

Thruster SI-MCT01 Instruction Manual



Issue 7

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In respect of the Electromagnetic Compatibility Directive 89/336/EEC, attention is drawn to the following:

- The SEAEYE SI-MCT01 'as delivered' complies with the essential protection requirements of the EMC Directive 89/336/EEC.
- In order to ensure that the SEAEYE SI-MCT01 complies with the Directive when installed for operational use, the installation instructions contained within this Technical Manual must be adhered to.
- The end user of (or authority responsible for) the installation of the SI-MCT01 becomes responsible for the complete installation's compliance with the Directive, particularly under the following circumstances:
 - additional equipments are used in conjunction with the system (unless they are supplied by SEAEYE MARINE LTD), or
 - modifications are made to the system (or part thereof), or
 - surface equipment is removed from its 'as-built' enclosures for subsequent installation in third-party racks or consoles.
- During Maintenance Procedures, when the system is operated outside its normal operating environment and/or screened enclosures are opened for access, the equipment may emit, or be susceptible to, electromagnetic interference (EMI). The equipment should be sited away from safety critical, essential communication, or navigation systems during such activities. It is advisable to site the surface equipment away from critical electronic systems at all times.
- It is recommended that electrical power for the SEAEYE SI-MCT01 is provided using a dedicated supply which is not also used to power safety critical, essential communication, or navigation equipment.
- Any questions in respect of the Compliance of any SEAEYE MARINE LTD equipment with the EMC Directive, or any field reports of EMC related faults, should be addressed to the Technical Director at SEAEYE MARINE LTD.



Seaeye House, Lower Quay Road, Fareham, Hampshire, PO16 0RQ, England

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Products sold by SEAEYE MARINE LIMITED (hereafter referred to as SEAEYE) are guaranteed to the **original** purchaser as follows:

Subject to the exceptions and upon the conditions stated hereafter, SEAEYE agrees to correct, either by way of repair, or at SEAEYE's sole discretion, by way of replacement, any defect of material or workmanship which develops as follows:

- SEAEYE MCT Thruster Motors : 12 months,
- SEAEYE parts returned on completion of Repair : 3 months,

of dispatch of the product to the **original** purchaser by SEAEYE or its authorised representative, provided that the investigation and factory inspection by SEAEYE disclose that such defect developed under normal and proper use and not due to fair wear and tear or misuse by the user for its intended purpose. Repair or replacement are the exclusive remedies under this guarantee, and further provided that the guarantee granted hereby shall not include parts, materials, or spare parts that SEAEYE considers as expendables under normal operating conditions.

The exceptions and conditions mentioned above are as follows:

1. SEAEYE make no guarantee concerning components or accessories that are not of its own manufacture. All goods sold and manufactured by other manufacturers are sold subject to the manufacturer's guarantee, which shall be assigned to the purchaser or authorised representative. SEAEYE in so far as it is appointed by the agents of a manufacturer to carry out repair work under such guarantees will, where it considers it appropriate, carry out the necessary repair work on terms agreed by SEAEYE and purchaser or authorized representative having regard to the liability of the manufacturer under its guarantee. Notwithstanding anything in this paragraph, any goods sold but not manufactured by SEAEYE are not supplied with any warranty whether express or implied and warranty imposed by common law or statute including the warranty of merchantable quality and the implied warranty of fitness for a particular purpose contained in the UK Sales of Goods Act 1979 Section 14 is expressly excluded although SEAEYE undertakes to take reasonable care in supplying suitable goods and giving particulars of performance.
2. SEAEYE shall be released from all obligations under its guarantee in the events that repairs or modifications are made by persons other than its own authorised service personnel or trained and authorized representative, unless such repairs or modifications by others are made with prior written consent by a Director of SEAEYE. In the event of a failure, and the

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purchaser or agent authorized by the purchaser or the operator fails to take prompt and reasonable action to prevent further damage, SEAEYE will not accept any responsibility for consequent damage. "Normal and Proper use" of a product includes without limitation performing routine preventative maintenance in accordance with the appropriate instructions within the appropriate service and/or maintenance manual.

3. SEAEYE products, systems and parts are Ex-works at the company's UK site. SEAEYE is not responsible for carriage/shipment/duty/taxes/insurance or any other costs for any product, system or part either dispatched to or from the company's UK site.
4. There are no guarantees which extend beyond those expressly provided for herein and the aforesaid guarantee and SEAEYE's obligations and liabilities there under are in lieu of, and the customer waives, all other guarantees, express or implied, and all other liabilities therefore arising by law or otherwise, including without limitation any implied guarantee of merchantability or fitness for a particular purpose, and all obligations and liabilities with respect to loss of use, revenue or profit, or indirect, consequential or incidental damages of any kind and from manufacture, sale, handling, shipment, repair, maintenance or replacement of said products.
5. Representations and warranties made by any person, including dealers and representatives of SEAEYE that are inconsistent or in conflict with the terms of this guarantee (including but not limited to the limitations of the liability of SEAEYE as set forth previously), shall not be binding upon SEAEYE unless reduced to writing and approved by an officer of SEAEYE.
6. SEAEYE's liability arising from the sale or use of a product sold by SEAEYE shall be limited to SEAEYE's cost of correcting defects, as provided herein, or the total cost of such product as shown on the purchase order pursuant to which it was purchased, whichever is less. All such liabilities will terminate upon expiration of the guarantee period.
7. This guarantee shall be provided for and governed by the prevailing laws of England.

General Information

Specifications: SEAEYE reserves the right to change specifications at any time without due notice and without incurring any obligation to incorporate any new features in any of its previous products, whether or not they have been sold.

Damage in Shipment: Each new product is carefully examined and checked prior to dispatch from SEAEYE's premises. It should be carefully examined and operationally tested on receipt by the receiving party. If the product is damaged in any way, then a claim should be lodged with the carrier. New or repaired product that has been damaged in transit should not be returned to SEAEYE without first obtaining specific shipping instructions from SEAEYE.

Repairs: If any fault develops, the following steps should be taken:

- Notify SEAEYE and give full details of the difficulty. Include in this notification the model type and its serial number. On receipt of this information SEAEYE may elect to either issue service instructions or provide full shipping data for the return of the equipment.
- After shipping instructions are supplied, forward the product(s) prepaid and repairs will be estimated and the client informed prior to any repairs to the fault(s) being carried out.
- The client may then issue SEAEYE an approved purchase order to cover the costs of the repair, if the fault has been caused by misuse or is not under guarantee.

Introduction

The SI-MCT01 is the culmination of Seaeye's proven brushless DC motor technology and impressive new developments in magnetics and materials sciences. RS485 communication facilitates the rapid integration of the SI-MCT01 into all manner of subsea applications from ROV and AUV propulsion to prime mover applications such as pumps. With simplicity and versatility in mind the SI-MCT01 can be controlled simultaneously with up to 128 similar nodes from a single serial port.

Specifications

Nominal Voltage:	48VDC
Nominal Power:	300W
Forward Thrust @ 300W:	13 kgf
Reverse Thrust @ 300W:	12.8 kgf
Propeller Speed @ 300W:	960 r.p.m
Propeller Diameter:	180 mm
Weight in Air:	4.3 kg (including propeller and nozzle)
Weight in Seawater:	2.5 kg (including propeller and nozzle)
Depth Rating:	300 m
Control Signal:	RS485
Connector:	5-Way Connector
	2 x Power
	2 x Telemetry
	1 x Earth

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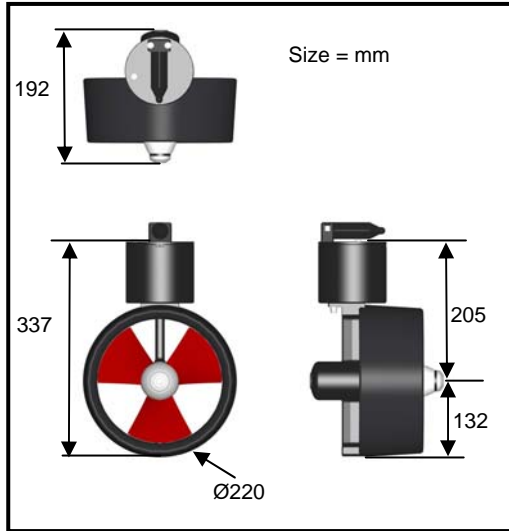


Fig. 1. Dimensions

Connection

External		Internal	
Pin 1	Brown	Red/White	+48/+24 V
Pin 2	Red	Yellow	Telemetry A
Pin 3	Orange	Blue	Telemetry B
Pin 4	Yellow	Black/Grey	0 V
Pin 5	Green	Green	Earth

Telemetry MUST be fused at: **F250mA**

Supply MUST be fused at: **F8A(T)**

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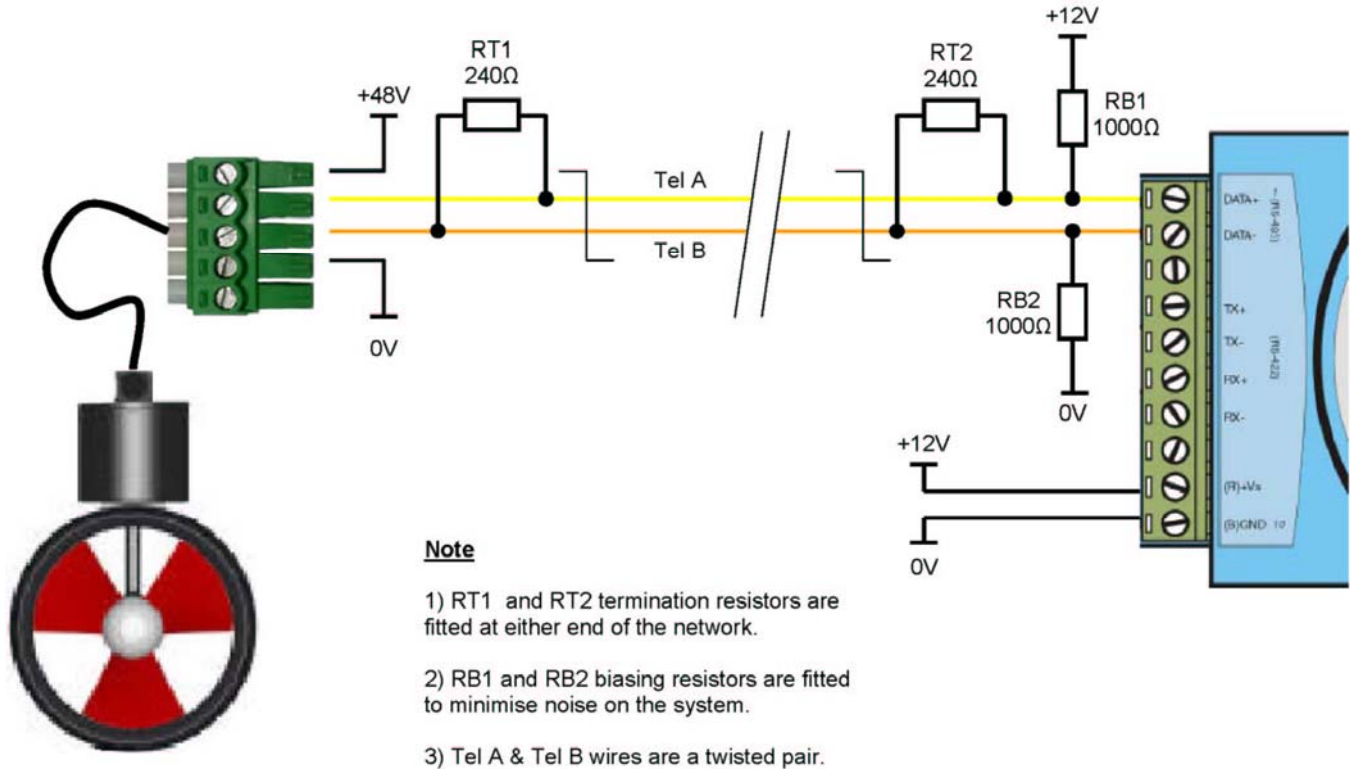


Fig. 2. Thruster Connection

Seaeye Marine Thrusters - Electronics Explained

The Thruster Control Loop

To maintain constant speed under varying loads, Thrusters must operate within a closed loop control system.

Open loop systems apply power to the motor in proportion to the operator demand. The actual motor shaft speed, however, is dependent upon loading and will change under different operating conditions. Only in calm, minimal sea currents and tides would the vehicle remain stable, otherwise Auto function control would be very unreliable.

In a closed loop control system, the power applied to the motor is determined by the **difference** between the **user demand** and the **actual shaft speed**.

For a fixed user demand:

- Increased propeller loading causes the motor to slow down. This increases the difference between actual and demand speed which is a difference known as **error**. This error is measured by the **thruster electronics feedback loop** and causes more power to be applied to the motor until the actual speed equals the demand speed reducing the error to zero.
- Decreased propeller loading causes the actual speed to rise above that required, the difference or error is negative, causing a reduction in applied power until the motor shaft speed falls and the error is again reduced to zero.

Control loop INPUT signal

The propeller speed is determined by the mark-space ratio of the SPEED input signal to the thruster. The actual shaft speed (as determined by the speed feedback circuit) is subtracted from the input demand signal to produce an error voltage, which is proportional to the difference between the required speed and the actual propeller speed.

Overload trip

Jamming of the propeller or gradual fouling causes the thruster current to rise above safe levels. If left unchecked, either gradual or instant current growth will exceed the permitted levels causing thruster overheating or destruction of the drive FETs. A current sensor provides indication of a fault condition. A temporary over current trip may be cleared by reversing the direction of the Thruster. If the overload condition persists, then the trip condition will continue preventing damage to the thruster.

SI-MCT01 Thruster Control

Introduction

This document details the telemetry specification for the SI-MCT01 Thruster.

Node Configuration

The network of nodes uses a Master/Slave configuration. The controller Input being the master and all other nodes are slaves. The master node initiates communication and the slave will then reply.

Packet construction

There are two types of packets a *Surface to Subsea* (controller to thruster) and *Subsea to Surface* (thruster to controller).

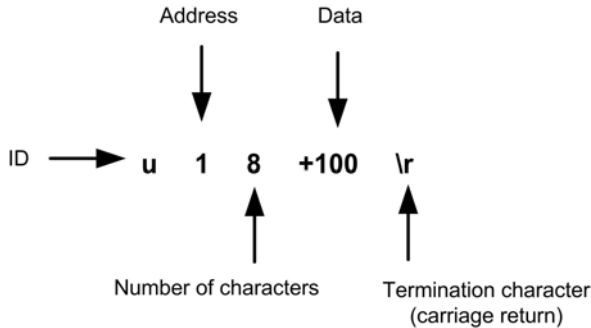


Fig. 3. Example of surface to subsea

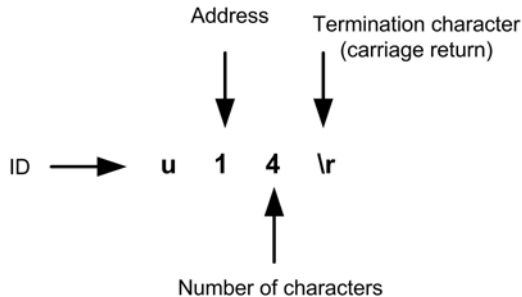


Fig. 4. Example of subsea to surface

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Field name	Field width	Example Character	Description
ID	1	u	ID of thruster node. Lower case indicates surface to subsea, uppercase indicates subsea to surface.
ADDRESS	1	1	Address of node. Total of 35 different addresses for each type of node 0 to 9, then A to Z. Address 0 is reserved for broadcast to all nodes of ID specified. Only 35 nodes of any type allowed.
NUMBER OF CHARACTERS	1	8	Number of characters used in packet. This includes the encoding characters and carriage return. Therefore a minimum of 4 will always be sent. Total of 36 characters can be sent 4 to 9, then A to Z.
DATA	0 to 32	+100	Data sent in packet. This can only be up to 32 characters long.
TERMINATION	1	\r	Terminating character '\r' (carriage return).

The example `u18+100\r` specifies the following information

- u thruster node addressed from surface to subsea
- 1 address 1
- 8 8 characters in total used in this packet
- +100 a demand of +100% required

A correct acknowledge reply from the node to the handcontroller would be `U14\r`

- U thruster node reply
- 1 from address 1
- 4 4 characters in total used in this packet

This sequence of packets shows the demand from the handcontroller to thruster 1 of +100%. The thruster then replies with a acknowledge packet.

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The following table gives the various commands available for the MCT1 thruster.

Data		Function	Reply	Notes
Command	Value			
+	0 to 100	Forward demand 0 to +100%	Ack	
-	1 to 100	Reverse demand 0 to -100%	Ack	
?	R	Request output speed	0 to 6250	Motor rpm (divide by 5 to give propeller rpm)
?	C	Request motor current	0 to 10	0 to 6 Amps
?	b	Request baud rate		
?	h	Request total time run	hH mM	H = hours M = minutes
?	n	Request node name	string	Up to 8 chars
?	v	Request version number	mmnn	mm - major number nn - minor number
x	0	Disable eeprom write		
x	1	Enable eeprom write		
z		Reset node	Non zero on success	
n	0 to F	Set node address	Non zero on success	Eprom Write must be enabled
b	0	Set baud rate 57600 (default)	Non zero on success	Eprom Write must be enabled
b	1	Set baud rate 4800	Non zero on success	Eprom Write must be enabled
b	2	Set baud rate 9600	Non zero on success	Eprom Write must be enabled
b	3	Set baud rate 19200	Non zero on success	Eprom Write must be enabled
b	4	Set baud rate 38400	Non zero on success	Eprom Write must be enabled

Control Notes

The commands are in standard ASCII format, 1 Start, 8 Data, 1 Stop, 0 Parity, user selectable Baud Rate (57600 default) and the terminating character '\r' is a single carriage return.

To set either a new address or baud rate eeprom write must be enabled. The new address or baud rate will not take effect until the node is reset.

If the thruster does not receive a command for 1 second or more the thruster demand is zeroed.

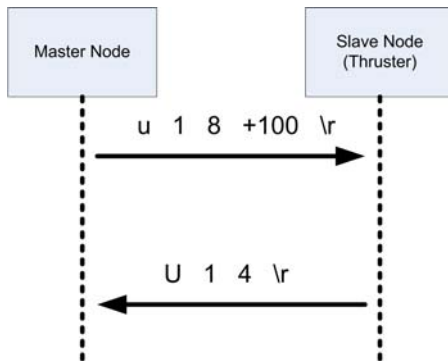
Communication Example

The example `u18+100\r` specifies the following information

- `u` thruster node addressed from surface to subsea
- `1` address 1
- `8` 8 characters in total used in this message
- `+100` a demand of +100% required

A correct acknowledge reply from the node to the handcontroller would be `U14\r`

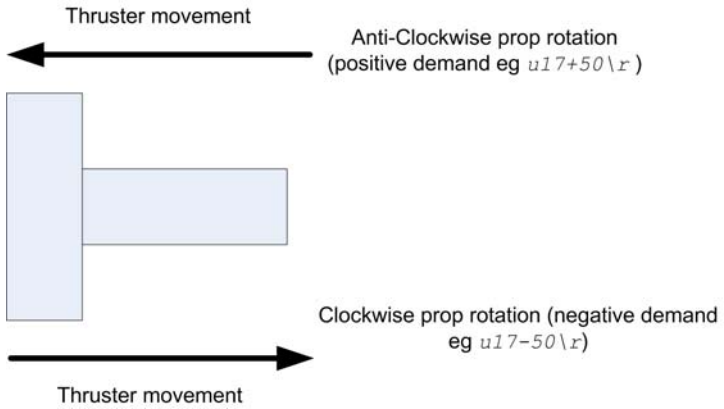
- `U` thruster node reply
- `1` from address 1
- `4` 4 characters in total used in this message



The figure shows the sequence of messages for a demand from the controller to thruster address 1 of +100%. The thruster then replies with an acknowledge message.

Thrust Direction due to Demand

The following diagram shows the direction of thruster travel depending on the demand given.



Maintenance - Thruster Propeller Replacement

Frequency of Task

The propeller should be checked before and after thruster usage. The propeller should be replaced when there is obvious damage to propeller.

Introduction

The purpose of this check is to ensure that the thruster is working efficiently

Tools Required

The following tools may be required:

- Allen Keys (common sizes)

Parts Required

The following parts may be required:

- Thruster Propeller (Part Number P01780).
- Loctite 222.
- Lubricating Oil (Aqua Shield or similar).

Procedure

WARNINGS:



DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT ISOLATE ALL THE UNITS POWER SUPPLIES.



POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE THRUSTER ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENACE ACTIVITY IS IN PROGRESS.



DANGER TO PERSONNEL AND EQUIPMENT. THRUSTERS MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE THRUSTER IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.

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Proceed as follows:

1. Visually examine the propeller to see if replacement is completely necessary.



Fig. 5. Propeller Assembly

2. Remove the socket head screw, spring washer and propeller retainer.

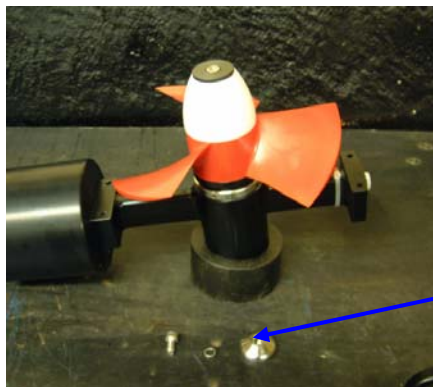


Fig. 6. Retainer Parts

3. The propeller assembly can now be removed; it may be difficult to remove as it is magnetically coupled.

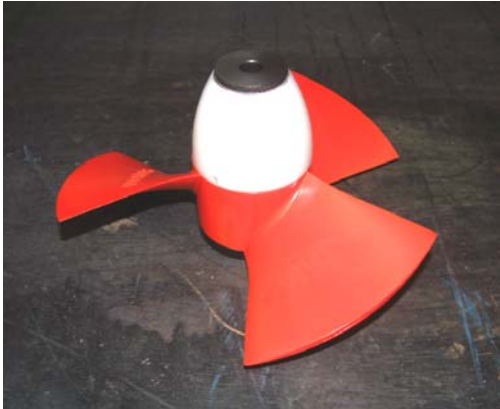


Fig. 7. Propeller Assembly Removed

- 4. The propeller assembly can now be dismantled, they are holes either side of the nose cone and one in the magnetic coupling, these can be used for the 'C' spanners to disassemble.

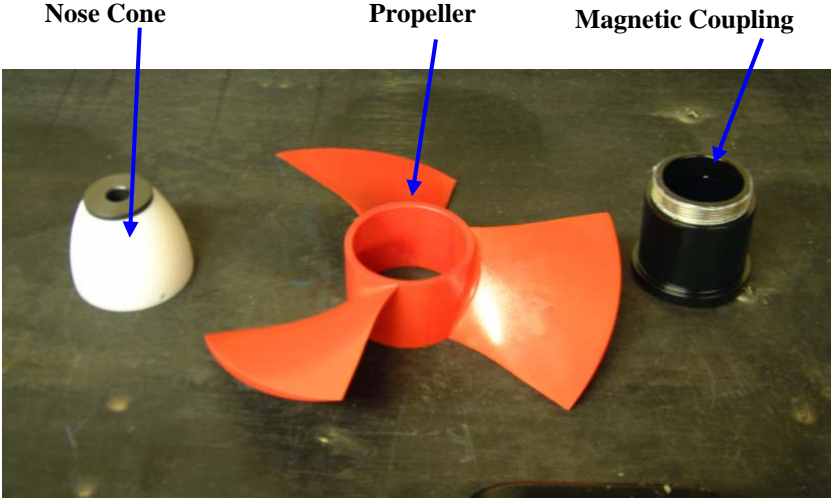


Fig. 8. Propeller Coupling Assembly

- 5. The propeller can now be changed.

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- 6. When fitting the magnetic coupling to the nose cone, use Loctite 222 on the nose cone threads.

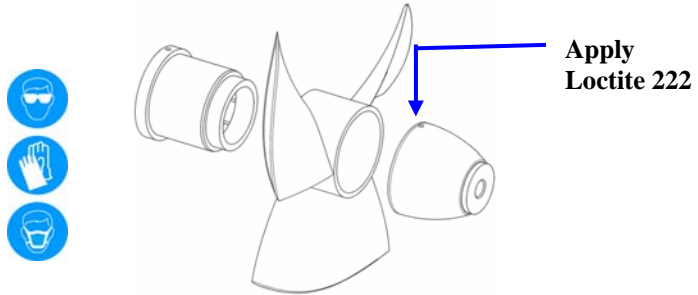


Fig. 9. Propeller Fitment

- 7. Use the 'C' spanners to tighten the assembly together.
- 8. Apply a small amount of lubricating oil (Aqua Shield or similar) to the internal propeller bearing assembly.

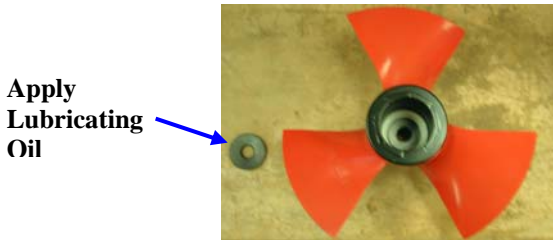


Fig. 10. Propeller Assembly

- 9. Refit the propeller assembly to the thruster using the retaining socket screw and spring washer.



Fig. 11. Thruster Propeller Fitment

- 10. When fully tightened, there should still be a slight lateral movement of the propeller to ensure that it is not 'locked' onto the thruster shaft.

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