



Exploration & Production

GENERAL SPECIFICATION

STRUCTURAL

GS STR 485

Remote Operate Vehicle (ROV)

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Contents

<u>1. Scope</u>	3
<u>2. Reference documents</u>	3
<u>3. General information concerning Remote Operated Vehicles (ROV)</u>	4
3.1 <u>Different types of ROV Relative dimensions</u>	4
3.2 <u>Characteristics</u>	5
<u>4. Observation ROV (OBSROV)</u>	5
4.1 <u>General</u>	5
4.2 <u>Equipment</u>	6
4.3 <u>Basic vehicle</u>	6
4.4 <u>Displays</u>	6
4.5 <u>Navigation</u>	7
<u>5. Working ROV (WOROV)</u>	7
5.1 <u>General</u>	7
5.2 <u>Equipment</u>	8
5.3 <u>Basic vehicle</u>	8
5.4 <u>Displays</u>	10
5.5 <u>Navigation</u>	10
<u>6. Choice of ROV</u>	11
6.1 <u>General</u>	11
6.2 <u>Nominal use</u>	11
6.3 <u>Use in backup mode</u>	12
<u>7. Integration tests and receiving inspections</u>	12
7.1 <u>General</u>	12
7.2 <u>Prototype tool tests</u>	12

1. Scope

This specification concerns Remote Operated Vehicles (ROV).

The purpose of this specification is to set down recommendations for use, establish the criteria governing the choice of tools, and define acceptance test and trial conditions.

All exemptions in respect of this specification shall be submitted to COMPANY for approval.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Choice of reference documents

Where national regulations exist, their provisions and those of the standards and codes to which they refer shall apply, supplementing or amending the provisions of this document.

If there are no national regulations covering all or part of the subject of this document, the reference documents shall be strictly applied, as supplemented by the provisions of this document.

Recognition of reference documents

Only the main reference documents are mentioned; the CONTRACTOR shall be responsible for complying with all secondary reference documents dealing with the subject of this document.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
DNV	Rules for the certification of lifting appliances
AODC 051	Guidance note on the safe and efficient operation of Remotely Operated Vehicle (ROV)
AODC	Code of practice for the safe use of electricity underwater
OLF 040	Recommended guide lines for ROV services

Regulations

Reference	Title
Not applicable	



Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

The provisions of this document shall be applied in the light of the supplementary documents supplied by COMPANY, including:

- Country specificity appendices
- Job specification
- Data sheets
- Articles and conditions; list of tasks
- Quality assurance provisions.

Reference	Title
GS STR 481	Design and operation of ROV interfaces with subsea production systems

3. General information concerning Remote Operated Vehicles (ROV)

This type of equipment is obtained from specialist companies. There is a wide variety of ROVs available on the market.

Some ROVs are used only for observation; these are designated OBSROV. Other, more powerful ROVs can be used to perform tasks underwater using one or more manipulator arms; these are designated WOROVS.

3.1 Different types of ROV Relative dimensions

- Observation (OBSROV): small
- Drilling assistance (DRIROV): medium
- Pipeline inspection (PIROV): small
- Working (WOROVS): large.

3.2 Characteristics

The characteristics that define the various types of ROV are:

- Name of MANUFACTURER
- Name of ROV
- Main tasks
- Maximum working depth
- Maximum current accepted while working
- Propulsion/HP power/pulling force
- Maximum forward/reverse speed
- Transport cage between surface and working area
- Maximum distance between the ROV and its cage during operations
- Sensors (depth gauge, bearing measurement, etc.)
- Manipulators (force feedback, force, working area)
- Method of maintaining working position (grappling arms, etc.)
- Weight/dimensions/payload
- Area required on the floating support for the equipment
- Number of vehicles in service
- Per diem rental during operations and on standby.

A ROV must be suited to the work required. The two main types of vessel in service are:

- Observation ROVs (OBSROV)
- Working ROVs (WOROV).

4. Observation ROV (OBSROV)

4.1 General

The observation ROV (OBSROV) is small, easy to manoeuvre and stable. OBSROVs are easy to deploy from a boat with a dynamic positioning system.

OBSROVs are used mainly for the following operations:

- Observation of divers during underwater operations
- Identification of working areas prior to an operation
- Video recording and photographing underwater
- Visual inspection of structures, pipelines, interfaces prior to installation or maintenance operations
- Visual assistance during installation or removal of equipment
- Visual assistance for a WOROV while it is working

- Visual assistance for tools, robots and submersible mechanical handling devices
- Visual inspection of electrical and umbilical cables, etc.

These functions require a small and very manoeuvrable ROV. For underwater work, the OBSROV is of crucial importance. It is vital. It has no means of maintaining position (Free flying).

4.2 Equipment

The OBSROV equipment shall include, in addition to the vehicle:

- A support for easy deployment of the TMS and the vehicle from the boat
- An umbilical between the support and the TMS. Allowing the ROV to reach the seabed at the work site
- A Tether Management System (TMS) including the transport cage and a submersible winch
- A tether between the TMS and the vehicle, Length: 120 m minimum
- A control container
- A workshop container with the basic tools and spare parts required for normal maintenance and on-site repair operations

4.3 Basic vehicle

The dimensions of the vehicle (in meters) must not exceed:

- 1.2 m long
- 0.8 m wide
- 0.6 m high.

It must be easily manoeuvrable, stable and be able to move in all directions under the thrust of its propellers.

The speed of movement must be at least:

- 0.8 m/s forward
- 0.5 m/s in reverse
- 0.5 m/s sideways
- 0.25 m/s ascending or descending.

The propellers must be protected to avoid injuring divers and damaging the umbilicals.

The system should be able to be deployed without interfering with other activities such as divers or assistance.

4.4 Displays

4.4.1 TV

The most commonly used standard is the European PAL system. The vehicle shall be equipped with a monochrome and colour camera that operates with low lighting levels and projectors with

adjustable intensity. The camera and its projectors shall be mounted on a support which offers azimuth adjustment of plus or minus 45° from the control cabin. The focal length of the camera shall allow automatic adjustment for distances between 0.25 m and 10. Another camera shall be positioned on the cage or on the back of the vehicle.

The TV monitor system shall comprise at least:

- A colour monitor for the pilot
- A monochrome monitor in the diving or operations control room
- A monochrome or colour monitor on the bridge

The following shall be displayed at all times:

- Depth
- Date and time
- Bearing of vehicle.

The images from the vehicle's camera and all the above information shall be recorded on at least one video recorder.

4.4.2 Photographs

The vehicle needs to be able to be fitted with a colour camera with a flash attachment, with focal length that is adjusted automatically between 0.25 m and 2.5 m. The instrument shall be fixed to the vehicle in such a way that the area photographed is located within the field of the TV camera. Snapshots shall be triggered from the ROV's control cabin. The films used shall be compatible with the photographic laboratory on board.

4.5 Navigation

4.5.1 Depth gauge

The vehicle shall be equipped with an accurate system for measuring depth to a resolution of 100 mm and accurate to plus or minus 100 mm. Depth shall be displayed at all times on the screen.

4.5.2 Compass

The vehicle shall be equipped with a magnetic compass or gyro-compass, with a resolution of 1; measurement error must be less than 10°. The bearing shall be displayed at all times on the TV monitor.

5. Working ROV (WOROV)

5.1 General

WOROVs are used for the following operations:

- Installing transponders
- Installing guidelines
- Replacing guide posts
- Installing and removing protective caps

- Opening and closing valves
- Performing cleaning operations
- Replacing instruments
- Replacing small modules (control POD, nozzle or valve insert)
- Performing non-destructive tests
- Taking measurements (metrology)
- Operating control panels
- Connecting or replacing electrical or hydraulic feeder links
- Positioning and connecting production lines
- Cutting cables.

These operations are given by way of example, and are by no means exhaustive.

5.2 Equipment

The WROV equipment shall include, in addition to the vehicle:

- A Tether Management System (TMS) including the transport cage (with trough frame lift capacity of 2500 kg optional) and a submersible winch
- A tether between the TMS and the vehicle (120 m minimum)
- A support for easy deployment of the TMS and the vehicle from the boat
- An umbilical between the support and the TMS (allowing the ROV to reach the seabed at the work site)
- An umbilical winch on the surface (may be part of the support)
- A control container - A workshop container with the basic tools and spare parts required for normal maintenance and on-site repair operations
- A photographic laboratory
- Tools for fitting manipulator arms
- A diesel generator set (optional).

5.3 Basic vehicle

The dimensions of the vehicle (in meters) must not exceed:

- 3 m long
- 1.65 m wide
- 1.8 m high.

Taken into consideration the prevailing environment condition such as:

- Current, water depth, visibility i must be easily manoeuvrable, stable and be able to move in all directions under the thrust of its propellers.

The propellers must be protected to avoid injuring divers and damaging the umbilical.

The system should be able to be deployed without interfering with other activities such as diving and assistance.

In order to accommodate tool package the following services must be supply.

- Through ROV frame lift capacity of 2500 kg (Optional).
- Valve pack for output of tooling with 210 bars pressure and 30/40 litre flow.
- Isolated HPU (Dirty HPU) for additional tooling.

5.3.1 Manipulator arms

The vehicle shall be equipped with two manipulator arms for grappling and manipulation purposes. The main arms shall be fitted with miniature TV cameras, with zoom capability.

The main manipulator shall have the following characteristics:

- 7 (seven) functions, master/slave operation, position information feedback
- Linear working area: 1.2 m minimum
- Lifting force fully extended: 400 N minimum
- Rotation torque at the wrist: 75 Nm minimum
- Continuous rotation of the wrist
- Gripping force: 400 N minimum
- The end of the manipulator arm shall accommodate various special tools

The secondary arm shall have the following characteristics:

- 5 (five) grappling functions
- Linear working area: 1.05 m minimum
- Lifting force fully extended: 1000 N (1500 N in fallback position)
- Rotation torque at the wrist: 75 Nm minimum
- Wrist rotation: 300
- Gripping force: 2000 N minimum
- Sufficient power to maintain the vehicle during manipulation operations

5.3.2 Handling system and umbilical

The handling system arrangement shall meet the following requirement

SWL design shall be able to handle:

- (In air) The total weight of the ROV the TMS and (2500 kg additional weight Optional)
- (In water) The total weight of the ROV the TMS and the umbilical weight at the maximum depth.

If an A frame is use a (Optional: additional overhead clearance of 1500 mm between the top of the TMS and the lifting shave shall be provided).

The lifting umbilical shall be designed and manufactured taken into consideration the prevailing operational parameter such as:

- Current
- Depth
- Launch and recovery speed.

Detailed documentation shall be made available to document the reliability of the umbilical, and demonstrate the MANUFACTURER tract record.

5.4 Displays

The display system shall include at least:

- A high resolution black and white camera with remote controlled adjustment in elevation (240°) and azimuth (180°) modes
- A high resolution colour camera with remote controlled adjustment in elevation (240°) and azimuth (180°) modes
- A black and white camera fixed to the back of the ROV
- A black and white camera mounted on the TMS.

All these cameras shall be combined with power adjustable lighting, they shall be controlled from the surface cubicle and feature "autofocus" from 0.25 m to 10 m.

The quality of the imaging system should allow colour images to be printed from the video with a quality equivalent to that of a 35 mm instrument.

The European SVHS (PAL) system shall be used.

In addition to the video monitors required to carry out the work, the following must be provided:

- A colour monitor for the customer's representative
- A colour monitor for the person carrying out the inspection or operation
- Two SVHS video recorders.
- A video recorder for the customer's representative
- A video readout for text, date and time
- A colour video printer.

5.5 Navigation

The vehicle must have the following:

5.5.1 Depth gauge

An accurate system for measuring depth with a resolution of 100 mm and an accuracy of plus or minus 100 mm. Depth shall be displayed at all times on the TV monitor.

5.5.2 Compass

A magnetic compass or gyrocompass, with a resolution of 1°, measurement error of less than 5°. The bearing shall be displayed at all times on the TV monitor.

5.5.3 Sonar

A sonar with a range of 1 to 150 m, associated with acoustic beacons for locating the vehicle. This system must be compatible with the support boat's acoustic equipment.

A transponder for pinpointing from the surface support system.

In addition to the above information, the vehicle shall send roll and pitch readings to the surface.

6. Choice of ROV

6.1 General

It is very important to choose an ROV that is suited to the work in hand. The first step is to draw up a shortlist of vessels that can be used.

The following points must be analyzed when making a decision:

- Access to the working area
- Existing, reliable tools that can be adapted to the ROV; each ROV MANUFACTURER has a wide range of standard tools
- The facility to adapt new tools (prototypes)
- Surface equipment, cubicle, crane, space on board.

When making a choice, special attention should be paid to reliability/availability. In practice, some vessels stop work too often through failures. For important and expensive operations, it may be advantageous to have two ROVs on board to increase availability and save time by being able to refit one while the other is working.

6.2 Nominal use

Detailed preparation of the tasks to be performed is vital.

The detailed procedures shall be drawn up by the CONTRACTOR long before the operations, and distributed for checking and approval to the OWNER.

Interface studies are required if the WOROVS use new tools (prototypes). These interfaces are located between the ROV and the tools and between the tools and the equipment concerned. Interface drawings shall be submitted to the OWNER's approval.

From the start of design of the submarine stations, it is very important to allow access and working areas of sufficient dimensions for the OBSROV and WOROVS vehicles.

The qualification of the personnel are extremely important:

- Experience
- Dexterity of pilots and operators using the manipulator arms
- Ability to put up with difficult situations
- Troubleshooting ability.

The equipment must be reliable, and a stock of spare parts is required so that a single component failure will not stop ROV operation and failures can be repaired quickly.

Particular attention shall be paid to photo/video quality.

6.3 Use in backup mode

The OBSROV and WOROVS can be used in backup mode for the following operations, given by way of example and by no means an exhaustive list:

- Display in the case of a utility camera failure during an operation.
- Activation of tools and equipment in backup mode if the nominal system stops operating. In this case, two ROVs may be needed (OBSROV and WOROVS).

The ROVs can also perform various functions such as:

- Retrieval of debris or objects hindering operations
- Cutting of cables
- Retrieval of seals
- Photography or filming.

7. Integration tests and receiving inspections

7.1 General

The tests are intended to:

- Check out operation of the nominal equipment (OBSROV, WOROVS)
- Check the working interfaces
- Test the new tools
- Train personnel
- Check out procedures.

The integration tests shall include: complete operation, on the surface and at shallow depths, of all the equipment required to perform the work.

Experience obtained from previous projects has shown that the integration tests carried out before operations at sea are often crucial to success. During the integration tests, the operational procedures are checked, and modified if necessary. The same personnel is used for integration and operations, which provides excellent training.

Nominal equipment tests

These tests shall be carried out at the relevant depth present at the work site, and shall be used to check out operation of the equipment and the capabilities of the operators.

7.2 Prototype tool tests

Some operations use special tools (prototypes); in this case, interface studies and rigorous user specifications shall be required (a small scale model of the equipment (1/10 or 1/12) is extremely useful for generating service specifications).

The interfaces shall be checked out on the surface (mechanical interfacing test) during the integration tests. Adjustments or modifications may be required.



Before operations succeed, tests at shallow depths shall be carried out to check out:

- The interfaces
- The procedures
- The capabilities of the pilots.

This last trial phase is very important; it provides an assurance that everything will operate correctly in subsequent operations.