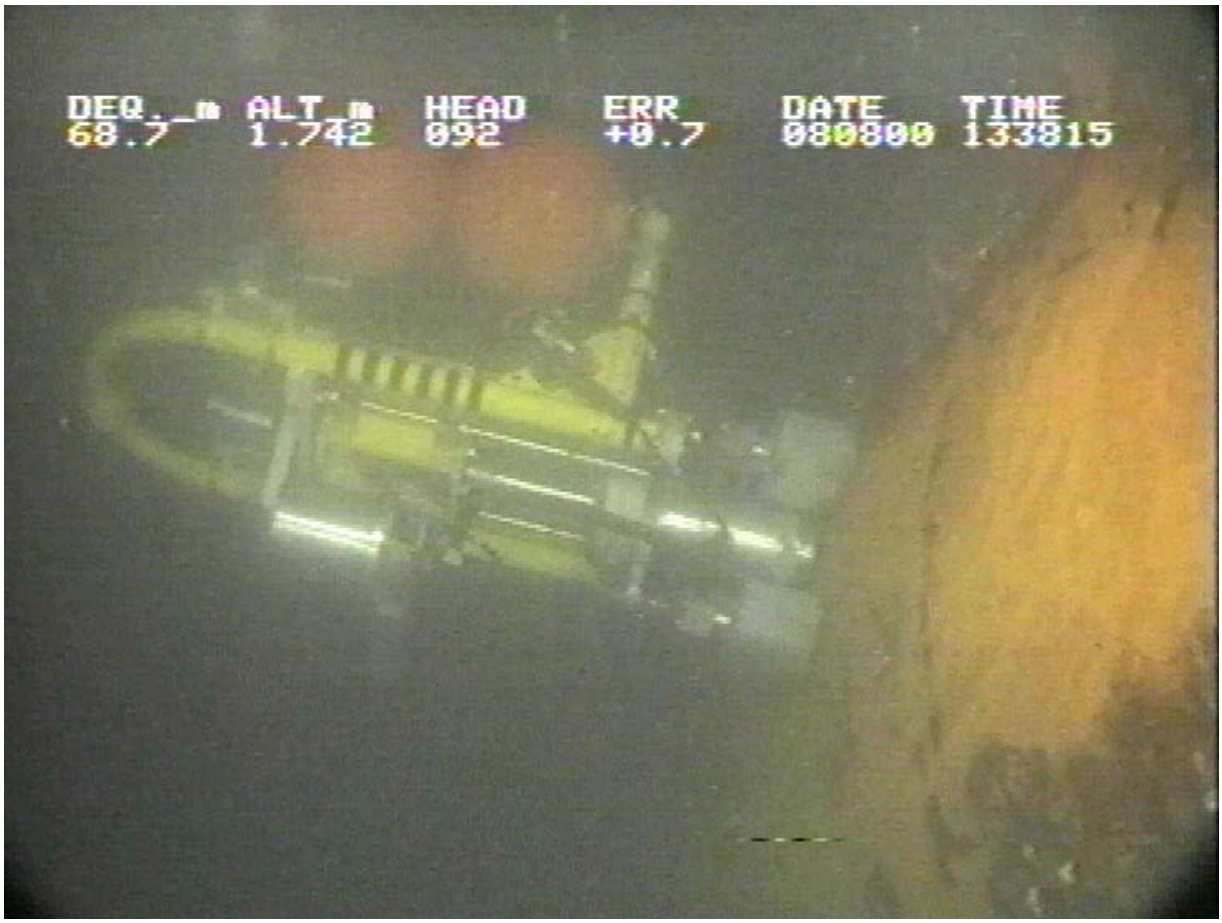
# TECHNICAL DESCRIPTION
# OIL SAMPLING TOOL - OST




FRAMO

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Oil & Gas Division

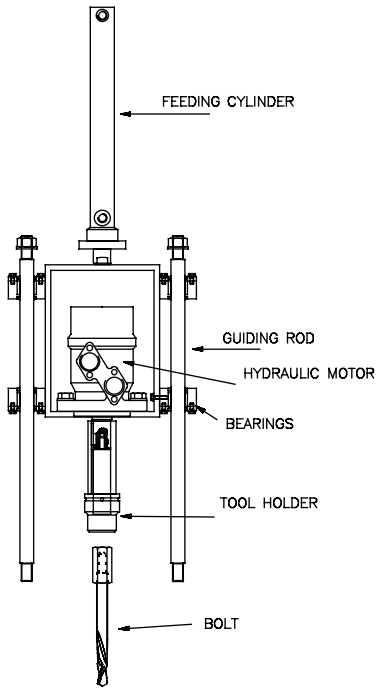
**FRAMO Oil Sampling Tool**

## BACKGROUND

The FRAMO Oil Sampling Tool project was launched as part of the Norwegian State Pollution Control Authority's program to determine remaining oil in sunken ships.
A lot of vessels along the coast of Norway represent a threat to the environment. Most of these ships were sunken during World War II.
The ships are all classified as war graves and during examination of ships this has to be taken into consideration.
The project early identified the need to develop a driverless tool that could penetrate the tanks of the vessels and measure the remaining volume in the tanks by identifying oil/water interface level. The use of divers is costly, especially in deep waters (100 feet and deeper).
The Oil Sampling Tool represents a cost effective method, and the system can be operated from a barge or a vessel.
In addition to be a cost effective method, the system is safe and time saving as no divers are used.

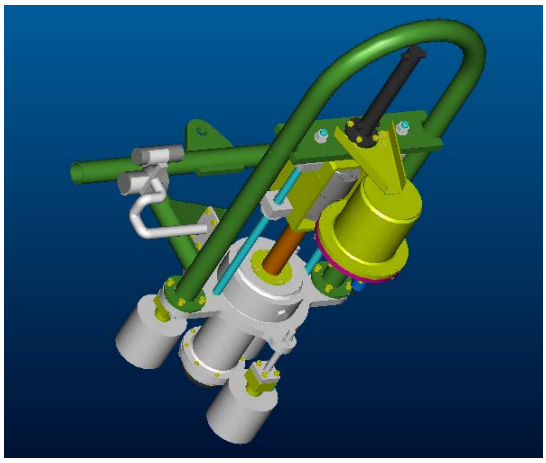
## GENERAL DESCRIPTION

The FRAMO Oil Sampling Tool operation is carried out from a surface vessel keeping its position by means of DP or four point mooring.
The FRAMO Oil Sampling Tool system is a driverless system capable of remote sampling and measure the remaining oil and other hazardous liquids from sunken vessels.
It will normally be launched into the sea by means of an onboard crane. In addition the FRAMO Oil Sampling Tool is assisted by a ROV (Remote Operated Vehicle).
The FRAMO Oil Sampling Tool system is powered from a surface hydraulic system via one hydraulic pressure hose and one hydraulic return hose.
The liquid from the wreck will be stored in a sample chamber in the Oil Sampling Tool, and taken to surface for analysis.
All controls of the FRAMO Oil Sampling Tool functionality is performed from a surface control system via a sub sea control cable.



*The FRAMO Oil Tapping Tool unit consists of the following main equipment:*

- One drilling machines
- Drill with thread cutter and threads; including a sealing gasket.
- Oil sampling chamber
- 3 off electro magnets, each 150 kg.
- One hydraulic control valve unit.
- One camera
- One illumination
- Framework, lifting gear, hydraulic connections and protecting screens.
- Materials:
  Framework, brackets and other supporting structures are made from sea-water resistant aluminum.
  Hydraulic motors and hydraulic cylinders are made from carbon steel. For further info see material specifications.

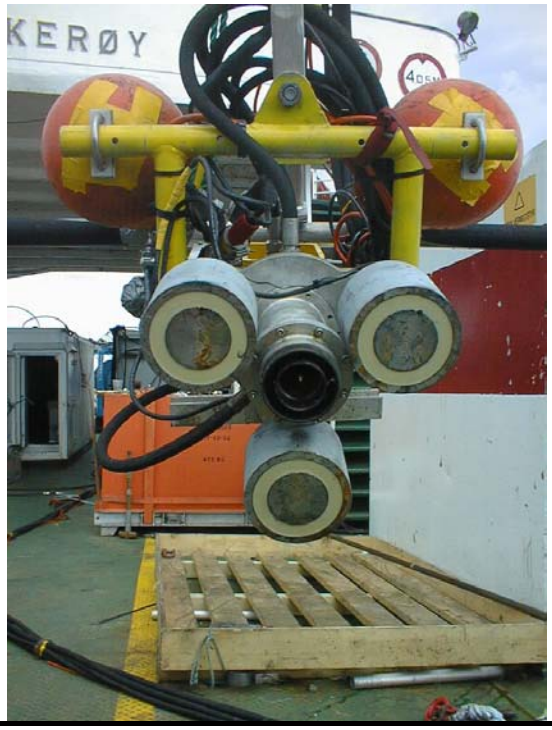


*Umbilical with:*

- High pressure hydraulic hose
- Low pressure hydraulic hose
- Control cable
- Video cable

*ROLS operating panel*

*Hydraulic powerpack*

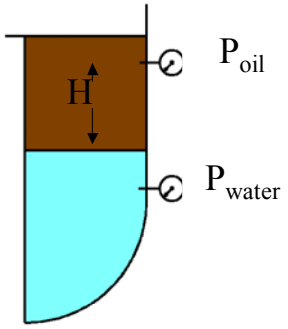


## INITIAL WORK

Prior to penetration of the hull, the oil tanks attachment points are marked by the ROV. Attachment points and co-ordinates are calculated from the as built drawings of the vessel. The co-ordinates are based upon known reference points such as frame nozzles welded to the hull of the ship, welding seams, water inlets etc. The predetermined attachment points are marked by magnetic pods, which later can be recognized by the ROV.

Each tank will have two penetration points, first cleaned by water jet or steel brushes. To avoid damage to the hull and reduced potential leakage, we start with steel brushes as low on the tank as possible. One penetration at the lower end of the hull, and one at the upper end of the hull. The reason for this is to make sure that there is one penetration in the water-phase and one in the oil-phase. The pressure gage measure ΔP between the tank and the ambient sea. By use of the ΔP measurement, and analysis of the density at the cargo, which is brought to the surface, it is possible to calculate the remaining volume of water and oil in the tanks. First calculate the interface oil/water level in the tank by below equation. By examining the as built drawings, it is possible to calculate the remaining volume of oil in the tanks.

$$H = \frac{P_{water} - P_{oil}}{SG_{water} - SG_{oil}}$$



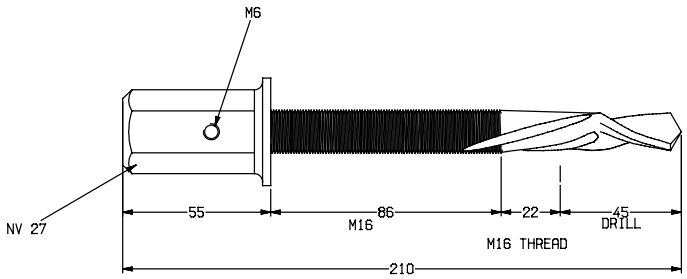

### Adjusting the contact angle

If it is necessary to adjust the angle of the FRAMO Oil Sampling Tool, this is done prior to lowering the tool into the water.

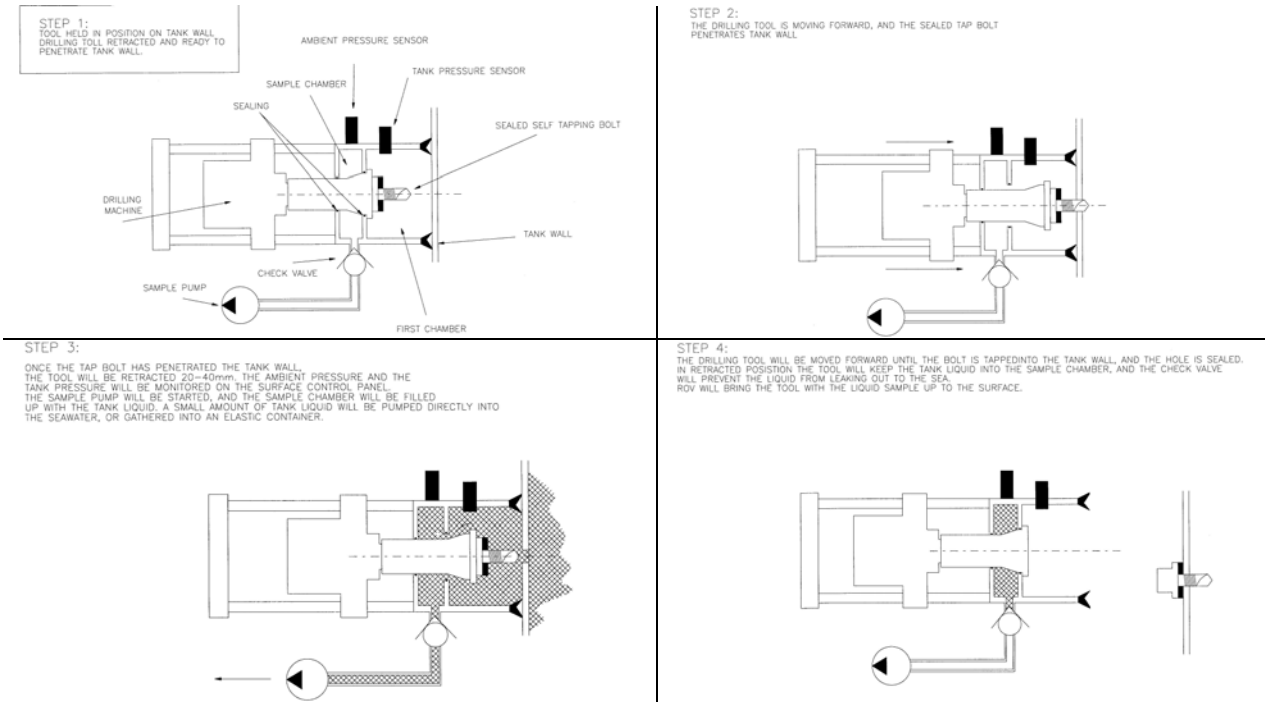
This angle is necessary to set in order to hit the angle in which the wreck is laying. This angle will be set finally as the electro magnets will force the FRAMO Oil Sampling Tool into the wreck side.

## FRAMO OIL TAPPING TOOL IN OPERATION

After the FRAMO Oil Sampling Tool is guided gently down to the lower end of the oil tank, and physical contact is established between the tool and the wreck, the three electromagnets are turned on. The ROV can then be released from the FRAMO Oil Sampling Tool and "fly" back to a position where it can observe the OST operation. After the FRAMO Oil Sampling Tool is in position and fixed to the hull, the drilling machine is started. A hydraulic cylinder moves the drilling unit in forward position, and the hole is made. The ΔP between the tank and the ambient sea is monitored. The sampling chamber is filled with cargo. After penetration, the bolt with threads is screwed into the hull, and the sealing gasket prevents cargo to escape from the hull. The wreck is then sealed. The bolt with numbering system can be used as a reference point in the future for offloading the wreck is the conclusion.




The electromagnets are turned off, and the FRAMO Oil Sampling Tool unit is taken to the surface by assistance of the ROV if necessary. The FRAMO Oil Sampling Tool is hoisted to the surface and prepared for the next penetration.




*Principle drawings Oil Sampling Tool*

## CONTROL PANEL

The control panel has a panel for “Bolting Machine Control”.
The required power supply is 220 VAC single phase, 50/60 Hz, 16 amps. The panel is designed for indoor use only, and will normally be placed on a desk. The weight is approximately 40 kg and can be carried by two persons.

### Drilling machine control

When pushing one of the activating buttons, the hydraulic motor and the hydraulic feeding cylinder will start simultaneously.

When pressing the retract button, the hydraulic motor will stop, and the hydraulic feeding cylinder will retract the drilling machine to the rear position.

The drilling speed and the feeding pressure is pre-set from factory, and should normally not be adjusted.
Pressure setting of the drilling machine must be set directly on the proportional valve on the FRAMO Oil Sampling Tool unit.

The electro magnets are also operated from the control panel.

## HYDRAULIC SYSTEM

The hydraulic system consists of proportional-valves stacked together, and an oil-filled pilot block with solenoid valves. Electrical control signals from the topside control panel controls the pilot solenoid valves. The solenoid valves controls the proportional valves.
All hydraulic pressure settings and flow limitations are adjusted by the proportional valves.
The hydraulic oil is routed to the hydraulic consumers through hydraulic hoses. All fittings are made of stainless steel.
For further information see hydraulic diagram.

## CAMERA SYSTEM

The FRAMO Oil Sampling Tool system is furnished with one black and white camera and one sub sea light. The camera is used for visible control over how far the bolt is in the hull.
Signals and power for the cameras and the lights are via hardwired umbilical to the surface.
Black and white monitors are connected to the junction box.
The camera system requires 220 VAC 50/60 single-phase power.

**REFERENCES:**

1. Norwegian State Pollution Control authorities - SFT

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|---|---|
| Project: | Wreck survey program summer 2000 |
| Vessels: | RFA Boardale and M/T Holmengraa |
| Operational water depth: | approx. 70 mtr. |
| Equipment: | Topside diesel/hydraulic power pack, ROV, brushes, steel thickness meter and FRAMO oil sampling tool (OST) |