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Entwurf

**Erdöl- und Erdgasindustrie –
Auslegung und Betrieb von Unterwasser-Fördersystemen –
Teil 8: Fernbetätigte Werkzeuge und Schnittstellen auf
Unterwasser-Produktionsanlagen (ISO/DIS 13628-8:2010);
Englische Fassung prEN ISO 13628-8:2010**

Petroleum and natural gas industries –
Design and operation of subsea production systems –
Part 8: Remotely operated tools and interfaces on subsea production systems
(ISO/DIS 13628-8:2010);
English version prEN ISO 13628-8:2010

Industries du pétrole et du gaz naturel –
Conception et exploitation des systèmes de production immergés –
Partie 8: Dispositifs à commande à distance et interfaces avec les systèmes de production
immergés (ISO/DIS 13628-8:2010);
Version anglaise prEN ISO 13628-8:2010

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2011-01-24 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 oder für Stellungnahmen zu Norm-Entwürfen der DKE unter www.dke.de/stellungnahme abgerufen werden;
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- 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 relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 96 Seiten

Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) im DIN

Nationales Vorwort

Dieses Dokument (prEN ISO 13628-8:2010) wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“, Subkomitee 4, Arbeitsgruppe 6 „Subsea 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.

Diese Norm enthält neben den gesetzlichen Einheiten auch die Einheiten „ft“, „in (inch)“, „kip“, „lb (pound)“, „lbf“ und „psi (psig)“ die in Deutschland nicht zugelassen sind. Es wird ausdrücklich darauf hingewiesen, dass die Anwendung dieser Einheiten im nationalen amtlichen und geschäftlichen Verkehr aufgrund des Gesetzes über Einheiten im Messwesen nicht zulässig ist.

Umrechnung:

Nicht-SI-Einheit	SI-Einheit	Umrechnung	
ft	m	1 ft	= 0,304 8 m
in (inch)	mm	1 inch	= 25,4 mm
kip	N	1 kip	= 4 448,22 N
lb (pound)	kg	1 lb	= 0,453 592 37 kg
lbf	N	1 lbf	= 4,448 222 N
psi (psig)	kPa	1 psi	= 6,894 757 kPa

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

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

ISO 13628-1	siehe	DIN EN ISO 13628-1
ISO 9001	siehe	DIN EN ISO 9001

Änderungen

Gegenüber DIN EN ISO 13628-8:2008-03 wurden folgende Änderungen vorgenommen:

- a) Änderung des Titels in *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 8: Remotely operated tools and interfaces on subsea productions systems*;
- b) Aufnahme des Inhalts von ISO 13628-9, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 9: Remotely Operated Tools (ROT) intervention systems*;
- c) EN ISO 13628-9, *Petroleum and natural gas industries — Design and operation of subsea production systems — Part 9: Remotely Operated Tools (ROT) intervention systems*, soll nach Veröffentlichung von EN ISO 13628-8 zurückgezogen werden;
- d) Änderung des Anwendungsbereichs zu „Remotely Operated Tools (ROT)“;
- e) Aktualisierungen der normativen Verweisungen;
- f) Erweiterungen der Begriffs- und Abkürzungsdefinitionen;
- g) neuer Abschnitt 4 „Subsea intervention concepts“;
- h) neues Bild 3 „Typical ROT Configuration“;
- i) neuer Abschnitt 5 „Subsea intervention systems design recommendations“;
- j) neuer Abschnitt 6 „ROV interfaces“;
- k) neuer Abschnitt 7 „Materials“;
- l) neuer Abschnitt 8 „Subsea marking“;
- m) neuer Abschnitt 9 „Validation and verification“;
- n) Erweiterung des Literaturverzeichnisses.

Nationaler Anhang NA (informativ)

Begriffe und Abkürzungen

Die Benennung der folgenden Begriffe und Abkürzungen ist identisch mit der Benennung in der englischen Fassung.

3 Begriffe und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe und Abkürzungen:

3.1 Begriffe

3.1.1

Funktionsanforderung

Kriterium, das mindestens erfüllt sein sollte, um dem/den festgelegten Ziel(en) zu entsprechen

ANMERKUNG Funktionsanforderungen sind leistungsorientiert und auf einen breiten Bereich von Entwicklungskonzepten anwendbar.

3.1.2

Richtlinie

Empfehlungen für anerkannte Praktiken, die in Verbindung mit der Einhaltung der zutreffenden gesetzlichen Anforderungen, Industrienormen, Standardverfahren und Philosophien gelten

3.1.3

Hersteller

Unternehmen, das für die Herstellung der Ausrüstung verantwortlich ist

3.1.4

Betreiber

Bediener

Unternehmen, das physikalisch das ROV (das Auslegersystem) betätigt

3.1.5

ferngelenktes Fahrzeug

ROV

(en: remotely operated vehicle)

frei schwimmendes oder kabelgeführtes tauchfähiges Fahrzeug für die Ausführung z. B. von Inspektionen, für die Betätigung von Ventilen, für die Durchführung hydraulischer Funktionen und sonstiger Aufgaben

ANMERKUNG ROVs können auch Werkzeugpakete für die Durchführung von Spezialaufgaben befördern, z. B. Einbringen und Montage von starren Doppelflanschen, flexiblen Förderleitungen und Versorgungsleitungen sowie zum Auswechseln von Bauteilen. Alternativ können Module oder Werkzeuge mit einem Kran eingesetzt und unter Wasser mit dem ROV verbunden werden.

ROVs werden in die folgenden Hauptklassen eingeteilt:

OBS-ROV — (IMCA-Klasse I und II): Bei diesen ROVs handelt es sich um kleine, mit Kameras/Leuchten ausgestattete Fahrzeuge, die auch Sensoren oder Prüfgeräte befördern können. Diese ROVs können eine manipulative Basiskapazität haben. Überwiegend werden sie jedoch für Prüf- und Überwachungszwecke angewendet.

W-ROV — (IMCA-Klasse III): Bei diesen ROVs handelt es sich um große Fahrzeuge, die üblicherweise mit einem Greifer für fünf Funktionen und Manipulatoren für sieben Funktionen ausgestattet sind. Im Allgemeinen haben sie die Fähigkeit zum gleichzeitigen Senden mehrerer Signale, wodurch die Anwendung mehrerer Sensoren und Werkzeuge möglich ist ohne dass ihnen ein eigenes Versorgungssystem zugeordnet werden muss. W-ROVs werden in Abhängigkeit von ihrem festgelegten Arbeitsbereich in zwei Klassen unterteilt: mittlere W-ROVs und große W-ROVs. W-ROVs können Werkzeugpakete für Spezialaufgaben transportieren, z. B. für das Verankern und das Verbindungen von Förderleitungen, Versorgungsleitungen und starren Rohrleitungsdoppelflanschen sowie zum Auswechseln von Bauteilen.

3.1.6

Primäreingriff

alle bei planmäßigen Eingriffsaufgaben durchgeführten Arbeiten

3.1.7

Sekundäreingriff

nicht geplante Eingriffsaufgaben

3.1.8

ROT-System

zweckbestimmte, unbemannte Unterwasser-Werkzeuge für Installations- und IMR-Aufgaben, die weiter gehende Fähigkeiten zum Anheben und/oder Umsetzen als frei schwimmende ROV-Systeme erfordern

ANMERKUNG Das ROT-System besteht aus drahtseilgeführten Werkzeugen, die zur Durchführung bestimmter Eingriffe unter Wasser mit Einrichtungen zur Steuerung und zur Unterstützung/Handhabung ausgestattet sind. Diese Werkzeuge werden im Allgemeinen an Tragseilen oder kombiniert an einem Tragseil/einer Versorgungsleitung eingesetzt. Zur seitlichen Führung dürfen Führungsdrähte, speziell für ROTs verwendete Antriebspropeller oder ROVs als unterstützende Elemente verwendet werden.

3.1.9

Nutzlast

Größe einer/eines an einem ROV geführten Bleimasse oder Arbeitspakets, um den Auftrieb des ROVs unter Wasser auszugleichen

3.1.10

Through-frame-lift (Heben/Transportieren mittels Rahmen)

maximale Tragfähigkeit des ROV-Rahmens für untergebaute Pakete und Werkzeuge

3.1.11

Deployment-System

die gesamte Ausrüstung, die für Ein- und Ausbau (Ausbringung und Rückführung) des ROV- und ROT-Systems benötigt wird

3.1.12

Tauchbewegungs-Ausgleichssystem

System zur Begrenzung der Auswirkungen einer vertikalen Bewegung von schwimmenden Objekten auf das ausgebrachte ROV- und ROT-System

3.1.13

Kufensystem

Gleitschienensystem

Rahmen für Lagerung, Transport, Hub- und Prüfvorgänge, der dazu dient, die Bewegung des ROT-Systems und der zu ersetzenden oder zu installierenden Module und Komponenten zu erleichtern

ANMERKUNG Kufen werden in Verbindung mit einem Kufensystem verwendet.

3.1.14

Unterwasser-Rohrleitungen

alle Rohrleitungen, Förderleitungen, Versorgungsleitungen und Kabel, die auf dem Meeresboden verlegt sind

3.1.15**Endverbindung**

Teil des Rohrleitungs-Verbindungssystems an der Schnittstelle zur Rohr- oder Förderleitung unter Wasser

3.1.16**Rohrleitungs-Verbindungssystem**

die separate oder in die Leitungen integrierte Ausrüstung zum Einziehen und Verbinden

3.1.17**Validierung**

Bestätigung, dass bestimmte Auslegungsanforderungen erfüllt wurden, indem ein objektiver Nachweis erbracht wird

ANMERKUNG Im Allgemeinen wird eine Validierung erreicht, indem Berechnungen, Überprüfungen der Auslegung, hydrostatische Prüfungen und werkseigene Abnahmeprüfungen durchgeführt werden.

3.1.18**Verifizierung**

Bestätigung, dass die betrieblichen Anforderungen für einen bestimmten Zweck oder eine bestimmte Anwendung erfüllt wurden, indem ein objektiver Nachweis erbracht wird

ANMERKUNG Im Allgemeinen wird eine Verifizierung erreicht, indem eine Qualifizierungsprüfung und/oder eine Integrationsprüfung des Systems durchgeführt wird/werden.

3.1.19**Einbaukopf**

Ende der Unterwasserleitung, das als Anschlussstelle für den Einziehdraht dient

3.2 Abkürzungen

AIAA	American Institute of Aeronautics and Astronautics
API	American Petroleum Institute, 1220 L Street NW, Washington, DC 20005 USA, Telefon: +1 202 682 2000, www.api.org
AUV	Autonomes Unterwasserfahrzeug
CCO	Auswechslung von Bauteilen
CL	Mittellinie
COG	Schwerpunkt
CT	Verbindungswerkzeug
DWT	Tiefwasserprüfung
FAT	Werkseigene Abnahmeprüfung
HAZOP	Gefährliche Arbeitsgänge
HPU	Hydraulischer Antrieb
ICS	Eingriffssteuersystem
IMCA	International Marine Contractors Association, 62 Grosvenor Garden, London SW1W 0AU, UK, Telefon: +44(0)20 7824 5520, www.imca-int.com
IMR	Inspektion, Wartung und Reparatur

MQC	Multi-Schnellverbinder
NAS	American Aerospace Association
NPT	National Pipe Thread (Nationales Rohrgewinde)
OBSROV	Überwachungs-ROV
PICS	Pull-in- und Verbindungssystem
ROV	Ferngelenktes Fahrzeug
ROT	Fernbetätigtes Werkzeug
SAE	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Telefon: +1 724 776 4841, www.sae.org
SAFOP	Sichere Arbeitsgänge
SIT	Integrationsprüfung des Systems
SPS	Unterwasser-Produktionssystem
SWT	Flachwasserprüfung
WROV	Arbeits-ROV
TDU	Werkzeug-Deploy-System (Einrichtung zum Ausbringen der Werkzeuge)

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN EN ISO 13628-1, *Erdöl- und Erdgasindustrie — Auslegung und Betrieb von Unterwasser-Produktionssystemen — Teil 1: Allgemeine Anforderungen und Empfehlungen*

DIN EN ISO 9001, *Qualitätsmanagementsysteme — Anforderungen*

Petroleum and natural gas industries — Design and operation of subsea production systems — Part 8: Remotely operated tools and interfaces on subsea production systems (ISO/DIS 13628-8:2010)

Erdöl- und Erdgasindustrie — Auslegung und Betrieb von Unterwasser-Fördersystemen — Teil 8: Fernbetätigte Werkzeuge und Schnittstellen auf Unterwasser-Produktionsanlagen (ISO/DIS 13628-8:2010)

Industries du pétrole et du gaz naturel — Conception et exploitation des systèmes de production immergés — Partie 8: Dispositifs à commande à distance et interfaces avec les systèmes de production immergés (ISO/DIS 13628-8:2010)

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Foreword

This document (prEN ISO 13628-8:2010) 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.

This document will supersede EN ISO 13628-8:2006.

Endorsement notice

The text of ISO/DIS 13628-8:2010 has been approved by CEN as a prEN ISO 13628-8:2010 without any modification.

Introduction

The part of ISO-13628 has been prepared to provide general recommendations and overall guidance for the design and operation of remotely operated tools comprising ROT and ROV tooling, used on subsea production systems for the petroleum and natural gas industries worldwide.

Specific design requirements are used where a standard design or operating principle has been adopted in the industry for a period of time. Requirements valid for certain geographic areas or environmental conditions, are included where applicable.

The functional recommendations for the tooling systems and interfaces on the subsea production system allow alternative solutions to suite field specific requirements. The intention is to facilitate and complement the decision process rather than replace individual engineering judgement and, where requirements are non-mandatory, to provide positive guidance for the selection of an optimum solution.

1 Scope

This part of ISO 13628 provides recommendations for development and design of remotely operated subsea tools and interfaces on subsea production systems in order to maximise the potential of standardising equipment and design principles.

This part of ISO 13628 does not cover manned intervention, vertical wellbore intervention, internal flowline inspection, tree running and tree running equipment. However, all the related subsea ROV/ROT interfaces are covered by this standard. It is applicable to the selection, design and operation of ROTs and ROVs including ROV tooling, hereafter defined in a common term as subsea intervention systems.

Also, the standard covers subsea intervention system interfaces on all parts of a subsea production system.

Intervention systems used for internal wellbore intervention, and the ROV system itself are not part of the scope of this standard.

2 Normative references

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

ISO 13628-1, *Petroleum and natural gas industries – Design and operation of subsea production systems – Part 1: General requirements and recommendations*

NOTE API RP 17A:2006, *Design and operation of subsea production systems – General requirements and recommendations* is a direct adoption of ISO 13628-1:2006, and equivalent in content.

ISO/TS 29001, *Petroleum, petrochemical and natural gas industries – Sector specific requirements – Requirements for product and service supply organizations*

ISO 9001:2000, *Quality management systems*

API SPEC 17D, *Specification for subsea wellhead and christmas tree equipment*

API Q1, *Specification for Quality Programs for the Petroleum, Petrochemical and Natural Gas Industry*

ASNT TC 1A, *Recommended Practice and ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel*

DNV 2.7-1, *Standard for certification – Offshore containers*

BS 7172-2, *Code of practice for safe use of cranes – Part 2: Inspection, testing and examination*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply:

3.1 Terms and definitions

3.1.1

functional requirement

minimum criterion which should be satisfied in order to meet a state objective or objectives

NOTE Functional requirements are performance oriented and are applicable to a wide range of development concepts.

3.1.2

guideline

recommendation of recognized practice to be considered in conjunction with applicable statutory requirements, industry standards, standard practices and philosophies

3.1.3

manufacturer

company responsible for the manufacture of the equipment

3.1.4

operator

company which physically operates the ROV (delivery system)

3.1.5

remotely operated vehicle

ROV

free-swimming or tethered submersible craft used to perform tasks such as inspection, valve operations, hydraulic functions and other general tasks

NOTE ROVs can also carry tooling packages for undertaking specific tasks such as pull-in and connection of rigid spools, flexible flowlines, umbilicals, and component replacement. Alternatively modules or tools may be deployed by crane and mated with the ROV subsea.

ROVs are grouped within the following main categories:

OBSROV – (IMCA class I & II) These vehicles are small vehicles fitted with cameras/lights and may carry sensors or inspection equipment. They may also have a basic manipulative capability. They are mainly used for inspection and monitoring.

WROV – (IMCA class III) These vehicles are large ROVs normally equipped with a five-function grabber and a seven-function manipulators. These commonly have multiplexing controls capability that allows additional sensors and tools to be operated without the need for a dedicated umbilical system. WROV are split into two classes: medium WROV and large WROV depending on their defined workscope. WROVs can carry tooling packages to undertake specific tasks such as tie-in and connection function for flowlines, umbilicals and rigid pipeline spools, and component replacement.

3.1.6

primary intervention

all work carried out during the scheduled intervention task

3.1.7

secondary intervention

unscheduled intervention tasks

3.1.8

ROT system

dedicated, unmanned, subsea tools used for installation and IMR tasks that require lift and/or handling capacity beyond that of free-swimming ROV systems

NOTE The ROT system comprises wire-suspended tools with control system and support-handling system for performing dedicated subsea intervention tasks. They are usually deployed on lift wires or a combined lift wire/umbilical. Lateral guidance may be via guidewires, dedicated thrusters or ROV assistance.

3.1.9

payload

amount of lead weight or work packages carried on ROV to make its buoyancy neutral in seawater

3.1.10

through frame lift

maximum load capacity of ROV frame for underslung packages and tooling

3.1.11

deployment system

all equipment involved in the launch and recovery of the ROV and ROT system

3.1.12

heave-compensated system

system that limits the effect of vertical vessel motion on the deployed ROV and ROT system

3.1.13

skid system

storage, transportation, lifting and testing frames to facilitate movement of the ROT systems and the modules and components to be replaced or installed

NOTE Skids are used in combination with a skidding system.

3.1.14

sealines

all pipelines, flowlines, umbilicals and cables installed on the seabed

3.1.15

termination head

part of the tie-in system interfacing with the end of the sealine or flowline

3.1.16

tie-in system

integrated or separate pull-in and connection related equipment

3.1.17

validation

confirmation that specified design requirements have been fulfilled, through the provision of objective evidence

NOTE Typically validation is achieved by calculations, design reviews, hydrostatic testing and Factory Acceptance Testing.

3.1.18

verification

confirmation that the operational requirements for a specific use or application have been fulfilled, through the provision of objective evidence

NOTE Typically verification is achieved by qualification testing and/or System Integration Testing.

3.1.19

pull-in head

end of sealine acting as attachment point for the pull-in wire

3.2 Abbreviated terms

AIAA American Institute of Aeronautics and Astronautics,

API American Petroleum Institute, 1220 L Street NW, Washington, DC 20005 USA,
Telephone: +1 202 682 2000, www.api.org

AUV autonomous underwater vehicle

CCO component change-out

CL center line

COG	center of gravity
CT	connection tool
DWT	deep water test
FAT	factory acceptance test
HAZOP	hazardous operations
HPU	hydraulic power unit
ICS	intervention control system
IMCA	International Marine Contractors Association, 52 Grosvenor Garden, London SW1W 0AU, UK, Telephone: +44 (0)20 7824 5520, www.imca-int.com
IMR	inspection, maintenance and repair
MQC	multi quick connector
NAS	American Aerospace Association
NPT	National Pipe Thread
OBSROV	observation class ROV
PICS	pull-in and connection system
ROV	remotely operated vehicle
ROT	remotely operated tool
SAE	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Telephone: +1 724 776 4841, www.sae.org
SAFOP	safe operations
SIT	system integration test
SPS	subsea production system
SWT	shallow water test
WROV	work class ROV
TDU	tool deployment unit

4 Subsea intervention concepts

4.1 General

4.1.1 It is the intent of this standard to take a system wide approach to the design and implementation of subsea intervention.

4.1.2 A subsea intervention system typically includes the following componets:

- a) tooling for dedicated intervention tasks;
- b) complimentary equipment (tool basket, guideposts etc.);
- c) deck handling equipment;
- d) control system;
- e) deployment/landing equipment;
- f) guidance and entry equipment;
- g) ROV spread interface with equipment and tools.

4.1.3 There are several methods to ensure safe and efficient guidance of the subsea intervention system to the subsea work site. Typical methods include:

- a) surface guidewire systems;
- b) guidelineless systems;
- c) subsea deployed guidewire systems;
- d) thruster assisted systems;
- e) ROV assisted guidance.

4.1.4 The selection of equipment and intervention methods should be decided when establishing the intervention strategy. (see subclause 4.6).

4.1.5 Common recommendation for the subsea intervention systems should be used as far as practical. However specific recommendations for ROV and ROT systems and their subsystems are included in separate chapters where design or operational requirements require as such.

4.1.6 Design of subsea systems and associated remotely operated tooling system in a optimum manner, is dependant on a system design approach. The main focus areas in this respect are standardisation of interfaces, equipment and intervention methods. Subsea intervention systems should be designed in parallel with subsea production systems to allow for intervention friendly solutions for the life of field. The specification covers tooling design, design of intervention interfaces on the subsea equipment, and guidelines for implementing intervention friendly designs.

4.1.7 The design should focus on the safe and efficient handling including deck handling, operation and maintainability of the subsea tools and interfaces. System for easy testing after mobilisation should be provided.

4.1.8 The standards for the selection and use of remotely operated tooling interfaces have generally selected one interface for a specific application. The inclusion of a particular approach or recommendation does not imply that it is the only approach or the only interface to be used for that application.

4.1.9 In determining the suitability of standardization of remotely operated tooling system interfaces for installation, maintenance or inspection tasks on subsea equipment, it is necessary to adopt a general philosophy regarding subsea intervention. Details of the intervention philosophy is described within this part of ISO 13628, as are the associated evaluation criteria used in selecting the interfaces incorporated into these recommendations.

4.1.10 This part of ISO 13628 is not intended to obviate the need for sound engineering judgement as to when and where its provisions are to be utilized, and users need to be aware that additional or differing details may be required to meet a particular service or local legislation.

4.1.11 With this part of ISO 13628, it is not wished to deter the development of new technology. The intention is to facilitate and complement the decision processes, and the responsible engineer is encouraged to review standard interfaces and re-use intervention tooling in the interests of minimising life-cycle costs and increasing the use of proven interfaces.

4.1.12 The interfaces on the subsea production system can apply equally to ROTs and ROVs.

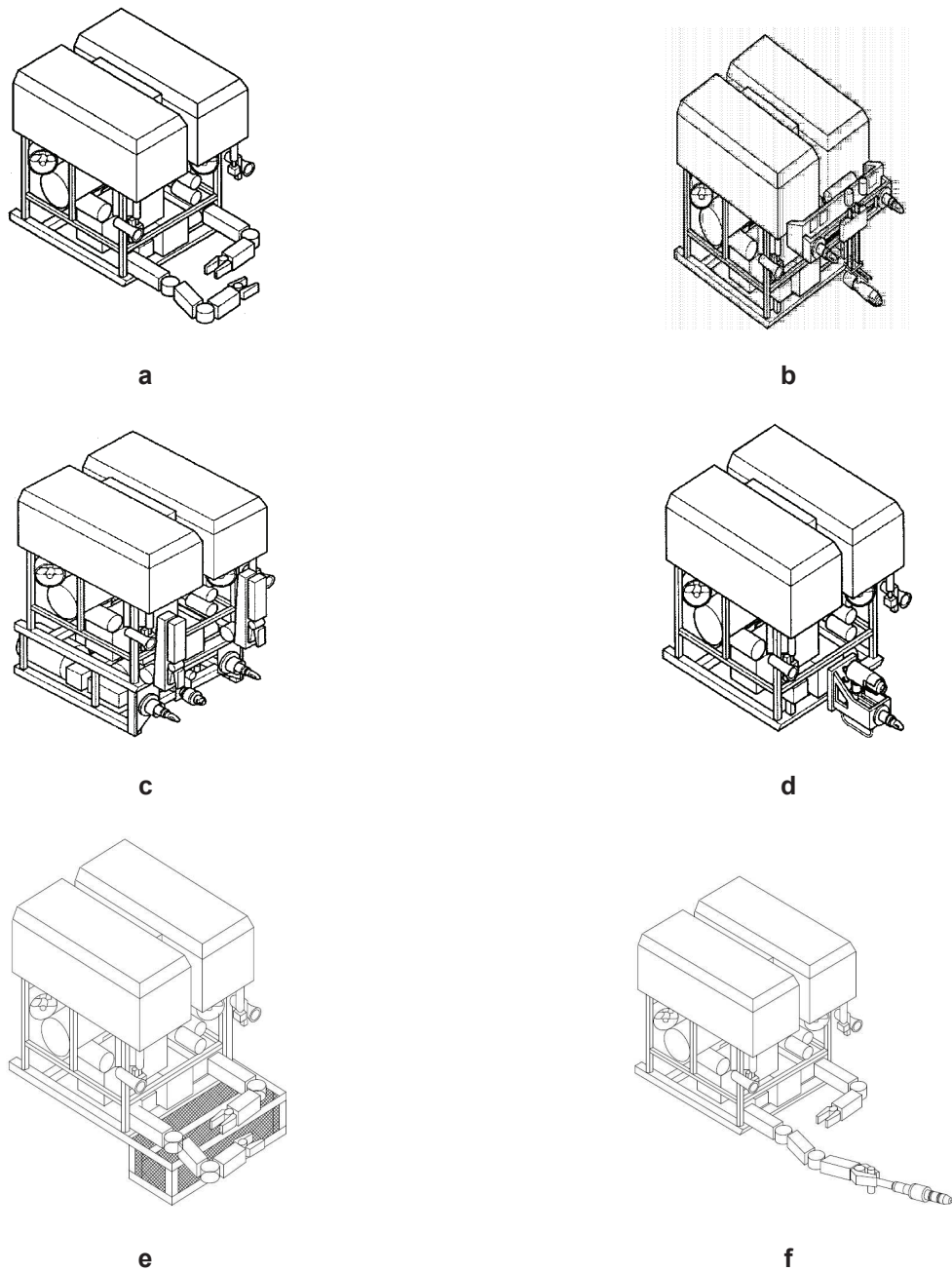
4.2 Typical ROV Configurations

4.2.1 ROV are essentially configured for carrying out intervention tasks in six ways (see Figure 1):

- a) with manipulators for direct operation of the interface (Figure 1a);
- b) with TDUs (Figure 1b);
- c) with tool skids or frames (Figure 1c);
- d) with single point docking tool (Figure 1d);
- e) the operation may be supported by an external basket for ROV tools and subsea components or modules (Figure 1e);
- f) with a manipulator-held tool, including hydraulic or electric stabs for supply of hydraulic or electric power (Figure 1f).

4.2.2 WROVs have normally a base configuration consisting of a left hand 5-function grabber arm and right hand 7-function manipulator.

4.2.3 Interface tooling, so far as possible, should be designed to operate with a range of WROVs and not be limited in application to one design only, thus allowing the use of ROVs and intervention vessels of opportunity. For the purpose of securing access for safe and efficient ROV operations, a dimensional envelope, representing the majority of ROVs in the market, is specified, see 6.2.1.



KEY

- a ROV with manipulators
- b twin point docking tool delivery system
- c underslung tool skid
- d single point docking tool delivery system
- e ROV with external basket
- f ROV with external handheld tooling

Figure 1 — Typical work class ROV operationally configured

4.2.4 Figure 2 shows ROV and typical interfaces on a subsea tree.

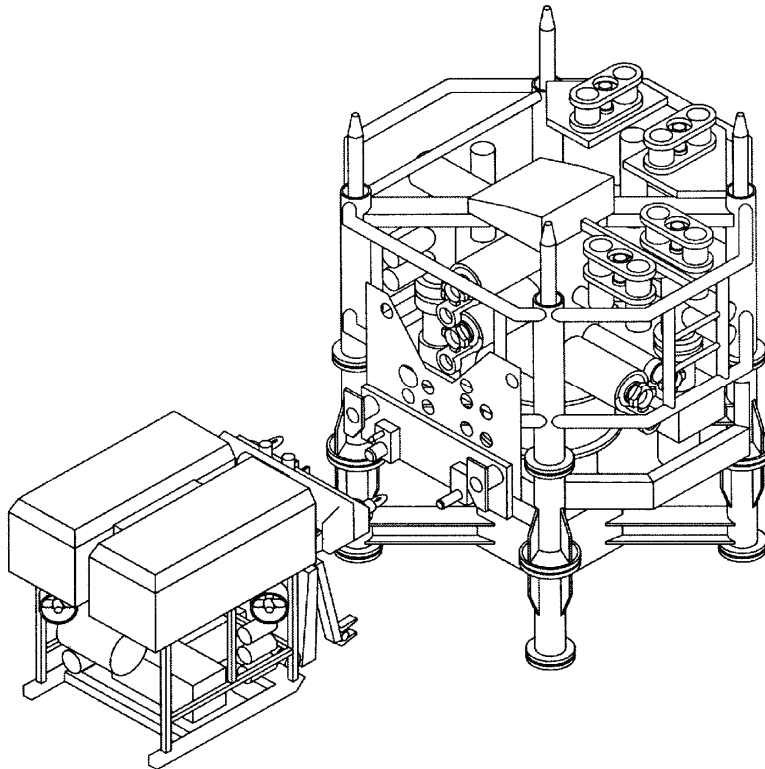


Figure 2 — Typical interfaces on a subsea tree

4.3 Intervention vessels

4.3.1 For various geographic regions and environmental conditions, different intervention vessels are used for the performance of installation and IMR activities.

4.3.2 In harsh environments, IMR vessels equipped with moon pools and dedicated handling systems, have been used extensively in order to allow for all year operations, while other areas less exposed to wind and sea have used standard supply vessels.

4.3.3 These are important aspects when selecting the intervention strategy for individual fields.

4.4 Component and module intervention

4.4.1 Installation and retrieval of subsea components and modules may be performed by use of ROVs or ROTs or a combination of these.

4.4.2 The replacement of subsea components and modules that cannot be carried by a ROV, may be handled by a lift line or drill pipe designed to support the weight and dynamic loads of the tool and the component being replaced.

4.4.3 The operation may be supported with a second down line such as a separate control umbilical or the ROVs umbilical/tether.

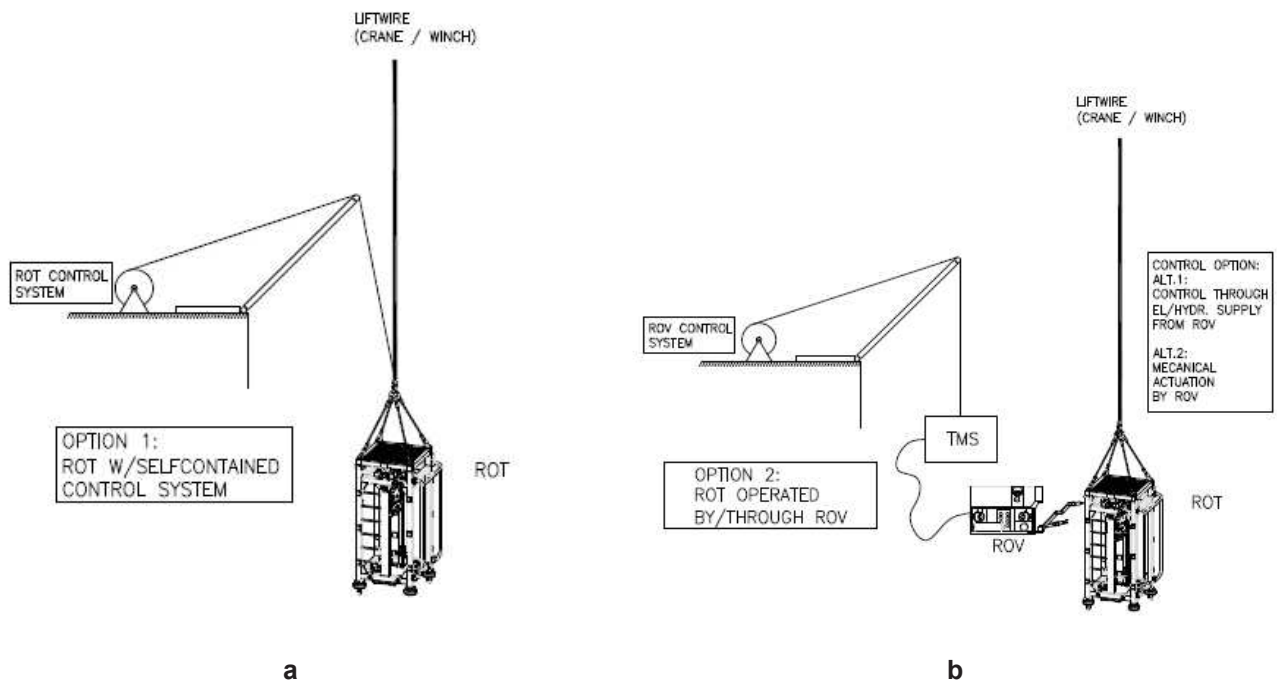
4.4.4 If multiple lines are used, it is recommended to select separate deployment areas of the intervention vessel to avoid entanglement.

NOTE ROTs includes tools which are initially deployed subsea by a crane or winch. The tool could then be utilized and manipulated by ROV and flown to the working location.

4.4.5 The tools can be controlled and operated by dedicated, self-contained control system, through the ROV control system or by mechanical actuation by use of manipulator or ROV tools.

4.4.6 An illustration of alternative subsea intervention systems for component or module intervention, is shown in Figure 3a and Figure 3b.

4.4.7 The breakdown of the subsea intervention system into sub-elements and components as presented in this part of ISO 13628 should not pose limitations on the selection of new intervention concepts whose functionality and reliability can be documented.



KEY

- a ROT with self-contained control system
- b ROT with ROV manipulation/ROV supplied hydraulic and/or electric power
- 1 lift wire (crane or winch)
- 2 ROT control system
- 3 Option 1: ROT with self-contained control system
- 4 Control Option 1: control through EL/HYD supply from ROV
- 5 Control Option 2: mechanical actuation by ROV
- 6 TMS
- 7 Option 2: ROT operated by and through ROV

Figure 3 — Typical ROT Configuration

4.5 Tie-in systems

4.5.1 General

4.5.1.1 Flowline and umbilical connection without the use of divers has been in use for a significant number of years. Connection and tie-in by diver-less systems of flexible or rigid flowlines, umbilicals or all these is a prerequisite for deepwater developments.

4.5.1.2 A typical connection system would consist of the inboard hub (mounted on the subsea tree or manifold), the outboard hub (connected to the end of the flowline or umbilical), a seal plate, clamp, cap and the connection tooling.

4.5.1.3 The inboard hub normally has minimal movement in the horizontal plane and the flowline (outboard) hub is normally pulled in towards the inboard hub, where it locates onto the opposite hub. The system is typically finally connected by clamp, or collet or mandrel using the ROV tooling, which activates one or two jackscrews or a connector.

4.5.1.4 Pull-in of hubs can be in the horizontal plane, with or without buoyancy, or of a hinge and lockdown type assembly.

4.5.1.5 Hot stabbing for seal tests is normal. Low pressure back seal tests may be used to verify seal integrity. It is recommended to have this test circuit independent from the main control system, including an isolation valve and gauge for leakage monitoring.

4.5.1.6 A seal assembly and connection can also include hydraulic couplings.

4.5.1.7 The tie-in connector should:

- a) achieve a reliable diver-less connection, that is capable of being tested for its integrity (sealing will be either metal to metal or a combination of metal and elastomeric sealing);
- b) achieve a short-stroke connection minimising hub movement and residual stress;
- c) allow for subsea seal surface cleaning and inspection;
- d) allow for subsea seal replacement.

4.5.2 Flowline tie-in systems

4.5.2.1 Flowline tie-in systems are used for tie-in of rigid and flexible flowlines and spools.

4.5.2.2 The tools may be designed as a combined pull-in and connection tool, or as separate tools.

4.5.2.3 Various connector types, such as clamp, collet, mandrel or bolted flanges may be used with the tools.

4.5.3 Umbilical tie-in systems

Umbilical tie-in systems are normally combined pull-in and connection tools, which additional to axial alignment provide a means of rotating the connector.

4.5.4 Flying leads connections

Flying leads may be connected as individual electric or hydraulic lines or as part of multiple line connection by use of a junction plate.

4.6 Intervention strategies

4.6.1 General

4.6.1.1 The development of an intervention strategy is of high importance for the overall field architecture, and should be determined on the basis of a multidisciplinary systems approach at an early stage of systems engineering.

4.6.1.2 The intervention strategy selection may be based on use of a combination of tooling including ROV, AUV and ROT technologies.

4.6.1.3 The following list states aspects impacting the intervention strategy and should be considered when developing a strategy:

- a) field development plan;
- b) field architecture and infrastructure;
- c) environmental and metocean data;
- d) mobilisation and demobilisation of subsea intervention systems and associated modules;
- e) deck handling principles;
- f) standardisation of tools and interfaces;
- g) quantity of tools (including back-up tools and tools needed onshore during fabrication and testing);
- h) guidance method of modules and tools;
- i) replacement in one or two tooling missions;
- j) multi-purpose tools versus dedicated tools;
- k) the selection of mechanically operated tools versus hydraulically operated tools;
- l) reuse of intervention systems;
- m) wet storage of tools;
- n) categorisation of critical and non-critical operations;
- o) deck space requirement and deck layout;
- p) operational issues with respect to the vessel, e.g., simultaneous operations between subsea intervention and drilling or completion activities;
- q) environmental aspects, including e.g., water depths, current conditions and seabed conditions;
- r) access at the subsea location;
- s) need for technology qualification;
- t) subsea worksite tool function verification equipment, e.g., torque or pressure verification;
- u) need to develop testing philosophy.

4.6.2 System considerations

The design, configuration and operation of the subsea intervention system impacts directly on the life cycle cost for the entire subsea production system. In order to obtain an subsea production system design providing safe and cost effective intervention operations, it is important to obtain a closed loop between subsea production system design and the subsea intervention system design.

4.6.3 Subsea intervention system development

4.6.3.1 Subsea intervention systems should be designed with consideration for all phases of an intervention operation, which typically are:

- a) mobilisation (specific issues at the location in question);
- b) deck handling and preparation;
- c) launch, descent and landing;
- d) primary and secondary intervention task;
- e) testing;
- f) complementary tasks;
- g) retrieval;
- h) demobilisation;
- i) contingency operations;
- j) emergency situations, e.g., vessel drift off.

4.6.3.2 During the evaluation, consideration should be given to reasonably foreseeable misuse of the subsea intervention system.

4.6.3.3 Selection of subsea intervention systems running philosophy is determined by:

- a) availability requirements (logistics and mobilisation time for equipment);
- b) field-specific parameters (water depth, wave, current and seabed conditions);
- c) vessel requirements and interfaces (deck space requirement and deck layout);
- d) ROV requirements, including the number and class of ROV required to perform the various intervention tasks;
- e) intervention task-specific parameters (planned versus unplanned operation, complexity, frequency and subsea to interface considerations).

4.7 System interfaces

4.7.1 To ensure safe and efficient operations, the Intervention vessel interface information should be communicated between the tool supplier and the tool operator.

4.7.2 Intervention vessel interface information from the equipment manufacturer shall include equipment datasheets for both ROV tools and ROT, and include the following information:

4.7.2.1 Equipment performance data:

- a) specific utility requirements (e.g air, water, electricity, fluids);
- b) specific communications protocols with control system;
- c) video and data output capabilities;

- d) equipment dimensions;operational footprint (e.g., ROV panel docking);
- e) depth rating;
- f) weight in water/in air.

— **4.7.2.2** Interface data:

- a) electrical and hydraulic connections;
- b) hydraulic requirements (e.g., fluid, flow and pressure, cleanliness);
- c) deployment and handling requirements.

— **4.7.2.3** Transport data:

- a) dimensions, footprint ,inclusive transport container etc.;
- b) seafastening and deck load distribution;
- c) utility requirements (e.g air, water, electricity, fluids);
- d) ROV topside equipment interface requirements;
- e) system layout drawings/equipment drawings/pictures;
- f) contact information.

— **4.7.2.4** User documentation including necessary details for mobilisation, operation, maintenance and preservation, storage and transportation of the specific equipment:

- a) handling and operation instruction incl. maintenance and preservation;
- b) technical description and component identification including pictorial representation (for spare part ordering);
- c) interface data;
- d) equipment performance data;
- e) outline operation procedure;
- f) hydraulic schematics and electrical wiring diagrams;
- g) maintenance, preservation and storage program;
- h) drawings.

5 Subsea intervention systems design recommendations

This clause provides functional recommendations for the design of remotely operated subsea intervention systems. Requirements for respectively ROV and ROT based tooling systems have as far as possible been merged into common sections. Equipment specific recommendations are specified where applicable.

5.1 Surface equipment

5.1.1 General

5.1.1.1 Based on the selected intervention strategy, the remotely operated tools may require guidance during launch and recovery and landing and retrieval onto to the subsea system. This sub-clause states recommendations for equipment used for handling of the tools on deck, and deployment/retrieval operations.

5.1.1.2 The recommendations given, apply in general for equipment needing a handling system due to weight, lifting height or accessibility.

5.1.2 Deck handling systems

5.1.2.1 Deck handling equipment and launching techniques should be selected to ensure that a wide range of vessels can be used. Flexibility should be provided without compromising safety and reliability of the work, both on surface and subsea.

5.1.2.2 Main issues are:

- a) means of moving subsea intervention equipment on deck (skid systems versus. use of vessel cranes);
- b) means of deploying and landing subsea intervention systems (winches and simple mobile A-frames versus. use of complex purpose-made heave-compensated systems);
- c) means of installing on and removing from the intervention vessel (mob/demob);

5.1.2.3 The selection of equipment should be dictated by the nature of the intervention task (e.g., tie-in operation, module replacement), safety for personnel, environmental considerations affecting the operation and time available to carry out the required operation.

5.1.2.4 The following recommendations apply:

- a) skids and baskets for the various tools and the involved modules should provide safe and efficient transportation and deck operations;
- b) lifting points should be designed according to a recognized lifting standard (e.g., API 17D, BS 7121-2);
- c) each tool, including the tool skids, should be supplied with handling devices (e.g., lifting slings) certified for the maximum expected dry handling mass. This should, where applicable, include the dry mass of the module to be handled by the ROT;
- d) the tool skids and baskets should be balanced for safe lifting and handling with the dedicated tool and, when applicable, with the replaceable module installed;
- e) on the surface, replacement of components and modules in the various tools should be performed by skidding when required for safe operation due to vessel movement;
- f) when required, tool skids should include all facilities (piping, valves and gauges, etc.) for function testing of the various tools.

5.1.3 Deployment equipment

5.1.3.1 General

5.1.3.1.1 This subclause contains functional recommendations for the equipment and tools during the deployment and landing phases of the intervention task.

The following recommendation apply:

- a) operations in which sensitive components, as part of the subsea system, are involved should be carried out in a two-step sequence. The ROT should be landed and sufficiently secured prior to manipulation of sensitive components, e.g., hydraulic lines;
- b) the guide-funnels on the equipment and tools should enable safe, simple and efficient entering and securing of the guidewires and eliminate trapping of the wires;
- c) the design of the deployment system should consider emergency operations, for example vessel drift-off.
- d) the number of lines from the surface to the subsea work area should be minimized, to reduce the possibility of entanglement;
- e) when a subsea intervention system is deployed in a guidelineless operation, means of lateral and rotational control is recommended while entering into the subsea area in which sensitive components are exposed at the same level as the ROT;
- f) in order to achieve safe operation, the equipment, tools and the transportation skid should enable entering on tensioned guidewires;
- g) sufficient running clearance between the ROT and the nearest obstructing element should be ensured. Minimum 1,0 m (3,3 ft) clearance while on guidewires and 0,2 m (0,65 ft) while on guideposts should be provided. Cursor systems, guidecones and guideposts should be secured to avoid movements above the tolerance limits [1,0 m (3,3 ft) topside and 0,2 m (0,65 ft) subsea]. Running clearances for guidelineless systems needs to be defined. Protection of surrounding equipment by use of bumper bars may be considered;
- h) for guidewire based operations, equipment and tools should be designed for operation without heave compensation and with a landing speed of maximum 1,8 m/s (6 ft/s). A soft landing system should be considered for sensitive equipment.

5.1.3.2 Lift wire and umbilical winch systems

5.1.3.2.1 General

- a) The following requirements apply:
 - 1) winch load calculations shall be in accordance with the relevant standards and regulations in which appropriate considerations have been made for the dynamic loads;
 - 2) constant-tension winches should allow for instant and direct switchover from normal operation to constant tension;
 - 3) as well as local control, the winches should be equipped with a mobile remote operation to ensure a safe and well monitored operation;
 - 4) the lifting winch or deployment system should include a facility for depth display during operations.