



Push Off Release Transponder

PORT-MFE

(Medium Frequency)(Extended Life)

Operating Manual

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1. General Information

1.0 Introduction

This manual describes the ORE Offshore Push Off Acoustic Release/Transponder (PORT-MFE). This model is a lightweight, robust and easily deployable instrument. It can function both as an acoustic release and/or transponder unit for use at depths up to 3500 meters and with release loads up to 250 Kg and lifting loads to 1000 Kg.

1.1 General Description

The PORT-MFE has been designed for use as an instrument location and recovery system on oceanographic moorings and platforms. Additionally, the precision, high output power transponder feature, and coded interrogate make this instrument ideal for use with positioning systems in difficult acoustic environments.

The PORT-MFE utilizes a version of the ORE Offshore proven Binary Acoustic Command System (BACS) code structure. The BACS coding structure provides 12,000 possible secure command codes. Each release is factory programmed with its own unique command set, including an ENABLE, DISABLE, and a RELEASE command. Whenever the instrument receives an ENABLE command it responds with a status reply message which indicates the orientation of the instrument (tilted or not tilted). Whenever it receives a DISABLE command the unit responds with a number of pings indicated battery level status, the number of pings is:

- (6 pings is 90% to 100%) of battery life remaining.
- (5 pings is 60% to 90%) of battery life remaining.
- (4 pings is (30% to 60%) of battery life remaining.
- (3 pings is (10% to 30%) of battery life remaining.
- (2 pings is (Less than 10%) of battery life remaining.

The transponder function can be turned on or off with the ENABLE and DISABLE commands. There is also an Auto disable which will disable the transponder function if the system does not receive anything for a preset time period. This prevents running the batteries down if it is left enabled by mistake. When disabled the transponder will not reply when interrogated. This ensures that the unit will not interfere with nearby instruments and that no battery energy is wasted replying to interrogate signals meant for other systems. The transponder Enable / Disable command has no effect on the Release command.

The RELEASE command causes the mechanism on the instrument to rotate and to push off the threaded release link. While it is releasing the system transmits 1 ping for each complete rotation of the release shaft. Once the threaded link is completely pushed out the instrument is free. Upon completion of the release function the system will change to the enabled state if it was disabled. If the system was enabled when it is released it will remain enabled. The RELEASE command is not affected by the state of the transponder function (enabled or disabled).

1.2 Specifications

1.2.1 Mechanical

Standard Instrument

Depth rating	3500 meters
Maximum release load	250 kg
Maximum static lifting load	1000 kg
Overall length	68.6 cm
Mean diameter	8.9 cm
Weight in Water	3.6 kg
Weight in Air	9.1 kg

* Housing Material:	Type 6061 Aluminum
* Other Materials:	Delran, Nylon, Kynar, Ultem, Zinc Anodes
* Finish:	Hard anodized and Epoxy Painted
* Release type:	Mechanical (motor driven push off)

1.2.2 Acoustic

1.2.2.1 Command Receiver

- * Sensitivity: 78 dB re 1 μ Pa.
- * Receiver type: Multi-stage band pass with hard-limited-output (2000Hz/300Hz Bandwidths)
- * Pulse width: 10 ms
- * Period: 128 ms
- * Total Command Time: 6.7 seconds
- * Total lock out time: 7 seconds re beginning
- * Commands per tone pair: 2000 (6 pairs available)

1.2.2.2 BACS Command Structure:

Two 8-bit words separated by a 1.8-sec interval. Each word comprised of 8 bits from a 16-bit command. The 16-bit command is a 15 bit, 11 block cyclic code with an overall parity bit appended to the end to form a 16-bit code with a minimum Hamming distance of 4 bits. Additionally, two transitions are required within each word, and no repetitions of words are allowed in a command. The command is preceded by a wake up preamble.

1.2.2.3 BACS Command Coding:

* Binary FSK tone pairs:

Pair No.	"0"	"1"
1	17.483 kHz	17.986 kHz
2	17.483 kHz	18.506 kHz
3	17.483 kHz	19.084 kHz
4	17.986 kHz	18.506 kHz
5	17.986 kHz	19.084 kHz
6	18.506 kHz	19.084 kHz

1.2.2.4 Standard Command Functions:

ENABLE (Enable transponder) (returns tilt status)
DISABLE (Disable transponder) (returns battery life status)
RELEASE (Activate mechanical release mechanism) (pings once for each rotation of the release shaft followed by tilt status)

1.2.2.5 Transponder:

* Sensitivity:	78 dB re 1 μ Pa.
* Jitter:	< 0.1 ms
* Interrogate:	17 kHz pulse following an 8 bit code
* Post-filter bandwidth:	400 Hz.
* Minimum interrogate pulse width:	5 ms
* Reply frequency:	25 kHz standard
* Reply pulse width:	5 ms
* Reply Source Level:	192 dB re 1 μ Pa @ 1 m
* Turnaround Time:	100 ms
* Lockout time:	2 second

1.2.3 Power Supply, Standard Instrument

* 24 each "AA" alkaline cell welded pack	
* Main supplies	2 each 5v regulated
* Average current drain:	<50uA
* Design life (@ -2 degree C):	5 years
* Design life (@ -2 degree C):	35,000 replies @ 5 ms pulse width

1.2.4 Environmental

1.2.4.1 Temperature:

* Operating:	-10 degree C to + 40 degree C
* Storage: (Batteries removed)	-20 degree C to + 60 degree C

2. Installation

Introduction

This section contains the information relative to the basic set up of ORE Offshore's Push Off Release Transponder (PORT) including important details concerning the orientation of the unit on a mooring structure.

2.1 Installation Considerations

The transponder will operate in any orientation. However, specifics of the intended deployment will mandate special installation concerns.

2.2 Acoustic

Efforts should be made to ensure that there is a clear acoustic path between the PORT transducer and the source (typically a dunking transducer from a deck unit). Structural elements of a mooring system which have significantly different acoustic impedance than that of seawater will cause absorption or reflection of acoustic signals, which will degrade the operation of the unit. Floatation, including glass spheres, syntactic foam and plastic floats are particularly problematic. A float placed physically close to the transducer can create a blind area in the transducers beam pattern. This is usually only an issue when deployments are in deep water and the surface vessel is directly above the floatation. If this issue is suspected moving away from the mooring will solve the issue.

2.3 Mechanical

The release load is held through the top pad eye, housing and release link. There are isolation shoulder washers on the top pad eye to prevent electrical contact with the mooring. In some installations (such as a trawl resistant bottom mooring) the unit needs to be secured to the structure. It is important to verify that the release link is not obstructed in its motion, which could prevent it from disengaging.

The release link is treated as a disposable item in most applications. The release link is used to electrically isolate the release from the rest of the mooring. The release link is fabricated from "Ultem" a very high strength plastic. Arbitrary choice of an alternate release link could result in jamming, galvanic corrosion or mooring failure due to insufficient strength.

2.3.1 Bio-Fouling Prevention

Anti-fouling paint can be used to prevent bio-fouling on the housing and other external parts however please remember that system is made of aluminum so do not use paints that will react with it. Copper based paints should not be used. Tin based paints may be used. Plenty of grease is always a good idea on instruments deployed for long periods. It

is important to use grease on the threaded release shaft. We recommend using a silicone based grease.

2.4 Status Reply

The PORT is equipped with sensors that monitor the tilted or not tilted orientation of the system and release shaft rotation. This information allows the unit to send a coded status reply; based on the instruments orientation and to emit one ping each time the release shaft completes a rotation. The tilt status is useful for ascertaining whether the mooring or platform that has been deployed has landed as planned. At the end of a deployment the information is useful in determining whether, forces such as strong currents, or trawl activity have affected the mooring or platform. The status reply indicates one of two states, either "upright (within 50 degrees of upright)" or "tilted (more than 50 degrees from upright)". After an ENABLE command has been received, the unit transmits a series of pings encoded as follows:

Pattern	Status
* 6 pings at 2 second intervals	"upright"
* 3 pings at 2 second intervals	"tilted"

This same information is transmitted after a release command has been received and the 1 ping for each rotation status has been transmitted.

The tilt sensor is a 50-degree mechanical switch that is mounted on the release circuit board assembly. In the standard instrument configuration, with the release mechanism down, the unit is defined as "not tilted". For applications requiring a narrower maximum allowable angle of tilt optional tilt switches are available. The switch can also be installed at different angles to change the standard orientation.

3. Operating Instructions

Introduction

This section of the manual covers instructions for normal operations including turning on the instrument, opening and closing the housing, air acoustic tests, and post deployment considerations.

3.1 Turning on the unit

Push Off Release Transponders (PORTMFE) are carefully tested and shipped from the factory with a new battery pack installed (battery packs are disconnected unless otherwise requested). To use the PORT all that is required is opening the housing, plugging in the battery and then closing and purging the housing.

3.1.1 Opening the Housing

- * Remove the anti-rotation block from the release end of the instrument (Black Delrin block that keeps the release link from turning) by unscrewing the two nylon screws that hold it in place.
- * Pull the purge port plug out of the end cap (under the anti-rotation block).
- * Remove the Kynar retaining rod (White plastic rod) from the transducer end of the housing. (Simply pull the rod out and away from the housing)
- * Gently pull the transducer end cap free from the housing. You may need to work it side to side to get it started, but once the initial resistance is overcome the transducer should slide out easily.
- * The main electronics and battery pack assembly is connected to the transducer end cap. Carefully slide the assembly out enough to plug the connector from the battery pack into the electronics board if you are turning the system on.
- * If you are servicing o-rings or you simply wish to inspect the release end then slide the transducer and electronics assembly out enough to disconnect the 6 pin cable from (JP2) which goes to the motor.
- * To remove the release end cap pull the Kynar rod from the release end of the housing and then gently pull the end cap off.

3.1.2 Applying Power

- * The electronics assembly and battery pack, are mounted to an aluminum plate that is attached to the transducer end cap.
- * If the transducer cable (JP1) has been disconnected from the electronics assembly, plug it back into its header on the circuit board.
- * The battery pack has a lead wire with a three contact connector on it; simply plug this connector into the 3-pin header (JP3) on the circuit board.
- * The PORT will ping once after it has powered up and the transponder will be enabled.

3.1.3 Closing the Housing

*Make certain that the O-rings and O-ring surfaces are clean and lightly greased (use only silicone grease).

DO NOT APPLY ANY SILICONE GREASE TO THE POTTED TRANSDUCER.

* As the O-ring enters the housing bore, firm but gentle pressure must be applied to seat the end cap fully against the housing.

* Gently guide the release end cap and motor assembly back into the housing, taking care not to damage the sealing surface of the housing or pinch any cables. Be sure to align the orientation key while inserting it. While holding the end cap in place insert the Kynar retaining rod back into the slot. Continue inserting the rod until it comes out the other end of the slot.

* After connecting the motor cable gently guide the electronics assembly back into the housing, taking care not to damage the sealing surface of the housing or pinch any cables. Be sure to align the orientation key to the housing. While holding the end cap in place insert the Kynar retaining rod back into the slot. Continue inserting the rod until it comes out the other end of the slot.

* Grease the release shaft and internal threads on the release link. Install the release link (Ultem plastic threaded link) by threading it on to the shaft. The release link does not need to be tight. At this point simply screw it on until the link contacts the end cap and then back off ¼ turn.

* At this point it is good practice to perform an air acoustic test of the system by running through the command set for the PORT (See section 3.3).

* Replace the purge port plug and the anti-rotation block using the two nylon screws. You may need to rotate the release link in order to align the block properly. Rotate the link counter clockwise enough to align it with the block. The link does not have to touch the end cap when installed.

* Purge the instrument as per section 3.1.4

* It is recommended but not required that a wrap of 2 inch electrical tape be put on the housing and end cap seams to cover the slot where the closure rods are inserted. The purpose of this is to reduce the amount of sediment built up in the closure rod glands during deployments. Without the tape in place if a system is not cleaned immediately after recovery you may need to soak the gland in order to remove the rods.

3.1.4 Leak Detection and Condensation Prevention

ORE Offshore releases are provided with a 5/16-inch diameter purging port on the bottom (release end) end cap. The recommended procedure for preparation of the instruments atmosphere is as follows. The procedure assumes that the operator has a vacuum pump, dry nitrogen cylinder, gauge all arranged on a manifold setup. If you do not have the required equipment to purge the system then try to open the unit only in dry environments. Avoid opening the release in very humid environments. Desiccant packs can be placed inside the housing when purging is not available.

1. After verifying that all other (other than the purge port) o-ring seals have been cleaned, lubricated and assembled.
2. Prepare the purge port plug for installation; the plug must be ready for immediate insertion.
3. Insert a purge port vacuum adaptor and draw a -3 PSIG vacuum, do not exceed -3 PSIG.
4. Close the manifold valve to the instrument and allow the instrument to sit for 15 minutes. Check the gauge afterwards and verify that the vacuum did not change. This step is performed to detect gross o-ring problems.
5. Open the valve to the instruments purge port and:
 - * Backfill the housing with dry nitrogen gas, do not exceed +3 PSIG.
 - * Draw a -3 PSIG vacuum on the instrument; do not exceed -3 PSIG.
 - * In humid environments you should repeat this process up to four times.
 - * After drawing the final vacuum in this process, quickly insert the purging plug before the -3 PSIG vacuum is lost.
 - * Secure the purge plug with the anti-rotation block and nylon screws.

NOTE: When purging the instrument, be careful not to draw more than -3 PSIG vacuum, exceeding this figure can damage the batteries which in turn can result in instrument failure. If a purging set up is not available then place a desiccant pack inside the housing to help reduce moisture.

3.2 Arming the Instrument

The release mechanism is easily armed. Items required for arming are one release link, silicone based grease, and a flat blade screwdriver.

- * Make certain that the release shaft is free of debris and is not damaged.
- * Grease the threads on the shaft and inside the link.
- * Thread the release link on to the shaft until it bottoms out, then unscrew it ¼ turn to align it with the block.
- * Install the anti-rotation block using two nylon screws.
- * If you wish to test the release then send the release command. When the unit receives this command it will rotate the release shaft and push off the link. The system will ping once for each rotation of the shaft.
- * It is recommended but not required that a wrap of 2 inch electrical tape be put on the housing and end cap seams to cover the slot where the closure rods are inserted. The

purpose of this is to reduce the amount of sediment built up in the closure rod glands during deployments. Without the tape in place if a system is not cleaned immediately after recovery you may need to soak the gland in order to remove the rods.

3.3 Air Acoustic Testing

3.3.1 Setup

The specific acoustic impedance of air is quite different from that of seawater, which renders the transducer a far less efficient receiver when out of water. For this reason it is necessary to place the source (deck unit transducer or speaker) within a meter or two of the PORT transducer, with no obstructions to the acoustic path. Depending on the environment, some experimentation may be necessary to find a suitable location.

3.3.2 Tests

For the following tests it will be necessary to have the proper six digit commands unique to the unit being tested. If it appears that commands are not getting through, verify that the serial number of the unit being tested matches that on the sheet of command codes. Using a deck unit ascertain whether the PORT is enabled or disabled by interrogating it, if the unit has just been powered up it will be enabled. The PORT systems coded interrogate is listed on the configuration sheet with the command codes. The reply frequency is set to 25 kHz.

Using the deck unit, send the ENABLE command. The instrument should reply with a series of pings based on the orientation (tilt) in the electronics assembly.

Next send the RELEASE command and the shaft should rotate through seven rotations and send 1 ping for each complete rotation. After a successful release cycle the system will have transmitted 7 pings. If the shaft fails to turn 7 times or the cycle is somehow interrupted then after a one minute time out the PORT will send 9 fast pings. If the release shaft rotates successfully 7 times the system will return tilt status.

Interrogate the instrument using the deck unit and the proper code. It is unlikely that the deck unit will display a valid range because of the proximity of the two transducers, but you should be able to verify that the instrument transmits a reply pulse by listening to the alarm on the front panel of the deck unit.

Next send the DISABLE command. The instrument should reply with the appropriate number of pings to indicate battery life status. Now range on the instrument again with the deck unit. This time the unit should not transmit a reply pulse.

If the PORT is being shipped or stored it should be disabled to conserve battery life. The PORT should also be left disabled while deployed to conserve battery life. If the system is left enabled by mistake it will disable itself after a preset time (1 minute).

3.4 Post Deployment

After recovery, the unit should be cleaned and rinsed with fresh water to avoid salt buildup and deterioration of mechanical parts. A visual check of the housing and release

mechanism should be performed to detect any signs of damage, excessive wear, corrosion, etc. If the PORT is not to be used again soon, the unit should be turned off (follow procedure described in Section 3.1).

If the unit is to be stored for a long period of time, the batteries should be removed. See Maintenance procedures in Section 5.

4.2 Introduction to Series 8000 Command Coding

The code that is employed is 16 bits long with 11 bits of information. Specifically it is referred to as a 15, 11 block cyclic code with an overall even parity bit appended to the end. The information bits occupy the first 11 bit positions, the cyclic parity or redundant bits occupy the four positions after the information bits, and the overall parity bit occupies the last position. This particular code has good mathematical structure. The parity bits are easily calculated and a minimum Hamming distance of four bits exists between any two codes. The command timing is as follows:

- * 8 bits are sent with a period of about 128 ms and a pulse width of 10 ms
 - * A word decode interval is 2.718 seconds
 - * Following the first decode interval, a 40 ms detection window is open
 - * If a detection occurs in the window, a second word decode interval occurs
 - * During any of the sample gate intervals, if both "D0" and "D1" are present or if neither one is present then a command abort will occur and the command will not go through.
- From the 11 information bits there are approximately 2000 unique commands for each tone pair employed. Commands composed of equal or repeated words are excluded, as are some containing very few transitions. Since there are six tone pairs available (refer to the specification section), over 12,000 unique commands exist.

5. Maintenance

5.0 Maintenance

The PORT requires minimal maintenance. Pre-deployment preparations and checks, and post-deployment cleaning will fulfill most of the maintenance requirements. The important tasks are battery replacement, 'O' ring care and maintenance, and general cleaning, inspection, and lubrication of operational elements.

5.1 Battery Replacement

The PORTMFE uses a "AA" cell welded alkaline pack.

5.1.1 Battery Replacement Procedure

***** **WARNING** *****
IF THE UNDERWATER UNIT HAS BEEN DEPLOYED,
THERE IS THE POSSIBILITY OF INTERNAL PRESSURIZATION,
EXERCISE EXTREME CAUTION WHEN OPENING THE INSTRUMENT!

- * Open the instrument, refer to section 3.1.1
- * Separate the transducer end from the housing by gently pulling them apart. Be careful not to scratch the housing throat when pulling the assembly from the tube.
- * Disconnect the motor cable from the electronics assembly (JP2).
- * Remove the three screws that hold the (black Delrin) battery retainer plate in place.
- * Note the orientation of the wires remove the old battery pack and dispose of it properly.
- * Insert a new battery pack noting the wire orientation.
- * Re-install the battery retainer plate using the three screws.
- * Assemble the instrument, refer to section 3.1.3

5.2 O ring Considerations

The end cap assemblies of the PORT use a standard o-ring with a backup ring to provide watertight integrity to the electronics housing. The backup ring is flat on one side and concave on the other. The concave side is placed towards the o-ring and the o-ring should be towards the outside of the housing. Under normal usage, proper care and lubrication of the o-ring should provide several years of usage. However, like the batteries, the o-ring is an inexpensive component, which is absolutely critical to the successful operation of the entire system. It is good practice to replace the o-rings periodically, depending on frequency of use. It is essential to inspect the o-rings and sealing surfaces before and after each deployment.

Prepare the sealing surfaces for assembly by cleaning with a lint-free towel or swab, moistened if needed with alcohol. Inspect for scratches or nicks which could impair the o-rings ability to provide a seal. Apply a light coat of o-ring lubricant (typically silicone based grease) to the housing bore and o-ring to facilitate insertion of the end cap. Make sure the lubricant is compatible with Nitrile rubber. Inspect the o-ring for damage such as tears, dimples or other defects in the rubber. Replace any o-ring that is questionable or old. Lightly coat the o-ring with lubricant. Protect o-rings when stretching them over large diameters (i.e., cover diameter with plastic sleeve).

CAUTION

APPLYING TOO MUCH O-RING LUBRICANT CAN COMPROMISE A SEAL!

5.2.3 Additional O-Rings

There are additional o-rings, which provide the watertight integrity to the housing. These are located on the purge port and release shaft. Check and replace these o-rings periodically.

5.3 General Cleaning and Inspection

Whenever the unit has been recovered from a deployment, the unit should be cleaned and rinsed with fresh water to avoid salt buildup and deterioration of mechanical parts. A visual check of the housing and release mechanism should be performed to detect any signs of damage, excessive wear, corrosion, etc.

5.3.1 Inspection Particulars

- * Check condition of the threaded release shaft, particularly in the area of contact with the release link.
- * Check for wear, corrosion or distortion of the top pad eye (lifting eye).
- * Check for corrosion of the purge plug.
- * Check and replace if needed all o-rings.
- * Check and replace if needed the two zinc anodes.
- * Check the housing for signs of corrosion or damage to the hard coat.

APPENDIX A - DRAWINGS and FIGURES

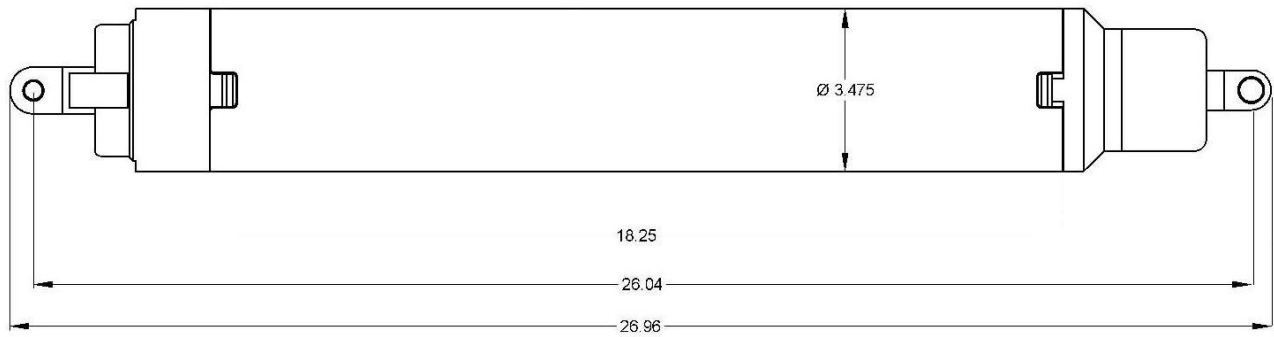


Figure 1 - PORT MECHANICAL

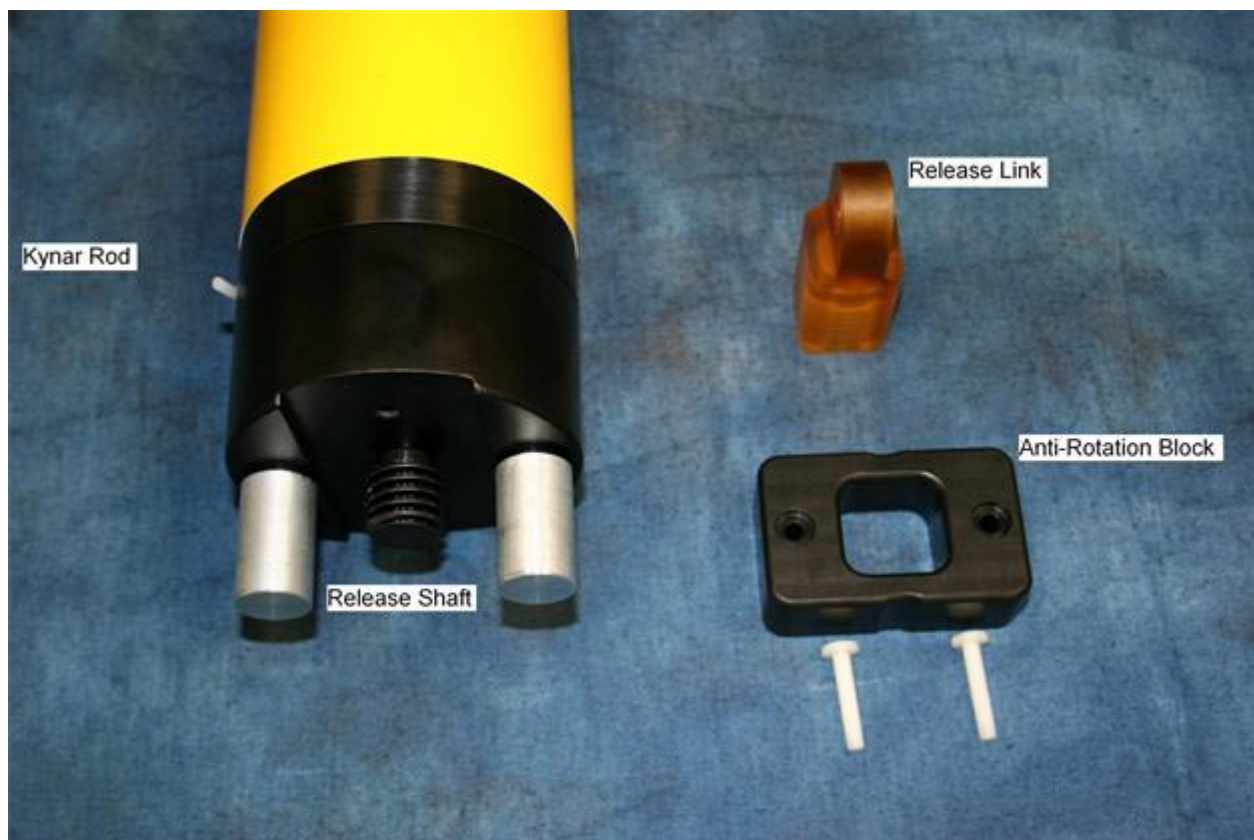


Figure 2 - PORT RELEASE PARTS