

Remotely operated vehicle (ROV) services

This NORSOK standard is developed with broad petroleum industry participation by interested parties in the Norwegian petroleum industry and is owned by the Norwegian petroleum industry represented by OLF and TBL. Please note that whilst every effort has been made to ensure the accuracy of this NORSOK standard, neither OLF nor TBL or any of their members will assume liability for any use thereof. NTS is responsible for the administration and publication of this NORSOK standard.

Norwegian Technology Centre
Oscarsgt. 20, Postbox 7072 Majorstuen
N-0306 Oslo
NORWAY

Copyrights reserved

Telephone: + 47 22 59 01 00
Fax: + 47 22 59 01 29
Email: norsok@nts.no
Website: www.nts.no/norsok



Documents

Document Sharing Hub

Foreword	3
Introduction	3
1 Scope	4
2 Normative and informative references	4
2.1 Normative references	4
2.2 Informative references	4
3 Terms, definitions and abbreviations	4
3.1 Terms and definitions	4
3.2 Abbreviations	5
4 Remotely operated vehicle (ROV) classification	6
4.1 Class I – Pure observation	6
4.2 Class II – Observation with payload option	6
4.3 Class III – Work class vehicles	6
4.4 Class IV – Seabed-working vehicles	6
4.5 Class V – Prototype or development vehicles	6
5 Administrative requirements	6
5.1 General	6
5.2 Documentation	6
5.3 Document availability	7
5.4 Responsibilities and authorities	7
5.5 Maintenance system	7
5.6 Reporting	8
6 Personnel qualification requirements	9
6.1 General	9
6.2 Crew requirements	9
6.3 Remotely operated vehicle (ROV) personnel requirements	10
6.4 Personnel qualifications – High voltage system	11
6.5 Personnel qualifications – Operation of handling systems	12
7 Interface requirements	12
7.1 Work site requirements	12
7.2 Remotely operated vehicle (ROV) system interface requirements	12
8 Technical requirements	13
8.1 General	13
8.2 ROV Class I – Pure observation vehicles	13
8.3 ROV Class II – Observation vehicles with payload option	14
8.4 ROV Class III – Work class vehicles	16
8.5 ROV Class IV - Seabed – working vehicles	19
8.6 Tether management system (TMS)	20
8.7 Umbilical/tether cables	20
8.8 Handling system	20
8.9 Control facilities	21
9 Operational requirements	22
9.1 Planning and execution	22
9.2 Mobilisation/demobilisation	22
9.3 Function testing prior to use	22
9.4 Familiarisation	23
9.5 Procedures	23
9.6 Transfer of experience	23
9.7 ROV observation of divers	23
10 Health, environment and safety (HES) requirements	23
10.1 Health and the working environment	23
10.2 The environment	24
10.3 Safety	24
10.4 Requirements for recording, reporting and using health, environment and safety (HES) data	24

Annex A (informative) Trenching	25
Annex B (normative) Remotely operated vehicle (ROV) system requirements	28

Provided by Standard Online AS for irsa 2013-07-21

Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are as far as possible intended to replace client specifications and serve as references in the authorities regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standards will be withdrawn.

The NORSOK standards are developed according to the consensus principle, generally applicable standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with supported by OLF (The Norwegian Oil Industry Association) and TBL (Federation of Norwegian Manufacturing Industries). NORSOK standards are administered and published by NTS (Norwegian Technology Centre).

Annex A is for information only. Annex B forms a normative part of this NORSOK standard.

Introduction

This NORSOK standard is a consequence of an industry wide effort to make a NORSOK standard for remote operated vehicles (ROV) services.

This NORSOK standard has been produced to establish a single common standard for ROV operations.

1 Scope

This NORSOK standard defines basic requirements for personnel, equipment and systems for ROV operations related to the petroleum industry.

2 Normative and informative references

The following standards include provisions and guidelines, which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognised standards may be used provided it can be shown that they meet or exceed the requirements and guidelines of the standards referenced below.

2.1 Normative references

AODC 035,	<i>Code of practice for the safe use of electricity underwater.</i>
IMCA R005,	<i>High Voltage Equipment - Safety procedures for working on remotely operated vehicles</i>
ISO 9001:2000,	<i>Series quality systems model for quality assurance in design, development, production, installation and servicing.</i>
ISO 13628-1:1999,	<i>Petroleum and natural gas industries – Design and operation of subsea production systems – Part 1: General requirements and recommendations.</i>
NORSOK U-100,	<i>Manned underwater operations.</i>

2.2 Informative references

IMCA R 14/01,	<i>Competence Assurance & Assessment Scheme</i>
ISO 13628-8,	<i>Petroleum and natural gas industries – Design and operation of subsea production systems – Part 8: Remotely Operated Vehicle (ROV) interfaces on subsea production systems</i>

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

shall

verbal form used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.2

should

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

3.1.3

may

verbal form used to indicate a course of action permissible within the limits of the standard

3.1.4

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.5

client

purchaser of ROV services

3.1.6

accident

event which causes personal injury, fire, environmental/material damage or loss of production

3.1.7**contractor**

the same as contractor group

3.1.8**contractor group**

contractor, his affiliated companies participating in the work, his subcontractors and their contractors and subcontractors, participating companies in a joint venture established for the performance of the work, and the employees of the aforementioned companies

3.1.9**ROV system**

system which comprises the ROV, the handling system, the surface control system and all associated equipment

3.1.10**ROV**

common term for ROV, AUV, UUV/UUVV and similar equipment, where ROV is equipment used in water with an ability to observe the surroundings and positioning itself remote controlled from the surface through a cable

NOTE AUV is equipment used in water with an ability to positioning itself without interference from surface control. UUV/UUVV is equipment used in water with an ability to positioning itself without cable to the surface.

3.1.11**lifting appliances**

any part of load bearing equipment used in conjunction with ROV systems equipment for lifting/handling

3.1.12**high voltage**

voltage values above 999 V

3.2 Abbreviations

AC	alternating current
AODC	Association of Offshore Diving Contractors (now part of IMCA, and also named International Association of Underwater Engineering Contractors)
AUV	autonomous underwater vehicle
CCD	charged couple device
CD	compact disc
CP	cathodic protection
DC	direct current
DVD	digital versatile disc
HES	health, environment and safety
IMCA	The International Marine Contractors Association
UdD	Utdanning- og forskningsdepartementet (Ministry of Education and Research)
LP	low pressure
NTS	Norsk Teknologisenter (Norwegian Technology Centre)
QA	quality assurance
ROV	remotely operated vehicle
TMS	tether management system
TOC	top of backfill cover
TOP	top of pipe
UUV	unmanned underwater vehicle
UUVV	unmanned untethered underwater vehicle
WLL	work load limit

4 Remotely operated vehicle (ROV) classification

4.1 Class I – Pure observation

Pure observation vehicles are physically limited to video observation. Generally they are small vehicles fitted with video camera, lights and thrusters. They cannot undertake any other task without considerable modification.

4.2 Class II – Observation with payload option

Vehicles capable of carrying additional sensors such as still colour cameras, cathodic protection measurement systems, additional video cameras and sonar systems. Class II vehicles should be capable of operating without loss of original function while carrying at least two additional sensors.

4.3 Class III – Work class vehicles

Vehicles large enough to carry additional sensors and/or manipulators. Class III vehicles commonly have a multiplexing capability that allows additional sensors and tools to operate without being “hardwired” through the umbilical system. These vehicles are larger and more powerful than Classes I and II.

Class III A – Workclass vehicles < 100 Hp

Class III B – Workclass vehicles 100 Hp to 150 Hp

Class III C – Workclass vehicles >150 Hp

4.4 Class IV – Seabed-working vehicles

Seabed-working vehicles manoeuvre on the seabed by a wheel or belt traction system, by thruster propellers or water jet power, or by combinations of any of these propulsion methods.

Class IV vehicles are typically much larger and heavier than Class III work class vehicles, and are configured for special purpose tasks. Such tasks typically include cable and pipeline trenching, excavation, dredging and other remotely operated seabed construction work.

4.5 Class V – Prototype or development vehicles

Vehicles in this class include those being developed and those regarded as prototypes. Special-purpose vehicles that do not fit into one of the other classes are also assigned to Class V. AUV is currently assigned to Class V.

5 Administrative requirements

5.1 General

Contractor shall establish and maintain a quality management system in accordance with ISO 9001:2000. Contractor shall utilise the system to continuously search for improvements to its processes both with respect to equipment and personnel. No activities shall start unless covered by appropriate procedures, plans or checklists. Furthermore, contractors shall establish and maintain matrixes for simple review by client such as:

- compliance to relevant regulations and standards;
- compliance to project specifications;
- compliance to personnel qualifications.

Contractor shall evaluate items of non-compliance. Qualified alternative solutions may be suggested. Contractor shall forward non-compliances to client for acceptance.

5.2 Documentation

Contractor shall establish necessary routines to document that the quality system meets the requirements outlined in ISO 9001:2000, 4.2.2. The documentation requirements shall aim at collecting data to ensure that quality standards and client requirements are met.

As a minimum, the contractor shall define, document and make available prior to mobilisation, the following:

- mobilisation plan;

- list of services required from work-site;
- structured plan for system acceptance test;
- procedure for normal and emergency operation of the equipment;
- procedure for maintenance of all equipment under the services;
- minimum list for spare parts;
- personnel competency matrix for allocated personnel.

5.3 Document availability

As a minimum, contractor shall ensure availability of updated editions of the following documents on the work site:

- contractors project QA manual/plan;
- contractors HES plan for the work-site;
- contractors operational manuals, pertaining to relevant contract;
- contractors contingency plan for the relevant contract, interfaced with clients plan for the relevant area;
- procedures for all activities pertaining to the relevant contract;
- relevant risk analysis;
- log to document operational activities;
- maintenance programmes and records for last 12 months.

5.4 Responsibilities and authorities

An organogram shall be produced to outline reporting lines at the work-site and in the onshore organisation. Interfaces towards other work-site teams, i.e. marine crew on a vessel, shall be described.

Job descriptions shall be made for relevant onshore project personnel and for ROV personnel, detailing responsibilities and authorities.

5.5 Maintenance system

5.5.1 General

A system for preventive maintenance shall be established, covering critical components comprising the ROV system. Historical data shall be logged to collect operational experience on critical components in order to ensure continuous improvements.

The maintenance program shall be based on manufacturer's recommendations and/or own experience. Test conditions and intervals for components and the facility in general, shall be specified. Contractor shall on regular interval review the maintenance system in order to meet the requirements in ISO 9001:2000, 8.5.

All maintenance shall be performed according to the maintenance plan and recorded. Last year's maintenance records for the components comprising the system shall be available onboard.

As a part of the maintenance system, contractor shall establish and maintain an inventory and equipment database. This database shall clearly define the minimum spare parts required for the system. The spare part list shall be defined based on failure mode and effect analysis. The stock level shall be sufficient to support the system for minimum 30 days of normal operation.

The maintenance program shall include a system for updating of certificates, covering all ROV related equipment, systems and machinery.

5.5.2 Time for maintenance

Contracts shall specify time allowed for scheduled maintenance and the maintenance intervals as required by the maintenance program relevant for the specific system and the type of activity at hand.

Contracts shall further define the functionality requirement relevant for the system as follows:

- ROV system available on request;
Maintenance and change outs to be agreed between client and ROV supplier at times convenient with respect to the activity.

- ROV system in water at all times minus maintenance intervals;
Maintenance and change outs to be performed in accordance with agreed intervals and time allowances.
- ROV system in water 24 h per day.
Requires back-up system at site. The status of the back-up system is irrelevant as long as it is ready when needed for change out with main system.

Downtime in excess of what is allowed and agreed (see above) shall be considered as breakdown.

5.6 Reporting

5.6.1 General

Contractors reporting of ROV operations shall be structured to provide the client with data to meet both regulatory and administration requirements in addition to internal requirements. The level of reporting requirements above standard shall be described in scope of work.

5.6.2 Contractors reporting responsibilities

5.6.2.1 Daily report

A report with a brief summary of the last 24 h events to be handed over to the client representative the following day, or according to the contract, and should be signed by both parts.

Daily report should as a minimum include the following:

- date /reference to contract no/job no;
- name of installation/vessel;
- name of personnel performing the work;
- arrival/departure of personnel
- time tagged activities and description of same;
- time table giving summary of hours in water, hours on standby, hours of maintenance and breakdown;
- list of additional equipment
- total working hours and reimbursable overtime
- a plan for the next 24 h.

5.6.2.2 Video log

During execution of the work, the crew shall make a video log for all recorded work. The log shall track all significant issues and have real time reference. The original log shall follow the video recording and be handed over to client as described in the scope of work.

As a minimum, the video log shall contend the following:

- date of recording reference to contract no/job no;
- name of support vessel;
- reference to daily log and dive log;
- real time reference to the tape;
- description of recorded event;
- reference to first hand report on special events.

5.6.2.3 First hand report

The ROV crew shall prepare first hand reports on special events as requested by client. These reports shall have a detailed description of the event, including sketches with possible measurements and supported by video recordings or pictures.

5.6.2.4 Maintenance report

Maintenance work performed shall be reported according to the established maintenance program. A copy of this report shall be made available to the client on request.

5.6.2.5 Equipment failure

Contractor shall have an established system for registration of equipment failures. This system shall meet the requirements in ISO 9001:2000, clause 8.

5.6.2.6 Reporting of undesired events

Contractor shall have a system for reporting of undesired events such as accidents, non-conformances and near-accidents with potential for damage to personnel and/or equipment. The system shall meet requirements in relevant legislation and industry standards. See clause 10.

5.6.2.7 Experience reporting

By the turn of the year or 30 days after the operation, the contractor should produce an experience report that evaluates the operation, procedures and equipment used.

6 Personnel qualification requirements

6.1 General

This clause of the standard addresses the personnel and crew requirements. The personnel operating ROV systems require training in a wide range of specialised fields.

The requirements below are set out to ensure that the operations are executed in a safe and efficient manner.

The personnel qualification requirements will be specified

- as crew qualification requirements,
- as qualification requirements for the individual positions.

6.2 Crew requirements

6.2.1 Manning level

The system manning level shall be based on the planned tasks and duties that are required to perform the work.

The manning levels for basic ROV operations are:

	12 h	24 h
Class I system	2	4
Class II system	2	4
Class III systems	3	6
Class IV systems (trencher)	4	8

Furthermore, job specific requirements may demand additional crew members due to

- requirements for maintenance and repair of additional tooling packages,
- specialised personnel for operating temporary sensors and equipment,
- overall offshore management of ROV operations,
- maintenance of eventual stand-by systems.

Sufficient, qualified personnel shall be allocated for scheduled maintenance work that shall take place outside the operational team's normal working hours.

6.2.2 Crew qualification requirements

The ROV crew in general shall as a minimum be able to maintain and operate the system.

When planning for a specific project, the overall crew competence should be obtained by proper planning and training.

6.3 Remotely operated vehicle (ROV) personnel requirements

6.3.1 General requirements

Due to the nature and complexity of ROV systems, the personnel operating and maintaining these systems require a broad based training to understand the various parts of the systems.

As a basis, the ROV personnel shall have a formal technical education within one of the following areas:

- electronics;
- automations;
- remote systems;
- hydraulics;
- electric.

NOTE In addition reference is made to IMCA R 14/01 "*Competence Assurance & Assessment Scheme*". Furthermore, this paragraph will be subject to revision after the enforcement of the coming formal Fjernstyrte undervannsoperasjoner (remote underwater operations) -Education/Graduate Diploma, effectuated by Oljeindustriens landsforening (The Norwegian Oil Industry Association) (OLF) and Utdannings- og forskningsdepartementet (Ministry of Education and Research) (UfD).

6.3.2 Personnel category requirements

6.3.2.1 Remotely operated vehicle (ROV) superintendent

The ROV superintendent shall as a minimum have the same qualifications and experience as ROV supervisor in addition to the following:

- experience in overall planning and management of offshore operations;
- two years as an ROV supervisor.

6.3.2.2 Remotely operated vehicle (ROV) supervisor

The ROV supervisor shall as a minimum have the same qualifications and experience as ROV pilot in addition to the following:

- formal administrative/leadership management training;
- training in first line of contract management;
- be fully conversant with all applicable legislation at the work-site;
- have training in first hand and task reporting;
- have a minimum of 3 years experience with relevant ROV operations.

6.3.2.3 Remotely operated vehicle (ROV) pilot

The ROV pilot shall as a minimum have the same qualifications and experience as ROV trainee in addition to the following:

- training in particular additional equipment planned for the work;
- be fully conversant with project manual and all applicable procedures for the work;
- have demonstrated knowledge in the type of intervention tasks planned;
- capable of keeping area views and guide other combined operations;
- minimum 200 h experience with relevant ROV operations;
- have training in task reporting;
- have knowledge in the type of intervention tasks planned;
- demonstrate dextrous use of master/slave manipulator;
- formal training in operation and maintenance of system in question;
- training in maintenance and repair of particular additional equipment planned for the work;
- have a documented knowledge of maintenance, repair, mobilisation and testing of ROV systems.

6.3.2.4 Remotely operated vehicle (ROV) trainee

The ROV trainee shall as a minimum have qualifications in accordance with 6.3.1 and have a agreed skill development plan, including

- formal training in operation and maintenance of system in question,
- training in maintenance and repair of particular additional equipment planned for the work,
- training in the use of master / slave manipulator.

NOTE The composition of a crew should make way for the inclusion of a trainee. This in order to enable training of inexperienced personnel and recruitment of new competence to the ROV industry.

6.4 Personnel qualifications – High voltage system

The majority of ROV systems have a power distribution system that operates with voltage above 999 V. In order to maintain these systems the personnel shall have undertaken training in high voltage safety procedures and be familiarised with the protection gear for system in question.

Personnel responsible for maintenance and repair of high voltage system shall, as a minimum be qualified as follows:

- qualified as ships electrician, electrician group A or L, automation technician or equivalent;
- additional recognised training in maintaining high voltage systems in question;
- courses held by the ROV high voltage equipment manufacturer;
- be familiar with AODC 035 and IMCA R005.

6.5 Personnel qualifications – Operation of handling systems

In conjunction with operation of ROV systems, personnel operating the handling system shall have accomplish formal training in use of such systems and have understanding of the limitations for such systems. The training shall cover all safety aspects of lifting operations and give background for daily inspection of the lifting equipment in question.

7 Interface requirements

7.1 Work site requirements

The work site (i.e. vessel, barge, installation or other) shall constitute a stable work platform from where the operations can be performed safely and efficiently.

The contract shall define and allow for sufficient space and access to required facilities, such as means of communication, offices, conference rooms, copying machines etc.

Contractor's personnel shall be allowed living conditions and catering that is suitable for the actual rotation schedules and working hours required by the contract. Cabin standards and catering services shall as a minimum be in accordance with relevant legislation and shall not be inferior to the standard relevant in the geographical area where the operations are going to take place.

Contractors work-site facilities shall be agreed and described in the contract.

7.2 Remotely operated vehicle (ROV) system interface requirements

The interface between ROV system and support vessel/installation is defined as critical for efficient mobilisation and use of ROV systems. These interfaces should be defined prior to issue scope of work to the contractor. All interfaces shall be addressed and agreed between client and contractor prior to mobilising equipment to site.

Typical interfaces/issues are

- a) weight of each unit shall be within the deck loading limit at the installation site. The weight of all major components shall be verified and registered prior to mobilisation,
- b) sufficient clean electric power available and terminated in J-box at installation site,
- c) connection for signal from hydro acoustic system available at installation site,
- d) connection point for communication,
- e) connection point for data transmission,
- f) connection point for video distribution,
- g) easy and safe access between control station and launch site,
- h) launch position free of obstructions,
- i) motion characteristic for launch area,
- j) safe distance between launch position and vessel thruster propellers,
- k) outlet of fresh water to be used for wash down of the system,
- l) possibility of protected area for maintenance work,
- m) system deck area shall be kept tidy and free for hazards,
- n) all hoses on deck shall be secured and protected,
- o) zone II interface requirements (if required),
- p) interface requirements for company provided item.

8 Technical requirements

8.1 General

This clause specifies the minimum technical requirements for ROV systems in the various classes, measurement requirements and units to be used.

A table for definition of client's ROV system requirements is included in Annex B. This table is based on the minimum requirements outlined in the standard for the relevant ROV classes, and shall be used as a description of the clients minimum and additional requirements and the contractors compliance to this. Also see ISO 13628-8.

8.2 ROV Class I – Pure observation vehicles

8.2.1 Operational depth

Maximum operational depth shall be specified. The ROV system shall satisfy all operational depth requirements. Length of umbilical shall be appropriate to the operational depth, included extra length for re-termination.

8.2.2 Buoyancy

Buoyancy shall ensure stability of the vehicle with neutral trim.

8.2.3 Ability to move in the horizontal and vertical plane.

The ability to move in the horizontal and vertical plane is the most important performance criteria.

Speed shall be given in m/s for forward, backward, lateral and vertical directions.

Speed testing shall be performed with standard equipment installed.

Speed measurement shall be carried out at a relevant depth.

Verification of speed in horizontal plane can be performed by using vessel positioning system, or measured distance.

If required, speed can be verified as follows:

Procedure using vessel positioning system:

- the average speed shall be measured moving towards the current and with the current;
- the ROV shall be given 5 m to accelerate up to speed;
- the measurement shall be over minimum 30 m in order to reduce influence of distance measurement accuracy;
- average of minimum two measurement to be used as the achieved speed of the ROV.

Procedure using measured distance:

- the distance shall meet a known length, i.e. quay side, subsea structure, pipeline;
- the ROV shall be given 5 m to accelerate up to speed;
- the measurement shall be over minimum 10 m;
- the current shall be taken into account; preferably the measurement shall be performed moving towards and against current.

Verification of speed in vertical plane shall be measured using the ROV depth gauge over a minimum of 20 m. The ROV shall be given 5 m to accelerate up to speed. Average of minimum two measurement to be used as the achieved speed of the ROV.

8.2.4 Cameras and lights

8.2.4.1 General

The cameras and lights constitute the viewing system. Acceptance criteria for the viewing system shall be as follows:

- interference-free pictures;
- the video system shall be able to record a minimum of 400 lines;