 Applicability.....	79
8.2 Functional requirements	79
8.3 Design requirements — Loads.....	82
8.4 Design methodology	83
8.5 Material requirements	86

8.6	Manufacturing requirements	88
8.7	Documentation	90
8.8	Factory acceptance tests.....	91
8.9	Marking and packaging.....	93
9	Subsea buoys	94
9.1	Applicability	94
9.2	Functional requirements.....	94
9.3	Design requirements.....	97
9.4	Material requirements	103
9.5	Manufacturing requirements	103
9.6	Documentation	104
9.7	Factory acceptance tests.....	106
9.8	Marking.....	109
10	Tethers.....	110
10.1	Applicability	110
10.2	Functional requirements.....	110
10.3	Design requirements.....	112
10.4	Material requirements	114
10.5	Manufacturing requirements	115
10.6	Documentation — Design report	115
10.7	Factory acceptance tests.....	116
10.8	Marking and packaging.....	116
11	Riser and tether bases	117
11.1	Applicability	117
11.2	Functional requirements — General	117
11.3	Functional requirements — Riser bases.....	118
11.4	Functional requirements — Tether bases.....	119
11.5	Design requirements.....	120
11.6	Material requirements	123
11.7	Manufacturing requirements	123
11.8	Documentation — Design report	124
11.9	Factory acceptance tests.....	125
11.10	Marking.....	127
12	General clamping device requirements	127
12.1	Applicability	127
12.2	Functional requirements.....	127
12.3	Design requirements.....	128
12.4	Material requirements — Polymer inner liner materials	130
12.5	Documentation — Clamp design report.....	130
13	Subsea buoy clamps.....	131
13.1	Applicability	131
13.2	Functional requirements.....	131
13.3	Design requirements.....	132
13.4	Material requirements	133
13.5	Manufacturing requirements — Process control	133
13.6	Documentation	134
13.7	Factory acceptance tests.....	134
13.8	Marking.....	135
14	Tether clamps	136
14.1	Applicability	136
14.2	Functional requirements.....	136
14.3	Design requirements.....	138
14.4	Material requirements	139
14.5	Manufacturing requirements — Process control	140
14.6	Documentation	141
14.7	Factory acceptance tests.....	142
14.8	Marking.....	143

15	Piggy-back systems	143
15.1	Applicability.....	143
15.2	Functional requirements	144
15.3	Design requirements	146
15.4	Material requirements	149
15.5	Manufacturing requirements	151
15.6	Documentation.....	151
15.7	Factory acceptance tests.....	152
15.8	Marking	154
16	Repair clamps	155
16.1	Applicability.....	155
16.2	Functional requirements	155
16.3	Design requirements	156
16.4	Material requirements	158
16.5	Manufacturing requirements	158
16.6	Documentation.....	159
16.7	Factory acceptance tests.....	160
16.8	Marking	161
17	I/J-tube seals	162
17.1	Applicability.....	162
17.2	Functional requirements	162
17.3	Design requirements	164
17.4	Material requirements	166
17.5	Manufacturing requirements	167
17.6	Documentation.....	167
17.7	Factory acceptance tests.....	169
17.8	Marking and packaging.....	171
18	Pull-in heads.....	172
18.1	Applicability.....	172
18.2	Functional requirements	172
18.3	Design requirements	173
18.4	Manufacturing requirements — Tolerances	174
18.5	Documentation requirements.....	174
18.6	Factory acceptance tests.....	176
18.7	Marking and packaging.....	177
19	Chinese fingers/cable grips	177
19.1	Applicability.....	177
19.2	Functional requirements	178
19.3	Design requirements	179
19.4	Material requirements	179
19.5	Manufacturing requirements	179
19.6	Documentation requirements.....	179
19.7	Factory acceptance tests.....	180
19.8	Marking	180
20	Connectors	181
20.1	Applicability.....	181
20.2	Functional requirements	181
20.3	Design requirements	182
20.4	Material requirements	185
20.5	Manufacturing requirements	185
20.6	Documentation.....	185
20.7	Factory acceptance tests.....	186
20.8	Marking and packaging	186
21	Load-transferring devices.....	187
21.1	Applicability.....	187
21.2	Functional requirements	187
21.3	Design requirements	189

21.4	Material requirements	193
21.5	Manufacturing requirements	193
21.6	Documentation	193
21.7	Factory acceptance tests.....	195
21.8	Marking and packaging.....	197
22	Mechanical protection.....	197
22.1	Applicability	197
22.2	Functional requirements — General	198
22.3	Functional requirements — Abrasion and impact protection	198
22.4	Functional requirements — Blanket protection	199
22.5	Design requirements — General.....	200
22.6	Design requirements — General.....	202
22.7	Material requirements	202
22.8	Manufacturing requirements — Process control	204
22.9	Documentation	204
22.10	Factory acceptance tests.....	205
22.11	Marking and packaging.....	206
23	Fire protection	207
23.1	Applicability	207
23.2	Functional requirements.....	207
23.3	Design requirements.....	209
23.4	Material requirements	212
23.5	Manufacturing requirements.....	214
23.6	Documentation	214
23.7	Factory acceptance tests.....	215
23.8	Marking.....	216
Annex A	(informative) Purchasing guidelines for bend stiffeners.....	217
Annex B	(informative) Purchasing guidelines for bend restrictors	222
Annex C	(informative) Purchasing guidelines for bellmouths	227
Annex D	(informative) Purchasing guidelines for buoyancy and ballast modules.....	231
Annex E	(informative) Purchasing guidelines for subsea buoys.....	241
Annex F	(informative) Purchasing guidelines for tethers	247
Annex G	(informative) Purchasing guidelines for riser and tether bases.....	251
Annex H	(informative) Purchasing guidelines for subsea buoy clamps	260
Annex I	(informative) Purchasing guidelines for tether clamps.....	264
Annex J	(informative) Purchasing guidelines for piggy-back systems	269
Annex K	(informative) Purchasing guidelines for repair clamps	275
Annex L	(informative) Purchasing guidelines for I/J-tube seals	279
Annex M	(informative) Purchasing guidelines for pull-in heads.....	283
Annex N	(informative) Purchasing guidelines for Chinese fingers/cable grips	285
Annex O	(informative) Purchasing guidelines for connectors.....	287
Annex P	(informative) Purchasing guidelines for load-transfer devices	292
Annex Q	(informative) Purchasing guidelines for mechanical protection.....	297
Annex R	(informative) Purchasing guidelines for fire protection	303
Bibliography		307

Foreword

This document (prEN ISO 13628-16:2010) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries", the secretariat of which is held by AFNOR.

This document is currently submitted to the parallel Enquiry.

Endorsement notice

The text of ISO/DIS 13628-16:2010 has been approved by CEN as a prEN ISO 13628-16:2010 without any

Introduction

This part of ISO 13628 is the result of a Joint Industry Project to develop a worldwide industry standard for the design, material selection, manufacture, documentation, testing, marking and packaging of flexible pipe ancillary equipment. The objective of this part of ISO 13628 is to provide an integrated approach, together with ISO 13628-2, ISO 13628-11 and ISO 13628-17, to the design of flexible pipe systems. Therefore it is intended that this part of ISO 13628 be used in close conjunction with these documents.

Within this part of ISO 13628, "shall" is used to state that a provision is mandatory; "should" is used to state that a provision is not mandatory, but is recommended as good practice; "may" is used to state that a provision is optional.

Système International (SI) units are used in this part of ISO 13628. United States Customary (USC) units may be given in brackets after the SI units.

1 Scope

This part of ISO 13628 defines the technical requirements for safe, dimensionally and functionally interchangeable flexible pipe ancillary equipment that is designed and manufactured to uniform standards and criteria.

Minimum requirements are specified for the design, material selection, manufacture, testing, documentation, marking and packaging of flexible pipe ancillary equipment, with reference to existing codes and standards where applicable. See ISO 13628-17 for guidelines on the use of ancillary equipment.

The applicability relating to a specific item of ancillary equipment is stated at the beginning of the particular clause for the ancillary equipment in question.

This part of ISO 13628 applies to the following flexible pipe ancillary equipment:

bend stiffeners,
bend restrictors,
bellmouths,
buoyancy modules and ballast modules,
subsea buoys,
tethers for subsea buoys and tether clamps,
riser and tether bases,
clamping devices,
piggy-back clamps,
repair clamps,
I/J-tube seals,
pull-in heads/installation aids,
connectors,

load-transfer devices,

mechanical protection,

fire protection.

This part of ISO 13628 may be used for bonded flexible pipe ancillary equipment, though any requirements specific to these applications are not addressed.

The applicability of requirements to umbilicals is indicated in the applicability subclauses of this part of ISO 13628 for the ancillary equipment in question.

This part of ISO 13628 does not cover flexible pipe ancillary equipment beyond the connector, with the exception of riser bases and load-transfer devices. Therefore this part of ISO 13628 does not cover turret structures or I-tubes and J-tubes for example. In addition, this part of ISO 13628 does not cover flexible pipe storage devices such as reels, for example.

This part of ISO 13628 is intended to cover ancillary equipment made from several material types, including metallic, polymer and composite materials. This part of ISO 13628 may also refer to material types for particular ancillary components that are not commonly used for such components currently, but may be adopted more frequently in the future.

This part of ISO 13628 applies to ancillary equipment used in association with the flexible pipe applications listed in Clause 1 of ISO 13628-2:2006.

This part of ISO 13628 does not apply to ancillary equipment used in association with any of the flexible pipe applications excluded in Clause 1 of ISO 13628-2:2006.

Annexes to this part of ISO 13628 are intended only as guidelines or for information.

2 Normative references

The following referenced documents are indispensable for the application of this part of ISO 13628. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Requirements of other standards included by reference in this part of ISO 13628 are essential to the safety and interchangeability of the product provided.

NOTE 2 Standards referenced in this part of ISO 13628 may be replaced by other international or national standards that can be shown to meet or exceed the requirements of the referenced standard. Manufacturers who choose to use other standards in lieu of standards referenced herein are responsible for documenting the equivalency of the standards.

NOTE 3 National standards and requirements (which may not all be referenced in this part of ISO 13628) may be relevant for some ancillary equipment in this part of ISO 13628. In some countries it may be required to design and certify platforms/vessels and their associated equipment in accordance with the standards of the certifying agency.

ISO 34-1, *Rubber, vulcanized or thermoplastic – Determination of tear strength – Part 1: Trouser, angle and crescent test pieces*

ISO 37, *Rubber, vulcanized or thermoplastic – Determination of tensile stress-strain properties*

ISO 62, *Plastics – Determination of water absorption*

ISO 75-1, *Plastics – Determination of temperature of deflection under load – Part 1: General test method*

ISO 75-2, *Plastics – Determination of temperature of deflection under load – Part 2: Plastics and ebonite*

ISO 178, *Plastics — Determination of flexural properties (CORR 14450, AMD 15772)*

ISO 179-1, *Plastics - Determination of Charpy impact properties - Part 1: Non-Instrumented impact test*

ISO 179-2, *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 527-1, *Plastics – Determination of tensile properties – Part 1: General principles*

ISO 527-2, *Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics*

ISO 604, *Plastics – Determination of compressive properties*

ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 1183 (all parts), *Plastics – Methods for determining the density of non-cellular plastics*

ISO 1431-1, *Rubber, vulcanised or thermoplastic – Resistance to ozone cracking – Part 1: Static and dynamic strain testing*

ISO 1827, *Rubber, vulcanized or thermoplastic – Determination of shear modulus and adhesion to rigid plates – Quadruple-shear methods*

ISO 7743, *Rubber, vulcanized, or thermoplastic — Determination of compressive stress-strain properties*

ISO 7784-2, *Paints and varnishes – Determination of resistance to abrasion – Part 2: Rotating abrasive rubber wheel method*

ISO 10423, *Petroleum and natural gas industries — Drilling and production equipment — Wellhead and christmas tree equipment*

ISO 10425, *Steel wire ropes for the petroleum and natural gas industries — Minimum requirements and terms of acceptance*

ISO 10474, *Steel and steel products – Inspection documents*

ISO 13628-2:2006, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 2: Unbonded flexible pipe systems for subsea and marine applications*

ISO 13628-4, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 4: Subsea wellhead and tree equipment*

ISO 13628-11:2002, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 11: Flexible pipe systems for subsea and marine applications*

ISO 13628-17¹⁾, *Petroleum, petrochemical and natural gas industries — Offshore structures — Part 17: Recommended practice for flexible pipe ancillary equipment*

ISO 19902, *Petroleum and natural gas industries — Fixed steel offshore structures*

AISC *Steel Construction Manual*

API RP 2A-WSD, *Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms — Working Stress Design*

1) To be published.

API Spec 2F, *Specification for Mooring Chain*

ASME, *Boilers and Pressure Vessels Section VIII — Rules for Construction of Pressure Vessels*

ASTM C177, *Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus*

ASTM C518, *Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus*

ASTM D256, *Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics*

ASTM D570, *Standard Test Method for Water Absorption of Plastics*

ASTM D624, *Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers*

ASTM D638, *Standard Test Method for Tensile Properties of Plastics*

ASTM D648, *Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position*

ASTM D695-02a, *Standard Test Method for Compressive Properties of Rigid Plastics*

ASTM D732, *Standard Test Method for Shear Strength of Plastics by Punch Tool*

ASTM D792, *Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement*

ASTM D1418, *Standard Practice for Rubber and Rubber Lattices — Nomenclature*

ASTM D2240, *Standard Test Method for Rubber Property — Durometer Hardness*

ASTM D4060, *Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*

ASTM E1269, *Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry*

BS PD 5500, *Specification for Unfired Fusion Welded Pressure Vessels*

BS 903-A9, *Physical Testing of Rubber. Determination of Abrasion Resistance*

DIN 53516, *Testing of Rubber and Elastomers; Determination of Abrasion Resistance*

DNV OS-D301, *Fire Protection*

DNV, *Rules for Certification of Lifting Appliances, 1994*

BS/EN 10083-1, *Steels for quenching and tempering. General technical delivery conditions*

BS/EN 10083-2, *Steels for quenching and tempering. Technical delivery conditions for non alloy steels*

Lloyd's Register of Shipping, *Code for Lifting Appliances in a Marine Environment*

NORSOK M-501, *Surface Preparation and Protective Coating*

NORSOK U-001, *Subsea Production Systems*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13628-2, ISO 13628-11 and the following apply. For description and additional information, see Clause 4 of ISO 13628-17.

3.1.1

accidental load

load caused by accidental occurrence

3.1.2

anchor base

structure used to secure one end of a tether to the seabed

3.1.3

ancillary component

component that is attached to the flexible pipe in order to perform one or more of the following functions:

- a) to control the flexible pipe behaviour;
- b) to provide a structural transition between the flexible pipe and adjacent structures;
- c) to attach other structures to the flexible pipe;
- d) to protect or repair the flexible pipe;
- e) to provide a seal along the flexible pipe length.

3.1.4

audit

documented investigation conducted by the purchaser to verify that applicable requirements are being implemented

3.1.5

ballast module

negatively buoyant component of which a number are used at discrete points over a length of flexible pipe to provide added weight

3.1.6

banding

device used to secure mechanical protection to the flexible pipe

3.1.7

batch

quantity of product produced during one operation

3.1.8

bend restrictor element

vertebra

unit part of bend restrictor, of which a series are linked together to form the complete length of the bend restrictor

3.1.9

bend stiffener base

face of the interface structure on the support structure side at which the bend stiffener begins

3.1.10

bend stiffener body

polymeric part of a bend stiffener that provides extra stiffness to the flexible pipe to prevent it from overbending

NOTE 1 The bend stiffener body, for a particular bend stiffener configuration, is shown in Figure 1.

NOTE 2 Bend stiffener caps often incorporate the male part of the bend stiffener mechanism, and the bellmouths often incorporate the female part.

3.1.11

bend stiffener cap

structural component of some bend stiffener designs comprising a cylindrical metallic shell that fits externally around part of the bend stiffener length adjacent to the bend stiffener base

NOTE An example of a bend stiffener cap, for a particular bend stiffener configuration, is shown in Figure 1.

3.1.12

bend stiffener hatching mechanism

a structure or mechanism that connects a bend stiffener to a supporting structure allowing the bending to be transferred from the bend stiffener to the supporting structure

3.1.13

bend stiffener protective liner

polymeric sleeve that internally covers the end fitting recess in an end fitting adjacent interface structure, avoiding contact between flexible pipe's external sheath and metallic parts of the interface structure

NOTE An example of a bend stiffener protective liner, for a particular bend stiffener configuration, is shown in Figure 1.

3.1.14

bend stiffener tip

end of the bend stiffener body opposite the base

NOTE The bend stiffener tip, for a particular bend stiffener configuration, is shown in Figure 1.

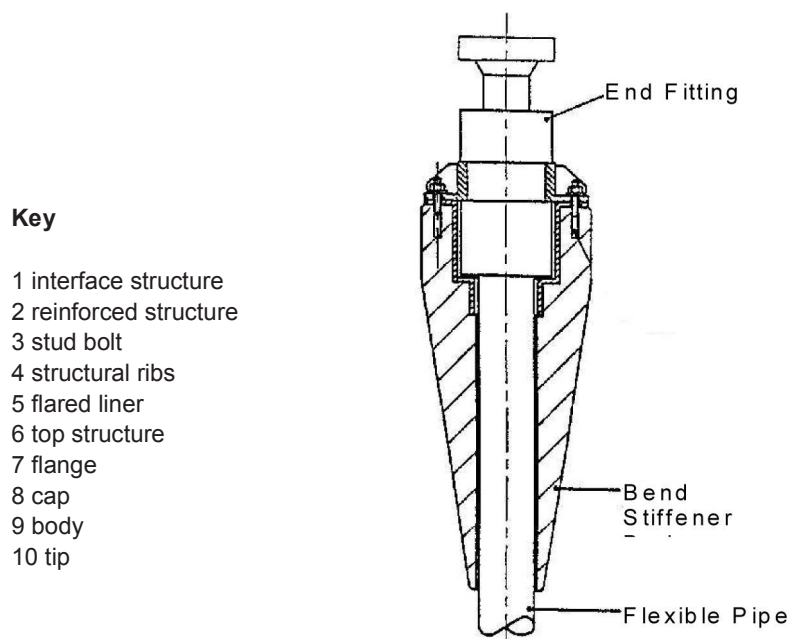


Figure 1 — Example of I-tube bend stiffener

3.1.15

bending stress

portion of primary stress proportional to the distance from the centroid of a cross section, excluding the effects of discontinuities and stress concentrations

[API RP 2RD]

3.1.16

blown foam

polymer foam containing no microspheres or macrospheres

3.1.17

bridle

load-bearing structure that forms the transition between a subsea buoy frame and its tethers

3.1.18

buoyancy element

part of a buoyancy module or some subsea buoys that gives uplift to the module or buoy

NOTE The buoyancy element comprises a buoyant material that may have a protective external skin. It does not include buoyancy tanks.

3.1.19

buoyancy module

discrete component, consisting of a buoyancy element, an internal clamp and any necessary fasteners to secure these components in position, used to provide net uplift to flexible pipes by attaching a series of such components along a length of pipe

3.1.20

buoyancy tank

part of some subsea buoys that consists of a pressure vessel filled with gas at ambient or higher pressure that gives uplift to the subsea buoy

3.1.21

chemical ageing

degradation of a material over time, due to exposure to chemicals, caused by changes at the molecular level

3.1.22

Chinese finger

device used during flexible pipe installation that consists of a meshed structure that grips around the flexible pipe outer sheath

NOTE The mesh is configured such that the higher the load applied to it the tighter its grip.

3.1.23

clamp body

part of a clamp that is in surface contact with the flexible pipe outer sheath

3.1.24

clamp inner liner

part of some clamp bodies that consists of a compliant lining of material in contact with the flexible pipe outer sheath that allows for variations in the flexible pipe external diameter

3.1.25

composite

combination of a polymer material and a reinforcing material that enhances the properties of the polymer

3.1.26

composite syntactic foam

composite material consisting of a polymer matrix containing both microspheres and macrospheres

3.1.27

connector

device used to provide a leak-tight structural connection between the end fitting and adjacent piping

NOTE It does not include flexible pipe end fittings.

3.1.28

crushing capacity

maximum localised radial compressive load that a flexible pipe can resist

3.1.29

deformed locking radius

radius of a bend restrictor during lock-up with applied loading

3.1.30

design methodology verification report

evaluation report prepared by an independent verification agent at the time of an initial review, for a specific manufacturer, confirming the suitability and appropriate limits on the manufacturer's design methodologies

NOTE The design methodology verification report can include occasional amendments or revisions to address extensions beyond previous limits or revisions of methodologies.

3.1.31

design verification

process of proving design by testing

3.1.32

diver-assisted I/J-tube seal

I/J-tube seal that requires diver assistance to make-up the seal

NOTE It can incorporate a clamping device.

3.1.33

diverless I/J-tube seal

I/J-tube seal that does not require diver assistance

NOTE The seal is created by pulling it in to an I/J-tube. A clamping device resists the pull-in forces.

3.1.34

dry repair

repair of a flexible pipe that has been retrieved from the water

3.1.35

dynamic bend restrictor

design scenario where there is intermittent lock-up between bend restrictor elements induced by external forces such as wave and current environmental loads

3.1.36

end fitting adjacent interface structure

bend stiffener interface structure where the end fitting is positioned within the interface structure

NOTE An example of an end fitting adjacent structure is shown in Figure 2.

3.1.37

end fitting remote interface structure

bend stiffener interface structure where the end fitting is positioned outside the interface structure

NOTE An example of an end-fitting remote interface structure is shown in Figure 3.

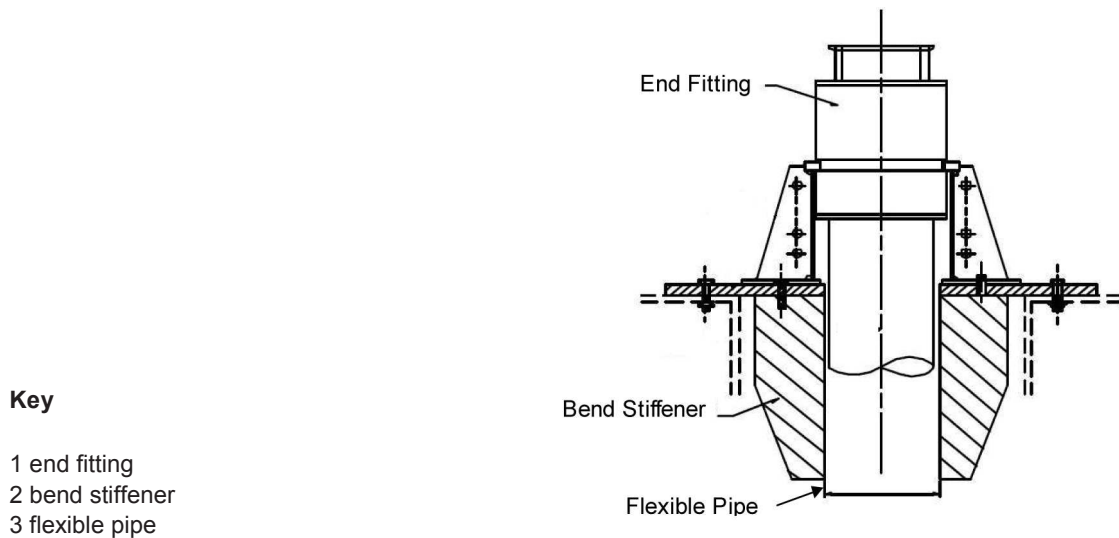


Figure 2 — Example of bend stiffener end fitting adjacent interface structure

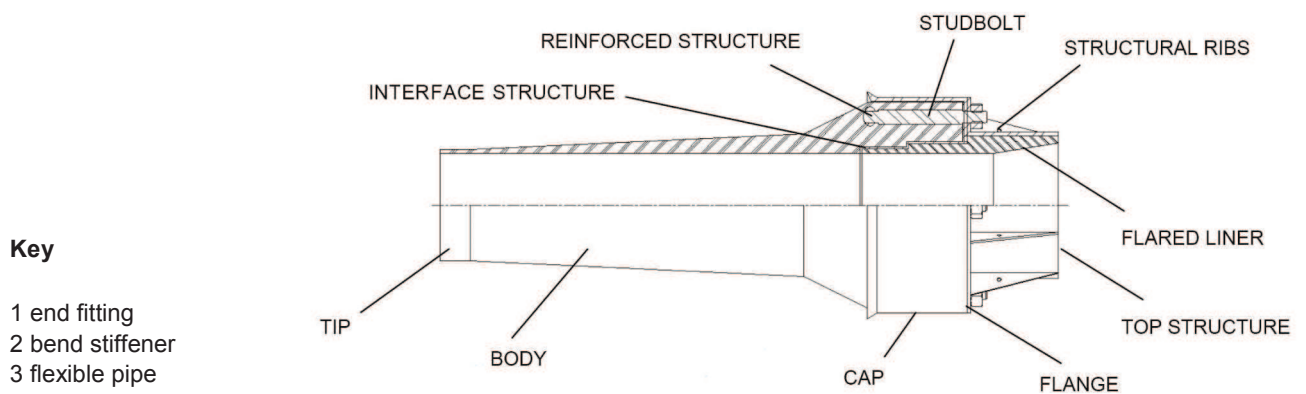


Figure 3 — Example of bend stiffener end fitting remote interface structure

3.1.38

environmental load

load induced by external environmental parameters

3.1.39

final net buoyancy

net buoyancy at the end of the service life

3.1.40

fire protection

layer of material that provides passive fire protection to the flexible pipe for a specified duration of time in the event of a fire

3.1.41

flexible pipe system

fluid conveyance system for which the flexible pipe(s) is the primary component and which includes ancillary components attached directly or indirectly to the pipe

3.1.42

flexible riser base connection

part of a riser base that forms the transition between the flexible pipe end fitting and the riser base structure

3.1.43

free-locking radius

radius of a bend restrictor during lock-up without applied loading

3.1.44

functional loads

all loads on the ancillary equipment during operation

3.1.45

galling

gradual removal of material from a surface due to repetitive relative motion with an adjacent surface

3.1.46

gutter

part of a subsea arch that the flexible pipe rests on and may be clamped to

3.1.47

heat distortion temperature

temperature at which an applied load causes a test sample to deflect by a specified amount

3.1.48

high power buoyancy

buoyant length of a flexible pipe with relatively high net buoyancy per unit length

3.1.49

hybrid bend restrictor

bend restrictor with a combination of polymer and metallic elements

3.1.50

hydrogen embrittlement

weakening of metallic material due to connection to CP system

3.1.51

hysteresis

bending behaviour of a flexible pipe characterised by a change in the bending stiffness, observable in the moment-curvature relationship, when the friction of the flexible pipe tensile armour layers is overcome and the contribution of the polymer layers to the bending stiffness dominates

NOTE When the direction of curvature is changed, the higher stiffness due to friction resumes until it is again overcome. The moment-curvature relationship is similar to an elastic-plastic response and, for regular cyclic bending, forms a closed loop.

3.1.52

I/J-tube seal

device that fits around a flexible pipe and is used to provide a pressure-tight seal in an I/J-tube in order to contain corrosion-inhibited fluid within

3.1.53

independent verification agent

independent party or group, which can be the purchaser, selected by the manufacturer, that can verify the indicated methodologies or performance based on the technical literature, analyses, test results and other information provided by the manufacturer

NOTE The independent verification agent is also called upon to witness some measurements and tests related to material qualification.

3.1.54

initial net buoyancy

net buoyancy before immersion in seawater

3.1.55

installation

integration of the ancillary equipment into the flexible pipe system

NOTE This term does not refer to installation of the flexible pipe unless specifically stated.

3.1.56

interface structure

structure that transfers loads from a bend stiffener or bend restrictor to the adjacent structure

3.1.57

internal clamp strap

part of some buoyancy modules that secures the internal clamp body to the flexible pipe

NOTE The internal clamp strap is positioned within the interior of the buoyancy element.

3.1.58

I-tube bend stiffener

bend stiffener attached at the topside connection to a flexible pipe that is hung-off the vessel/platform via an I-tube

NOTE An example of an I-tube bend stiffener is shown in Figure 1.

3.1.59

lifting point

connection point on a structure used to interface with lifting equipment

3.1.60

load-transfer device

device that is used to transfer loads from the flexible pipe end fitting or bend limiter interface structure to the topsides structures but does not have any pressure-containing capacity

3.1.61

lock-up

locking together of individual bend restrictor elements

3.1.62

low power buoyancy

buoyant length of a flexible pipe with relatively low net buoyancy per unit length

3.1.63

lower catenary

length of flexible pipe between the riser base and the subsea buoy

3.1.64

macrosphere

ceramic, polymer or composite spheres greater than 1 mm in diameter that form a structural part of composite syntactic foams

3.1.65

manufacturer

for the purposes of this part of ISO 13628, the manufacturer of the ancillary equipment

3.1.66

mechanical protection

layer of material that encloses a prescribed length of flexible pipe in order to protect it against abrasion and impact loads or to provide clearance between the flexible pipe and other subsea lines

3.1.67
membrane stress

σ_m
average stress value across the thickness of a solid section, excluding the effects of discontinuities and stress concentrations

EXAMPLE The general primary membrane stress in a pipe loaded in pure tension is the tension divided by the cross-sectional area. σ_m may include global bending as in the case of a simple pipe loaded by a bending moment.

[API RP 2RD]

3.1.68
microsphere

ceramic, polymer or composite sphere between 1 μm and 1000 μm in diameter that forms a structural part of syntactic and composite syntactic foams

3.1.69
mix
unique mix of polymer material constituent components

3.1.70
module element
part of a buoyancy or ballast module that gives uplift or added weight to the module

NOTE The module element does not include buoyancy tanks.

3.1.71
net buoyancy
resulting buoyancy after considering all buoyant and non-buoyant components in a subsea buoy or buoyancy module

3.1.72
overboarding chute
arch-shaped structure positioned at the edge of a vessel that is used as an installation aid for flexible pipe

3.1.73
oxidative ageing
degradation of a material over time, due to exposure to oxygen, caused by changes at the molecular level

3.1.74
passive fire protection
coating, cladding, or free-standing system that provides thermal protection in the event of a fire and that requires no manual, mechanical or other means of initiation, replenishment or sustenance

[DNV OS-D301]

3.1.75
permanent ancillary equipment
ancillary equipment that is to be used for the entire service life of the flexible pipe

3.1.76
permanent bend stiffener
bend stiffener that is to be used for the entire service life of the flexible pipe

3.1.77
piggy-back clamp
spacer in a piggy-back system that is clamped to the supporting and supported pipe and does not allow relative movement of the supported pipe

3.1.78

piggy-back guide

spacer in a piggy-back system that is clamped to the supporting pipe and allows relative movement of the supported pipe

3.1.79

pull-in head

device used during flexible pipe installation to connect the flexible pipe end fitting to a pull-in wire, consisting of structure that connects to end-fitting and a connection that interfaces with lifting equipment

3.1.80

purchaser

flexible pipe system provider who is purchaser to ancillary equipment manufacturer

3.1.81

raw materials supplier

supplier of raw materials for any of the components of an item of ancillary equipment

3.1.82

reaction collar

bend restrictor interface structure comprising a split-shell configuration that clamps around the flexible pipe end fitting

3.1.83

reaction flange

bend restrictor interface structure comprising a split flange arrangement that bolts directly to the support structure over which a bend restrictor element is assembled

3.1.84

repair clamp

clamp that is positioned over a damaged area of flexible pipe as a means to repair such an area

3.1.85

riser base

structure positioned on the seabed used to provide a structural and pressure-tight connection between a flexible riser and a flowline

NOTE The riser base can be a PLET or a PLEM.

3.1.86

seabed connection

connection between flexible riser end fitting and riser base

3.1.87

seal element

part of an I/J-tube seal that provides the seal

3.1.88

secant modulus

slope of line drawn through the origin of a stress strain curve and intersecting a point on the stress strain curve corresponding to specified strain

3.1.89

secondary stress

any normal or shear stress that develops as a result of material constraint

NOTE This type of stress is self-limiting, which means that local yielding can relieve the conditions that cause the stress, and single application of load will not cause failure.

[API RP 2RD]

3.1.90

setting time

time required for polymer or composite component to reside in mould before being removed

3.1.91

snatch load

sudden load that acts on a slack tether with resulting dynamic amplification up to several times the applied tension

3.1.92

spacer

discrete component of which a number in series are used to piggy-back one or more supported pipes to a supporting pipe over a prescribed length

3.1.93

subsea buoy frame

structural part of a subsea buoy. Includes the gutters, housings for clamps and buoyancy tanks or buoyancy elements and connection points for tether connection hardware

3.1.94

support structure

structure that supports and transfers loads from a flexible pipe or bend limiter at either the topside, seabed or intermediate connection

3.1.95

supported pipe

pipe that is attached via a series of piggy-back clamps or guides to a supporting pipe over a prescribed length

NOTE A supported pipe can be a flexible pipe.

3.1.96

supporting pipe

pipe that supports one or more pipes via a series of piggy-back clamps or guides over a prescribed length

NOTE A supporting pipe can be a flexible pipe.

3.1.97

syntactic foam

composite material consisting of a polymer matrix containing microspheres only

3.1.98

system owner

purchaser of flexible pipe system from flexible pipe system provider

3.1.99

tear strength

measure of the force necessary to cause tearing of a sample of material (nicked or un-nicked) under specified conditions

3.1.100

temporary bend stiffener

bend stiffener that is required to satisfy its functional requirements temporarily for flexible pipe installation, handling or other activities but not in service

3.1.101

tether

chain or rope used to connect a flexible pipe or a subsea buoy to a tether base, including connecting hardware necessary at each end termination

3.1.102

tether base

structure that secures one or a group of tethers to the seabed, including tether connection points and lifting points

3.1.103

thermal ageing

degradation of a material over time, due to temperature, caused by changes at the molecular level

3.1.104

thermal shock

exposure to a large temperature variation within a short time period

3.1.105

truss

structural member, made up of several individual slender parts welded or bolted together, designed to carry a tension or compression force with the complete structure acting as a beam

3.1.106

topside connection

connection between flexible pipe end fitting and platform

3.1.107

upper catenary

length of flexible pipe between the platform and the subsea buoy

3.1.108

wet repair

repair of a flexible pipe *in situ*

3.2 Symbols and abbreviated terms

For the purposes of this document, the following symbols and abbreviated terms apply.

C_a allowable stress factor
 $C_a = 0,67$

NOTE 1 See API RP 2RD.

C_f design case factor

NOTE 2 See API RP 2RD.

σ_b bending stress

σ_m membrane stress

σ_q secondary stress

σ_{sc} stress at structural capacity

$(\sigma_x)_e$ Von Mises component of stress for σ_x

EXAMPLE $(\sigma_b)_e$ is the Von Mises membrane stress.

AISI American Iron and Steel Institute

API	American Petroleum Institute
AWS	American Welding Society
BV	Bureau Veritas
CP	corrosion protection
DIN	Deutsches Institut für Normung e.V.
DnV	Det norske Veritas
EMMUA	Engineering Equipment & Materials Users' Association
EPDM	ethylene propylene diene terpolymer
FAT	factory acceptance testing
FEA	finite element analysis
GVI	general visual inspection
HMPE	high modulus polyethylene
IAPSO	International Association for Physical Sciences of the Ocean
MBL	minimum breaking load
MBR	minimum bend radius
MBS	minimum breaking strength
MWL	mean water line
N/A	non-applicable
NDE	non-destructive examination
PCD	pitch circle diameter
PLEM	pipeline end manifold
PLET	pipeline end termination
ROV	remotely operated vehicle
SBR	styrene butadiene rubber
SWL	safe working load
UKOOA	United Kingdom Offshore Operators Association
UV	ultraviolet
VIV	vortex-induced vibration

4 General requirements

4.1 Introduction

All flexible pipe/umbilical ancillary equipment shall comply with Clause 4 (General Requirements) of this part of ISO 13628. Specific ancillary equipment shall comply with the subsequent clauses (Clause 5 onwards). Clamping devices (buoyancy module clamps, subsea buoy clamps, tether clamps, piggy-back clamps and guides, repair clamps and I/J-tubes seals with clamps shall comply with Clause 12 (General Clamping Device Requirements).

This clause covers minimum requirements for flexible pipe ancillary equipment that are general in nature. For a particular item of ancillary equipment, all applicable requirements in this clause are cross-referenced in the subsequent clauses.

4.2 Functional requirements

4.2.1 General

4.2.1.1 The purchaser shall specify their functional requirements for the ancillary equipment. The purchasing guidelines in Annexes A to R give a sample format for the specification of the functional requirements.

4.2.1.2 Functional requirements not specifically required by the purchaser which may affect the design, materials, manufacturing and testing of the ancillary equipment shall be specified by the manufacturer.

4.2.1.3 If the purchaser does not specify a requirement, and 4.2.1.2 does not apply, the manufacturer may assume that there is no requirement.

4.2.2 Overall requirements

The minimum overall functional requirements of the ancillary equipment that shall be demonstrated by the manufacturer are as follows.

- a) The ancillary equipment shall be capable of withstanding all design loads defined in the design requirements clause applicable to the ancillary equipment in question.
- b) The ancillary equipment shall perform its function for the specified service life.
- c) The ancillary equipment materials shall be compatible with the environment to which the material is exposed.
- d) Ancillary equipment metallic materials shall conform as a minimum to the corrosion requirements specified in 4.3.11 and in the corrosion requirements clause applicable to the ancillary equipment in question.

4.2.3 Flexible pipe/umbilicals design parameters

The purchaser shall provide a data sheet for all the flexible pipes to which the ancillary equipment is attached.

4.2.4 Temperature

4.2.4.1 The purchaser shall specify, for ancillary equipment that is to comprise polymer or composite components, the minimum and maximum air temperatures associated with the following conditions:

- a) storage;
- b) transport;

- c) installation;
- d) service, where applicable (only relevant to ancillary equipment situated wholly or partly above the MWL).

4.2.4.2 The purchaser shall specify the minimum and maximum seawater temperatures for the following conditions:

- a) ancillary equipment polymer or composite components that are to be submerged wholly or partly in seawater;
- b) ancillary equipment metallic components that are to be submerged wholly or partly in seawater and that are required to be protected by a dedicated CP system.

4.2.4.3 Where polymer or composite components of the ancillary equipment are in direct contact with the pipe outer surface, on either a continuous or intermittent basis, the purchaser shall specify one of the following:

- a) minimum and maximum temperature of the pipe outer surface due to the internal fluid temperature, on the basis of the following minimum set of considerations associated with the flexible pipe:
 - 1) operating temperatures;
 - 2) upset temperatures (number and range of cycles);
 - 3) gas cooling effects (time/temperature curve);
 - 4) fluid thermal characteristics;
 - 5) flow characteristics;
 - 6) storage, transport and installation conditions where applicable.
- b) U-value of the pipe and minimum and maximum internal fluid temperature on the basis of the considerations in a) 1) to a) 6) above. The purchaser shall specify the reference diameter (internal or external) used to calculate the U-value. Where U-value is specified per unit length, the purchaser shall specify to which reference length this refers.

4.2.5 External environment

The purchaser should specify whether ancillary equipment external polymer or composite components will be exposed to abnormally high levels of sunlight. This is relevant to hotter climates such as west of Africa. The purchaser should consider the expected cumulative length of exposure during storage, transport, installation and operation (if applicable). The manufacturer should, in turn, have defined allowable levels of UV exposure (see 4.7.5 of ISO 13628-17).

4.2.6 Corrosion protection

4.2.6.1 The corrosion protection coating requirements for metallic structures, including interface structures and fasteners, should be specified. These requirements may include a particular coating material. The purchaser may also specify a particular corrosion allowance instead of or in combination with a coating material. Alternatively, the purchaser may specify a corrosion-resistant material. Corrosion-resistant metals may obviate the requirement for a corrosion protection system.

4.2.6.2 The CP system requirements for metallic structures should be specified. The requirement for a CP system may include a preference for a particular anode material. It should be taken into account that it is not necessary to connect some components to a CP system because they are corrosion-resistant materials.

4.2.7 Installation

The purchaser shall specify ancillary equipment installation procedures and/or flexible pipe installation procedures that involve the ancillary equipment, as soon as they are available. These installation procedures shall provide sufficient information to the manufacturer to be able to determine the installation loads (if not specified separately, see the design loads clauses of this part of ISO 13628) on the ancillary equipment and any parameters that could have implications on the ancillary equipment design.

4.2.8 Design loads

4.2.8.1 Ancillary equipment loadcases that are induced by the flexible pipe shall be specified as in accordance with all load conditions specified in Table 6 of ISO 13628-2:2006.

4.2.8.2 The purchaser shall specify any safety factors and their corresponding magnitude that have been incorporated into the design loads that they have specified.

4.2.8.3 The purchaser shall specify whether all the load-bearing components of permanent ancillary equipment are to be inspected during operation under an integrity and condition-monitoring programme such that the manufacturer can determine the fatigue safety factor to use in accordance with 0.

4.2.8.4 The purchaser shall, where applicable, specify the points of application of design loads acting on the ancillary equipment. The purchaser shall also, where applicable, describe the axis system relating to the direction of the design loads acting on the ancillary equipment such that there is sufficient information for the manufacturer to convert the loads to another axis system.

4.2.9 Quantities

The purchaser shall specify, where applicable, the required quantity of the ancillary equipment required.

4.2.10 Spares

The purchaser should specify any requirements for numbers of spare items or components of ancillary equipment to offset any losses due to damage, for example.

4.2.11 Marking

The purchaser should specify any requirements for marking of the ancillary equipment. Minimum marking requirements are given in 4.8.1.

4.2.12 Pigmentation

The purchaser should specify any preferences for pigmentation of the ancillary equipment.

4.2.13 Documentation

The purchaser should specify the documentation, as listed in 4.6, to be delivered by the manufacturer.

4.2.14 Project information

The purchaser shall specify, as a minimum, the following information relating to the project in question:

- a) project title;
- b) location of development;
- c) delivery date;

- d) location of delivery;
- e) delivery terms and conditions.

4.3 Design requirements

4.3.1 General

4.3.1.1 The ancillary equipment design is based on the information supplied by the purchaser (see guidelines of Annexes A to R) in accordance with the functional requirements clause for the ancillary equipment in question. All this information shall be defined in the design premise (see 4.6.2), including design load cases and design acceptance criteria.

4.3.1.2 The design load cases shall be defined to analyse, as applicable, the effect on the ancillary equipment of functional, environmental and accidental loads, where applicable.

4.3.2 Load combinations and conditions

4.3.2.1 The ancillary equipment design shall be shown to meet the design requirements under all load combinations specified in this clause and the subsequent clause applicable to the ancillary equipment. Variation of the loads in time and space, load effects from the flexible pipe and its supports as well as environmental conditions shall be analysed.

4.3.2.2 The design load conditions that shall be analysed are, where applicable, flexible pipe transportation, installation, operation, fatigue, accidental and testing of the flexible pipe (where loads are induced in the ancillary equipment). Load combinations shall be as defined in the notes for Table 5 and the column headings in Table 6 of ISO 13628-2:2006. Load combinations with a yearly probability of occurrence less than 10^{-4} can be ignored. Factory acceptance test (FAT) load combinations, where applicable, shall be defined by the manufacturer based on the FAT procedures.

4.3.2.3 Results of the design load case analyses shall be shown to meet the design acceptance criteria and shall be documented in the design report

4.3.2.4 Design checks shall be carried out for any temporary conditions specified by the purchaser or the manufacturer. These shall include temporary conditions experienced by the ancillary equipment during storage, transport and installation. These shall be subject to the same design criteria as the design load conditions, as specified in the design criteria clauses of this part of ISO 13628.

4.3.2.5 The simultaneous occurrence of different load combinations shall be defined in the manufacturer's design premise (see 4.6.2). The probability of specific load classes or subclasses may be specified by the purchaser based on project-specific conditions. The probabilities of accidental and installation-related events should be specified by the purchaser. If the purchaser does not specify probabilities, the manufacturer shall propose the probabilities that will be used for the individual events in the design premise.

4.3.3 Load interface management

The manufacturer shall have documented procedures to ensure that global loads supplied by the purchaser are applied in the correct position in local analyses of the ancillary equipment. The manufacturer shall also have documented procedures to ensure that any differences between global and local axis systems are accounted for in the transfer of loads between global and local analyses.

4.3.4 Design load effects

For fatigue analysis, the distribution of loads over the service life of the ancillary equipment shall be based on methods which include all load parameters. Simplified methods are acceptable if the resulting load distribution can be shown to be conservative.

4.3.5 Design methodology

4.3.5.1 Initially and whenever revisions occur, the design methodology and manufacturing processes for permanent ancillary equipment shall be verified by an independent verification agent. The documentation submitted for verification of the design methodology shall include methodologies, any calculations performed and software tools used for the following, as a minimum:

- a) description of theoretical basis, including calculation procedures for the design parameters required for the design report;
- b) overview of stress/strain analysis methodology (in accordance with 4.3.7.1).
- c) validation of design methodologies and software tools with prototype tests, initially and whenever the current design is outside the envelope of previously verified designs (4.3.7.1). See ISO 13628-17 for guidelines on when the design is outside the design envelope. The validation shall include the capacity of all the ancillary equipment components. Simplified conservative analysis methods for checking of non-critical components are acceptable if the method does not influence the reliability of the calculation of stresses in the other components, and if approved by the purchaser;
- d) documented basis for stress concentration factors used including results of supporting FEA analysis;
- e) documented basis for utilisation factors, if these factors are not already specified in this part of ISO 13628;
- f) documented basis for polymer and composite material endurance limits or fatigue safety factors where applicable;
- g) overview of CP system design methodology where applicable;
- h) manufacturing and design tolerances;
- i) description of procedures and devices used to control manufacturing processes;
- j) calculations demonstrating that design satisfies functional requirements accounting for variations within manufacturing tolerance envelopes;
- k) description of welds used for metallic components;
- l) other effects that influence structural capacity;
- m) documentation of service life methodology, subject to the requirements of 4.3.8 to 4.3.10.

4.3.5.2 The independent verification agent shall review and evaluate the design methodology and the manufacturing processes to establish the range of applications for which they are suitable. The independent verification agent shall issue a certificate and a Design Methodology Verification Report describing the limits and constraints of the design methodology. The certificate shall be included by the manufacturer in the design report (see 4.6.3) and the Design Methodology Verification Report shall be available for review by the purchaser and flexible pipe system owner at the manufacturers' premises.

4.3.5.3 The design methodology shall account for the effects of the following unless the design is documented not to suffer from such effects:

- a) corrosion of metallic components unless the metal is documented to be corrosion-resistant in the specified environment;
- b) creep of polymer and composite materials subjected to constant loading;
- c) water absorption of polymer and composite materials in subsea ancillary equipment or ancillary equipment in contact with water;

- d) ageing of polymer and composite materials (due to mechanical, chemical and thermal degradation), see 4.4.4;
- e) exposure of polymer and composite materials to sudden temperature variations;
- f) effects of nonlinear material properties;
- g) effect of design temperatures on material properties;
- h) rupture or cracking of polymer and composite materials.

4.3.5.4 If the ancillary equipment design is outside the envelope of previously verified designs, then the manufacturer shall perform sufficient prototype tests to verify the design methodology for this new design and obtain a revision or amendment of the Design Methodology Verification Report by an independent verification agent. The determination of whether the ancillary equipment design is outside the envelope of previously verified designs should be determined by the purchaser based on the guidance provided in 4.6.3 of ISO 13628-17 and the subsequent Applicability of Prototype Tests clauses therein. The prototype tests shall verify fitness for-purpose for those design parameters which are outside the previously validated envelope. See ISO 13628-17 for guidelines on the tests which should be performed and recommendations on the test procedures.

4.3.6 Design criteria

4.3.6.1 Steel components (but not truss structures, pressure vessels, or ancillary equipment that performs a lifting function) shall be designed to the criteria specified in Table 1, and components comprising other materials (i.e. other metallic and polymer and composite components) shall be designed to independently verified and documented criteria specified by the manufacturer [see 4.3.5.1 e)], subject to the requirements of this clause. For truss structures, allowable deformations shall be in accordance with an appropriate international standard such as API RP 2A or AISC Steel Construction Design Manual. Ancillary equipment that performs a lifting function shall be designed in accordance with national regulations and an appropriate international standard such as those listed in Table 2. Allowable stresses for the other structures shall be in accordance with appropriate international standards of which examples are listed in the relevant clauses of this part of ISO 13628.

4.3.6.2 Corrosion analysis (as per 4.3.11.5) shall show that the material loss from corrosion does not cause utilisation factors to exceed the criteria of this clause under all load combinations.

4.3.6.3 The utilisations as specified in Table 1, which are not applicable to truss structures, pressure vessels, ancillary equipment that perform a lifting function or tethers, shall be calculated as the ratio of Von Mises stress of the indicated stress component or sum of stress components, at a point in the structure, to structural capacity. The stress shall be calculated using the design methodology specified in 4.3.5 and the subsequent design methodology clauses of this part of ISO 13628, subject to the design requirements of 4.3.7 and the subsequent design clauses of this part of ISO 13628. The calculated value shall include dynamic loads where applicable. The structural capacity shall be the minimum of the yield strength and 0,9 times the ultimate tensile strength of the material where tensile testing will accurately identify only this latter property. The yield or ultimate strength value used for design shall be either the mean value minus two standard deviations from the documented test data, or the minimum value as certified by the supplier.

NOTE The steel utilisation values have been selected in order to be consistent with the utilisations specified for steel components of the flexible pipe in ISO 13628-2. In accordance with 4.3.5.1 e), the manufacturer is required to submit as part of the design methodology a documented basis for utilisation values not already specified in this part of ISO 13628, i.e. non-steel metallic materials and polymer and composite materials.

The criteria for bending stress σ_b and stress concentrations σ_q (secondary stresses) are derived from the allowable stresses in API 2RD.

EXAMPLE The criteria for bending stress in API RP 2RD is $(\sigma_p + \sigma_b)_e < 1,5 C_f C_a \sigma_y$ where C_f is a design case factor ranging from 1,0 for an Operating Load Category to 1,5 for a Survival Load Category and C_a is an allowable stress factor and is equal to 0,67. The utilisations for bending stress σ_b and secondary stress σ_q are attained by substituting $C_f C_a$ by

the utilisation value for membrane stress σ_p in Table 1. The utilisation for membrane (average) stress in Table 1 for Extreme Operation is 0,85. Using 0,85 as the combined factor $C_f C_a$ gives the allowable utilisation for membrane stress plus bending stress $(\sigma_p + \sigma_b)_e / \sigma_y = 1,275$.

4.3.6.4 Polymer and composite material utilisations may be a factor of either the maximum allowable strain or stress and shall account for the following:

- a) material stress/strain behaviour established by small-scale material testing;
- b) reduction in mechanical properties due to ageing in the specified environment, if the maximum allowable strains or stresses are for un-aged material. Accounting for the effect of the reduction in properties through utilisation factors may be ignored for loads that act at the start of the service life (installation and FAT/Flexible Pipe Hydrostatic Test loads);
- c) creep behaviour, if component is subjected to constant loading. The utilisation factor shall be such as to prevent creep failure or loss of functional requirements during the service life, unless a creep analysis has been performed and demonstrated that there will not be any creep failure of the material or loss of functional requirements.

4.3.6.5 Fatigue life calculations shall be performed in accordance with the requirements of 4.3.10. Where calculated, the predicted fatigue life of steel components whose external surfaces are non-inspectable for crack sizes that are critical for fatigue, shall be at least 10 times the required service life. Where calculated, the predicted fatigue life of other metallic materials (e.g. titanium) and polymer and composite components shall use an independently verified fatigue safety with a documented basis. However, this fatigue safety factor shall be at least 10 times the required service life for non-inspectable components and at least 3 for inspectable components. Where it is practical to inspect all the surfaces of all the load-bearing components of the ancillary equipment for crack sizes that are critical for fatigue under the integrity and condition-monitoring programme, this factor may be reduced to 3. See the relevant integrity and condition monitoring clauses of ISO 13628-17 for guidelines and recommendations on integrity and condition monitoring.

NOTE The fatigue life factor of 10 has been selected in order to be consistent with the corresponding factor of the flexible pipe fatigue life in ISO 13628-2. This factor relates to the steel pressure and tensile armour layers of the pipe. The factor of 3 represents industry practice, such as in API RP 2RD, for steel components where all potential fatigue-induced flaws are accessible for inspection.

4.3.6.6 Reliability-based design may be applied as an alternative design method. All relevant design criteria for the reliability-based design cases should then be considered. It shall be proven that the level of safety obtained is not less than that given by this specification for comparable design cases.

Table 1 — Steel permissible utilisation factors (not applicable to truss structures, pressure vessels, ancillary equipment that perform a lifting function or tethers)^a

Stress component(s)	Von Mises stress component /structural capacity ^b	Service conditions ^a			Installation		Hydrostatic pressure test — Field acceptance ^{a, c}
		Normal operation					
		Recurrent operation	Extreme operation	Abnormal operation			
		Functional & environmental	Functional, environmental & accidental	Functional, environmental & accidental	Functional & environmental	Functional, environmental & accidental	
Membrane stress	$(\sigma_p)_e / \sigma_{sc}$	0,67/0,55 ^d	0,85	0,85	0,67	0,85	0,91
Membrane plus bending stress	$(\sigma_p + \sigma_b)_e / \sigma_{sc}^b$	1,0/0,825	1,275	1,275	1,0	1,275	1,365
Membrane plus bending plus secondary stress	$(\sigma_p + \sigma_b + \sigma_q)_e / \sigma_{sc}^b$	2,0/1,65	2,55	2,55	2,0	2,55	2,73

^a The load conditions in the table refer to the load conditions of the flexible pipe to which the ancillary equipment is attached.

^b In accordance with allowable stresses in API RP 2RD.

^c Applicable to ancillary equipment that restrain flexible pipe outer diameter variations such as clamping devices, for example.

^d Pressure-retaining ancillary equipment only.

Table 2 — Lifting standards

Designation	Title
API RP 2A	<i>Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms</i>
DnV	<i>Certification Notes 2.7-1 Offshore Containers</i>
DnV	<i>Rules for Certification of Lifting Appliances, 1994</i>
DnV	<i>Rules for Planning and Execution of Marine Operations</i>
Lloyd's Register of Shipping	<i>Code for Lifting Appliances in a Marine Environment</i>

4.3.7 Ancillary equipment design requirements

4.3.7.1 It shall be demonstrated through calculation (in accordance with 4.3.6.3) that stresses and strains in ancillary equipment are within allowable limits for their respective materials. See 4.3.6 for requirements on utilisations for metallic, polymer and composite materials. The analysis shall account for the following:

- a) design loads specified by the purchaser in accordance with the functional requirements clause and the design loads specified in the loads clause for the ancillary equipment in question;
- b) pre-loads in fasteners and straps;
- c) stresses in all components, including fasteners and welds;
- d) any stress concentrations, in areas of geometric discontinuity such as bolt holes and fillet radii. Stress concentrations shall be determined using FEA.

4.3.7.2 Local stress analysis of metallic structures shall be carried out in accordance with an appropriate international standard such as those listed in Table 3. Although some of the standards apply to fixed structures, some of the requirements are relevant to structures that are not fixed.

Table 3 — Examples of metallic structural design standards

Designation	Title
ISO 19902	<i>Petroleum and natural gas industries — Fixed offshore steel structures</i>
API RP 2A	<i>Planning, Designing, and Constructing Fixed Offshore Platforms – Working Stress Design</i>
API RP 2RD	<i>Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms</i>
BS 6235	<i>Code of Practice for Fixed Offshore Structures</i>
DnV-OS-C101	<i>Design of Offshore Steel Structures, General (LRFD Method)</i>
NORSOK N-001	<i>Structural Design</i>

4.3.7.3 Preload in fasteners for static applications shall be selected in order to provide sufficient compression in the bolted members to resist external loads and to create sufficient frictional forces between members to resist shear loads without exceeding the design criteria of Table 1 or, if not applicable, the relevant structural design standard. In dynamic applications, the preloads shall additionally be sufficient to limit the proportion of the cyclic stresses taken by the bolt such that the fatigue life criteria of 4.3.6.5 are satisfied.

4.3.8 Service life — General

The service life of permanent ancillary equipment shall be as a minimum equal to the required service life of the flexible pipe to which it is attached, if it is not explicitly specified by the purchaser.

4.3.9 Service life — Static applications

4.3.9.1 The service life analysis of permanent ancillary equipment shall document the properties of the materials for the specified service life, in accordance with the requirements of the materials requirements clause for the ancillary equipment in question. The minimum strength for metallic materials and minimum strength or elongation at break for polymer and composite materials, during the service life of the pipe, shall be used in the design calculations.

The analysis shall include as a minimum the following:

- a) creep due to long term loads, dimensional changes, and strain to failure in the operating environment;

- b) corrosion of metallic components unless the metal is documented to be corrosion-resistant in the specified environment;
- c) ageing of polymer and composite materials (due to mechanical, chemical and thermal degradation).

4.3.9.2 Further to 4.3.9.1 a), it shall be documented in the design report that creep of polymer and composite components that are subjected to constant loading does not cause stresses/strains in the material to exceed allowable limits or cause the product to fail to meet its functional requirements over the specified service life. The manufacturer shall have available documentation from the material supplier or other party that supports the material creep properties being used in the design.

4.3.10 Service life — Dynamic applications

4.3.10.1 The requirements of 4.3.9 shall apply.

4.3.10.2 For metallic components in dynamic applications, if it has been demonstrated from material testing that all material stress ranges inclusive of stress concentrations (including fasteners and welds) are below a documented and verifiable endurance limit established by testing and approved by purchaser, fatigue calculations are not required. If any fatigue stress is above this endurance limit or an endurance limit cannot be established, fatigue damage shall be based on Miner's method, or other methods from an appropriate international standard, using design S-N curves that have been validated for the metallic materials used, under the applicable service environments.

4.3.10.3 Fatigue analysis of metallic components shall be performed in accordance with an appropriate international standard.

4.3.10.4 For polymer and composite components in dynamic applications where it has been demonstrated from material testing that all material stress ranges inclusive of stress concentrations are below a documented and verifiable endurance limit approved by the purchaser, fatigue calculations are not required. When any fatigue stress is above this endurance limit or an endurance limit cannot be established, fatigue damage shall be calculated, using design fatigue curves that have been validated for the materials used for the specified cyclic load frequencies and under the applicable service environments. The fatigue life may also be demonstrated by prototype testing. Where prototype testing is used, the test conditions including as a minimum the load range magnitude and material temperature shall be representative of the specified application. The number of load cycles shall be sufficient to demonstrate the required fatigue safety factor. The demonstration of fatigue life shall account for the effects of the manufacturing process and the dimensions of the full-scale product on the materials fatigue life.

4.3.11 Corrosion protection

4.3.11.1 All external metallic surfaces of permanent ancillary equipment shall be prepared and coated in accordance with an appropriate international standard such as NORSOK M-501 for corrosion protection in the environmental conditions in question, unless the material is documented to be corrosion-resistant in the specified environment or a suitable corrosion allowance is being employed. The selection of the corrosion protection system shall consider the length of time that the component will be in storage and shall, if applicable, consider the length of time that the component is to be located in a subsea environment before installation operations commence. Temporary ancillary equipment shall be protected in accordance with above requirements should its storage duration before use either onshore, offshore or subsea lead to corrosion that would affect its functional requirements.

4.3.11.2 Selection of materials shall consider the effect of galvanic corrosion, if this could increase utilisation factors above allowable limits. If there is the possibility of galvanic corrosion, dissimilar metals shall be isolated from one another with insulation, a coating, a sufficient corrosion allowance or a CP override.

4.3.11.3 Requirements for internal and external corrosion allowances shall be evaluated in accordance with the location, conditions of installation, and the requirements specified in the functional requirements clause for the ancillary equipment in question. The manufacturer shall document this evaluation and its effect on the ancillary equipment components.