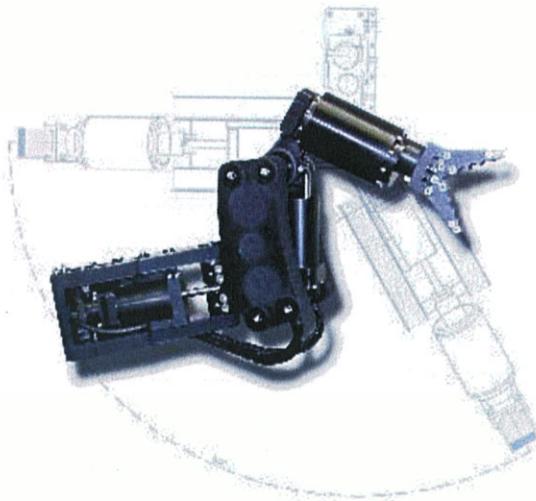


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## ASSEMBLY, MAINTENANCE & OPERATION MANUAL

### ARM MICRO 5E 5 Function Electric Manipulator ARM (Joystick USB Surface Controller)



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**1. UP DATE CHART**

ISSUE	SUBJECT	ORIGINATOR	VERIFICATION	APPROVAL
Draft A	Draft Issue	KD	MR	BJ
Issue A	Original Issue	KD	MR	BJ

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## 2. Introduction

This Equipment has been made in compliance with CE marking Standards.

This manual is written for suitably qualified personnel responsible for operation and maintenance of this equipment. Operating and maintaining must be done according to appropriate general rules.

Non appropriate or defective use may lead to an irreversible failure of components or the equipment. If any failure occurs, the user must check that the device is safe for its environment.

Before every operation, the operator must check that the system is correctly configured in accordance with this manual.

**CAUTION: REPAIRING THE EQUIPMENT WHILE SWITCHED ON IS RESERVED TO QUALIFIED TECHNICIANS**

## 3. Specification

SLEW	120 DEGREES
ELEVATE	90 DEGREES
ELBOW	132 DEGREES
JAW ROTATE	CONTINUOUS
JAW OPENING	125mm at the tips
REACH	640mm (from the Slew pivot)
LIFT	10Kg at 0.5 Amps at full extension
JAW ROTATE TORQUE	>10Nm at 2 Amps
JAW CLOSING FORCE	>50Kg at 2 Amps
JAW ROTATE SPEED	~ 60 RPM at 24vdc
WEIGHT	2.75Kg Total mass in fresh water 2.2Kg Mobile mass in fresh water 10.95Kg in air
SUPPLY	24 - 30vdc 240vac
DEPTH	300 METRES

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## 4. Description

### 4.1 System Components

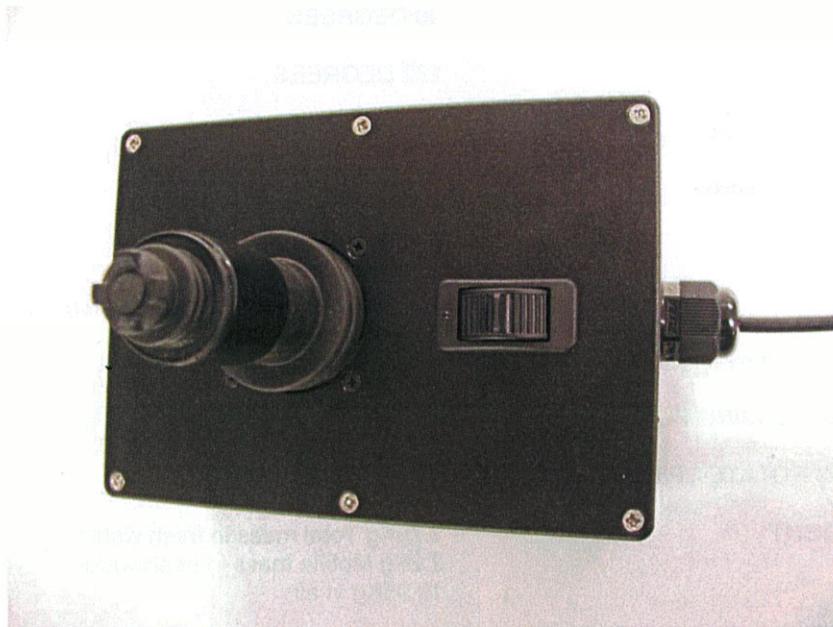
The five function Micro 5E Electric Arm consists of four major components, these are:-

- a) Surface Control Unit.
- b) SubSea Electronics Housing.
- c) The Manipulator Arm.
- d) Computer

### 4.2 Surface Electronics

The Arm can either be controlled by the Joystick USB Surface Controller or by the Laptop computer. The Joystick USB Surface Controller is powered only when plugged into the USB port of the Laptop Computer.

The Surface Control Unit illustrated below is the typical standard version. Custom designs can be supplied to suit customer requirements where size or configuration needs to be changed to suit the installation.



**Photo 1**  
**(Joystick USB Surface Controller)**



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The Manipulator arm is controlled via the Joystick, the Joystick Toggle and the Jaw Grip / Cutter switch (Positioned above the Joystick). The following movements of the Manipulator Arm in relation to the Surface Control Unit demands will occur and are proportional to the level of demand by the operator.



**Photo 2**  
**(Joystick and Jaw controls)**

#### **4.2.1 Demands**

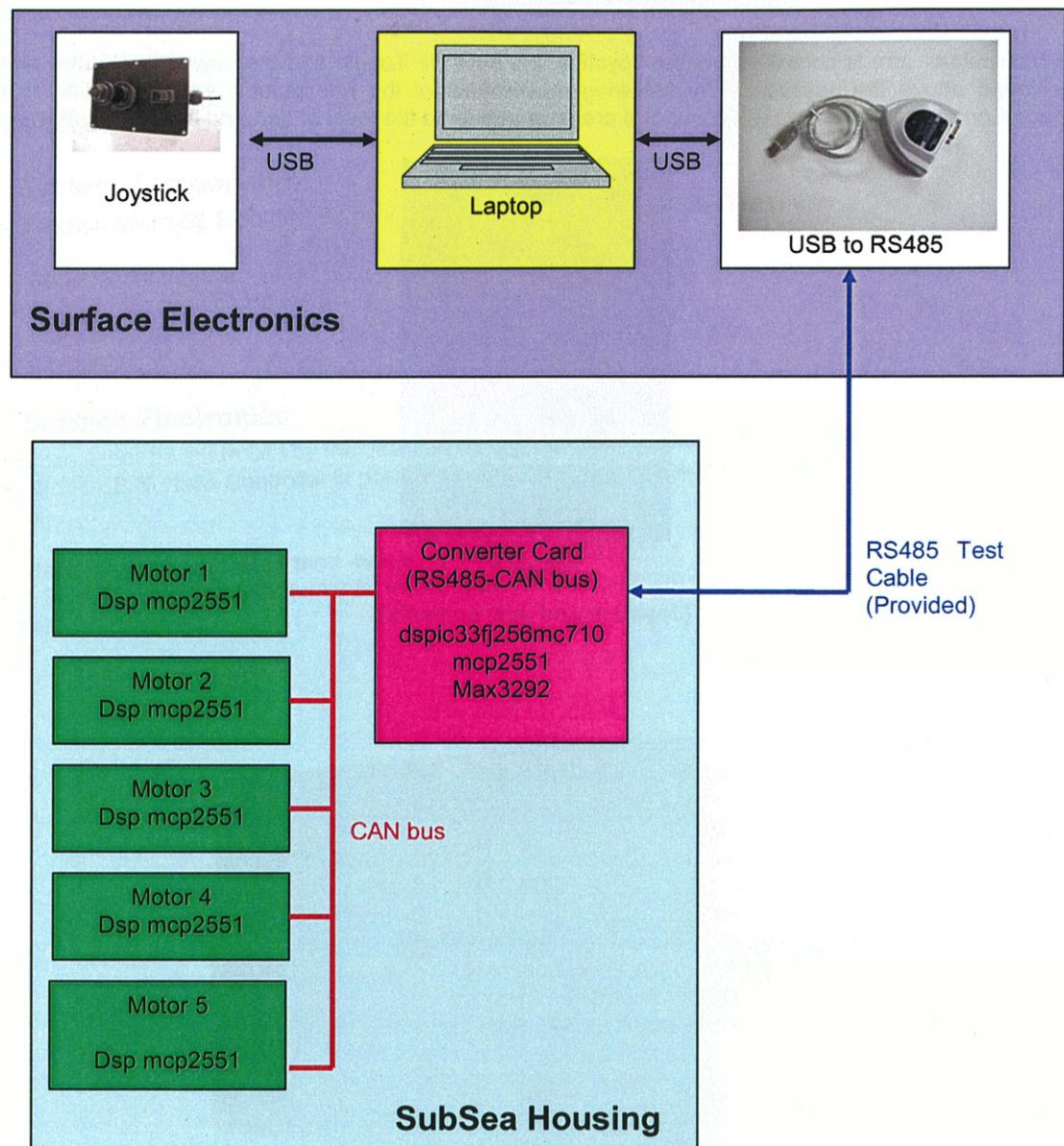
- Joystick pulled back (towards the operator) - Shoulder up.
- Joystick pushed forward (away from the operator) - Shoulder down.
- Joystick moved to the left - Slew left.
- Joystick moved to the right - Slew right.
- Toggle depressed back - Elbow up.
- Toggle depressed forward – Elbow down.
- Toggle depressed left – Jaw rotates to the left (counterclockwise).
- Toggle depressed right - Jaw rotates to the right (clockwise).
- Jaw Grip / Cutter pushed away from the operator – Jaws open.
- Jaw Grip / Cutter pulled towards the operator – Jaws close.

#### **4.2.1 Computer Controller**

The Computer supplied with this system has the following Key features:-

- Intel Core 2 Duo processor
- 1.6Ghz, 2Mb Cashe
- Windows 7 operating system
- 2GB Memory
- 160GB Hard Drive
- 32 Bit

The Control System used within this Laptop for driving the Arm and programming the control parameters are contained within Appendix A2.



DSP = Digital signal processor, used as main processor in Motor driver and converter card.  
 MCP2551 = CAN bus transceiver used in conjunction with DSP above  
 MAX3292 = RS485 transceiver used in conjunction with DSP above



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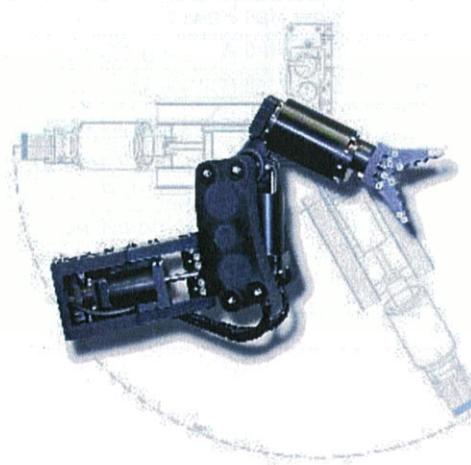
#### 4.3 SubSea Housing

This contains the Convertor Card (RS485 – CAN bus) and the five Motor Driver boards within a waterproof housing that are essential for the operation of the arm. Failure of the integrity of this Housing will render the system inoperative and probably cause irreparable damage. Connections are made through the seven Sub-Con type underwater matable connectors, the connector function and pin connections are shown in Section 5, Electrical Connections.



#### 4.4 Manipulator Arm

The manipulator supplied is the versatile 5 function version, and although it is tolerant to every day use care should be exercised with regard to the cables. The mounting arrangements for this Arm can be found at the rear of the manual



(Manipulator Arm)

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## 5. Electrical Connections

**5.1** Electrical connections are made to the SubSea Housing via Sub-Con type connectors for each of the arm functions, power and communications. These have been orientated and identified so that the possibility of incorrect connection has been reduced.

### 5.1.1 PL1 8 way Power and Communications

PIN	FUNCTION
1	24 Volt
2	24 Volt
3	0 Volt
4	0 Volt
5	RS485 L
6	RS485 H
7	RS485 Screen
8	Not defined

### 5.1.2 SKT1 8 way Slew

PIN	FUNCTION
1	Slew Phase A
2	Slew Phase B
3	Slew Phase C
4	Slew Hall Power
5	Slew Hall A
6	Slew Hall B
7	Slew Hall C
8	Slew Hall Ground



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#### SKT2 8 way Elbow

PIN	FUNCTION
1	Elbow Phase A
2	Elbow Phase B
3	Elbow Phase C
4	Elbow Hall Power
5	Elbow Hall A
6	Elbow Hall B
7	Elbow Hall C
8	Elbow Hall Ground

#### 5.1.3 SKT3 8 way Jaw Rotate

PIN	FUNCTION
1	Jaw Rotate Phase A
2	Jaw Rotate Phase B
3	Jaw Rotate Phase C
4	Jaw Rotate Hall Power
5	Jaw Rotate Hall A
6	Jaw Rotate Hall B
7	Jaw Rotate Hall C
8	Jaw Rotate Hall Ground

#### 5.1.4 SKT4 8 way Jaw Close

PIN	FUNCTION
1	Jaw Rotate Phase A
2	Jaw Rotate Phase B
3	Jaw Rotate Phase C
4	Jaw Rotate Hall Power
5	Jaw Rotate Hall A
6	Jaw Rotate Hall B
7	Jaw Rotate Hall C
8	Jaw Rotate Hall Ground

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### 5.1.5 SKT5 8 way Shoulder

PIN	FUNCTION
1	Shoulder Phase A
2	Shoulder Phase B
3	Shoulder Phase C
4	Shoulder Hall Power
5	Shoulder Hall A
6	Shoulder Hall B
7	Shoulder Hall C
8	Shoulder Hall Ground

The colour coding for each of the actuators follows a common theme and are as follows:-

FUNCTION	COLOUR
Phase A	Green
Phase B	Red
Phase C	Black
Hall Power	Yellow
Hall A	Blue
Hall B	Orange
Hall C	Brown
Hall Ground	White

## 5.2 Surface Electronics

Electrical connections from the Joystick USB Surface Controller to the computer are made via its own USB cable. The drivers for this require to be set up from the Start menu via the Control Panel – Games controllers. Connection of the laptop to the customer supplied underwater umbilical is made from the USB to RS 485 interface cable. The software for this has been supplied on the USB pen; Moxa USB serial Converter.



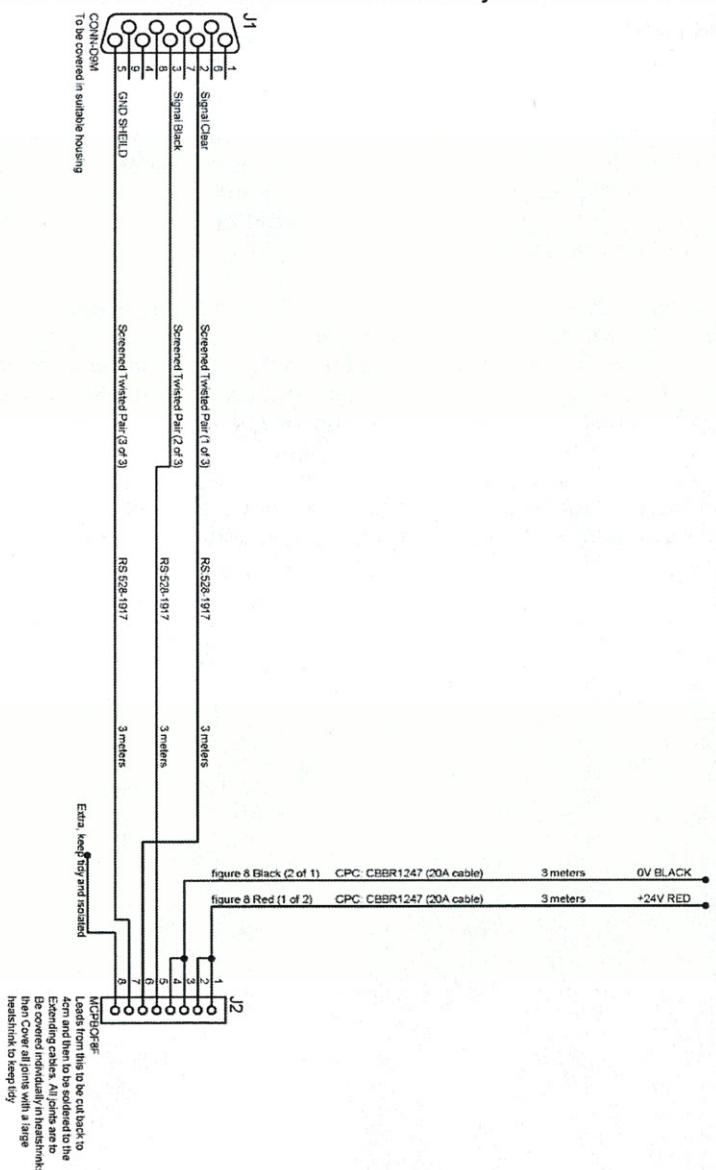
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## 6. Operating Procedure

### 6.1 Electrical Connection (Test)

Connect the Arm to the SubSea housing as detailed in section 5.1 above. Connect the Power / Communications test cable (As supplied) to the SubSea housing. Connect a suitable 24Vdc supply to the Red (positive) and Black (negative) cables. A DC supply that is able to supply 10amps will be sufficient to operate all of the Arms functions simultaneously. A schematic of the test cable is shown below.



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## 6.2 General Safety

Before applying power to the system, ensure that all personnel and equipments are clear from the working parameters of the Arm. Ensure that when the Arm is in operation, all persons are not physically close to the moving Arm as serious injury may occur.

## 6.3 Operation

Detailed operation functions of the Joystick USB Surface Controller are set out in Para 4.2.1. For detailed computer operation please see Appendix A1.

# 7. Assembly and Maintenance

## 7.1 General Caution

The Micro 5E Electric Arm has been designed for ease of maintenance by a competent engineer. The information contained in the sections below are for the individual assemblies i.e. Shoulder, Elbow, Slew actuators and the Jaw Unit. When dis-assembling the units care must be taken with sub-assemblies such as the Ballscrews, it is recommended that if possible the Actuator be retracted to its minimum length to avoid the Nut from becoming unwound from the Ballscrew.

After each use, wash the Arm with fresh water liberally and dry if possible. Check for tightness of fixtures and fittings adjusting if necessary. Check for galvanic corrosion of the arm, the first signs of which may appear upon sharp edges or corners. Touch up any scratches, marks or damage with black enamel paint as required, then spray with a water dispersant e.g. WD40. Finally check the condition of any anodes if fitted and replace if required. It is recommended that Magnesium anodes are used in fresh water, and Zinc Anodes used in Salt water.

If water ingress into the compensation system has taken place, all units must be cleaned and checked. Absolute cleanliness is paramount when disassembling / reassembling the actuators.



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## 7.2 ACTUATOR ASSEMBLY CONSUMABLES

Several typical items are used to assemble the manipulator. These are:-

- Molykote Solvent Metal Cleaner
- Loctite 222 Threadlocker
- Molykote 33 Medium Silicone grease ('O' Rings)
- Loctite 275 Threadlocker
- Rocol Sapphire Aqua 2 (Underwater grease for nuts bolts etc)
- Loctite 542 Thread Sealant
- WD40 water dispersant
- Loctite 401 SuperGlue (Not shown)
- Barium Chromate jointing compound (Not shown)

As shown below.





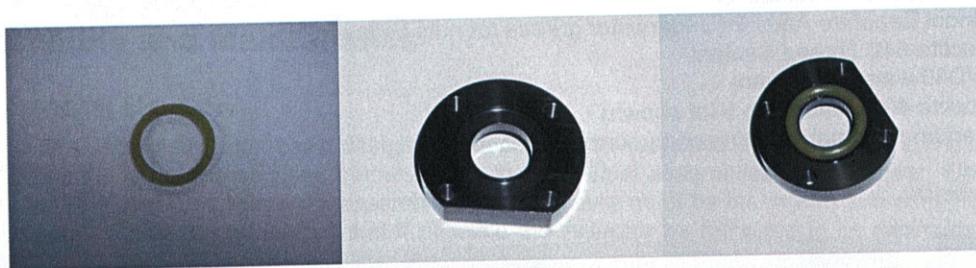
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### 7.3 SLEW, SHOULDER & ELBOW ACTUATOR ASSEMBLIES

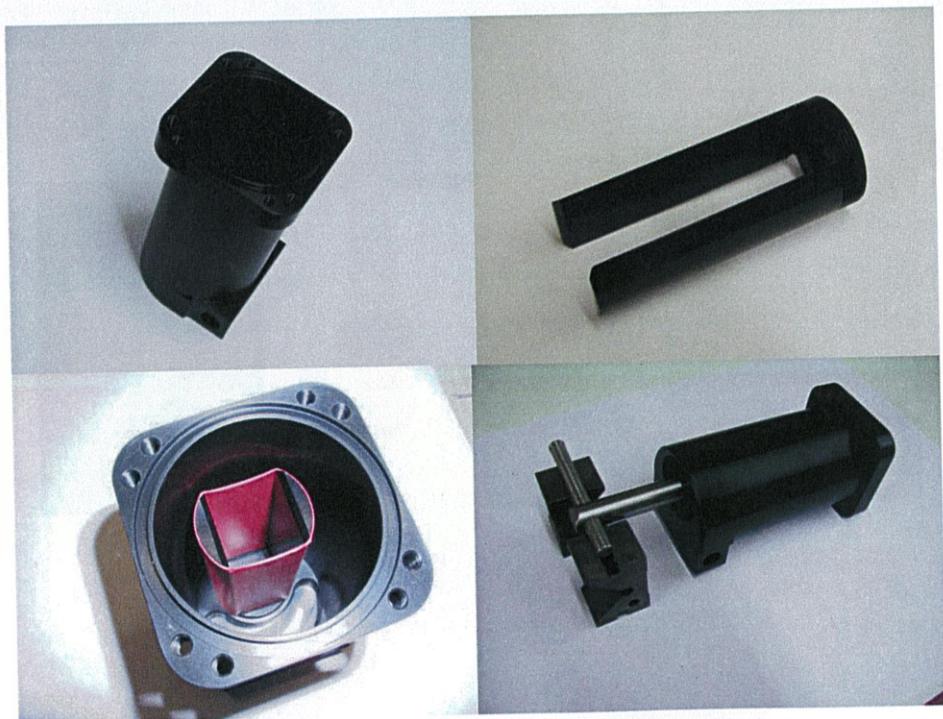
#### 7.3.1 Bearing Retainer

Assemble the polyurethane 'O' Ring into the recess of the Bearing Retainer using Loctite 401 Superglue after increasing the surface roughness of the side to be glued with abrasive paper and then cleaning thoroughly with a Solvent Cleaner.



#### 7.3.2 Actuator Housing

The Actuator Housing and the Guide Insert are manufactured in such a way that no serviceable parts are within.



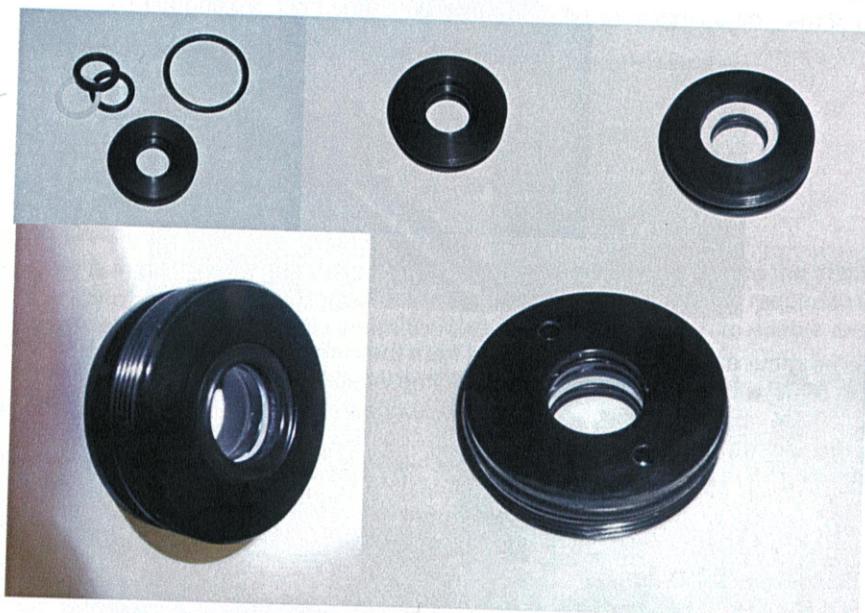


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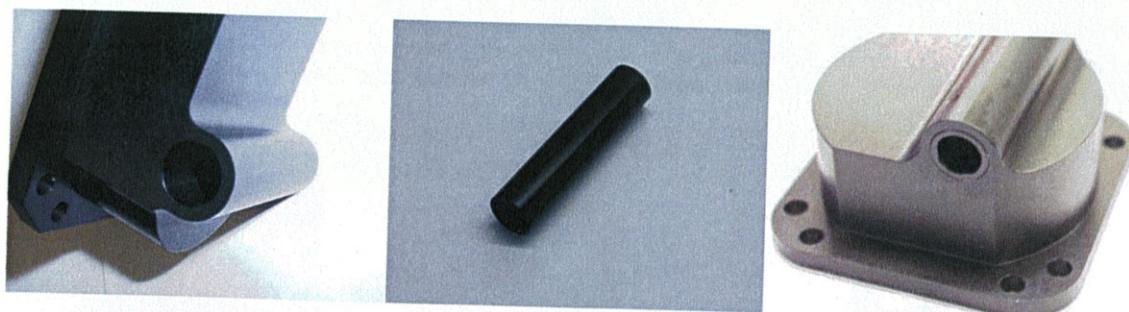
### 7.3.3 Seal Insert

With a small amount Silicone grease, grease the outer Quad Ring and assemble. Lightly grease with Silicone grease the PTFE backup ring and press gently into the Seal Insert, followed by the Quad ring after also being greased. Finally with a small amount Silicone grease, grease the outer 'O' Ring and assemble to the outer 'O' Ring groove of the Seal Insert.



### 7.3.4 Gear Housing

Clean thoroughly with a Solvent Cleaner the area of the Gear Housing where the Pivot Bush is to be fitted and the Pivot Bush. Then assemble using Loctite 275. Ensure that the Pivot Bush is aligned correctly with the outer edges of the Gear Housing. If there is a requirement to remove this Pivot Bush from the Gear Housing, gentle heating will be required using a hot air gun to degrade the Loctite 275 to aid removal. The Pivot Bush still may require pressing out.





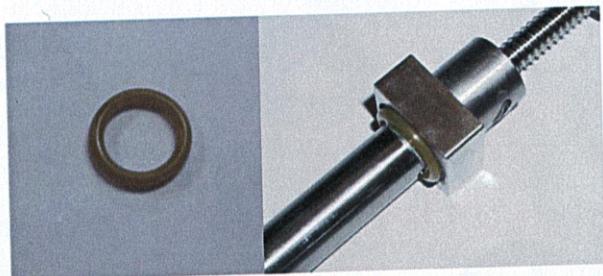
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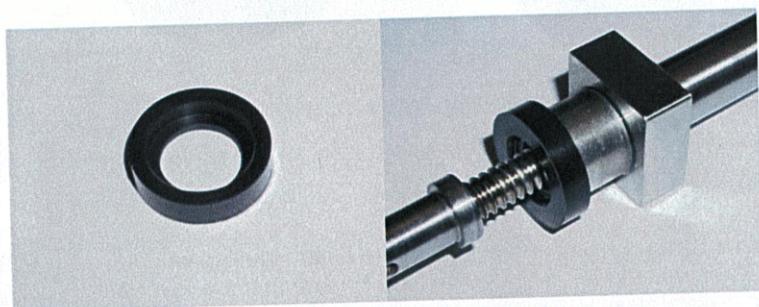
### 7.3.5 Rod & Ballscrew

Assemble the polyurethane 'O' Ring into the recess of the Rod using Loctite 401 Superglue after increasing the surface roughness of the side to be glued with abrasive paper and cleaning thoroughly with a Solvent Cleaner.

Clean the inside of the Rod as this may still have residual debris from prolonged use.



There should be no requirement to remove the Nut from the Ballscrew under normal routine maintenance. If it is required to remove the nut to replace the end stop Acetal, the Nut must be removed and refitted to the Ball Screw. Advice should be sought from the factory as removal of the nut will result in the internal balls becoming dislodged.



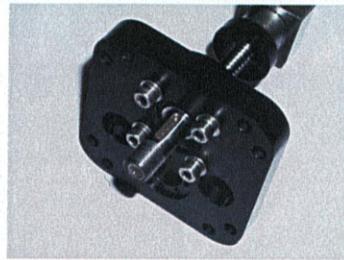
### 7.3.6 Bearing Housing Assembly

Insert the Bearing into the bearing housing and slide the Bearing retainer up to the Bearing Housing. Then secure using four off Socket Head Cap Screws, Spring washers and Plain washers as shown.



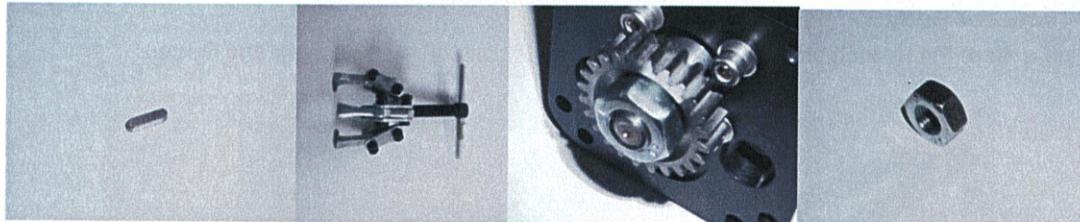
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Assemble the Ballscrew and Rod into the Bearing Housing ensuring that the 3mm Key is in place before pushing the gear over the shaft. .



### 7.3.7 Motor and Gears

Ensure that the Key is in position on the Ballscrew Shaft, then push the Gear onto the shaft. If this is to be removed at a later date, a small three legged puller (as shown below) may be required. If the gear is to tight to push onto the shaft by hand, gently warm the Gear using a hot air gun to enable easy assembly.



After cleaning the thread of the Ballscrew thoroughly with Solvent Cleaner, using a small amount of Loctite 275 assemble the Nut onto the shaft and tighten. Note that the nut has a thread pitch of 1.25mm which is unlike a normal M10 nut.

Assemble the Motor and Gearbox into the Bearing Housing and secure using eight off Socket Head Cap Screws and Spring washers, no plain washers are used in this location.

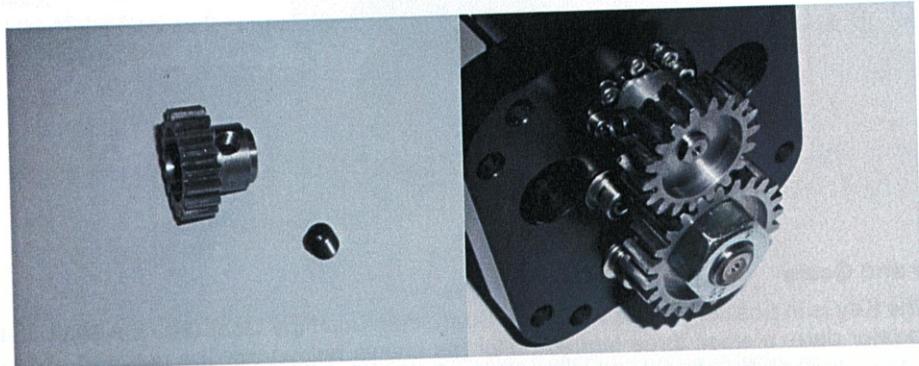




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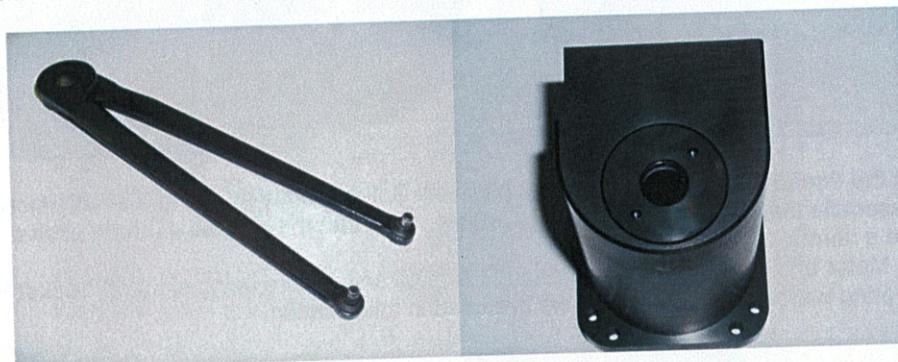
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After cleaning the Gear and its M5 tapped hole thoroughly with a Solvent Cleaner, using a small amount of Loctite 275 assemble the Socket Head Set Screw into the Gear. The Gearbox output shaft has a machined flat which the Socket Head Set Screw locate. Tighten, locking the Gear in a position with the gears aligned correctly.



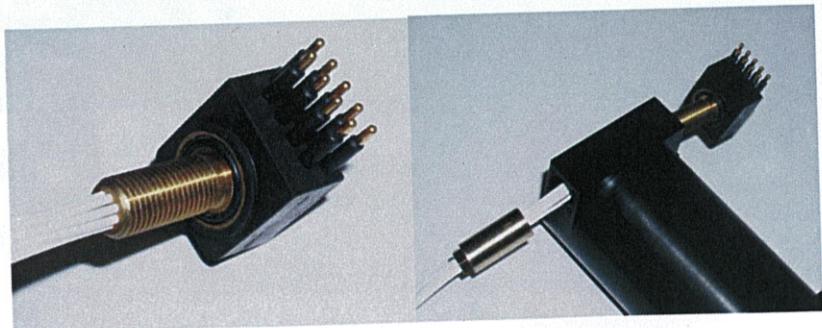
### 7.3.8 Actuator Body

Utilising a 4mm Pin wrench, screw in the Seal Insert into the Actuator Housing and tighten.



### 7.3.9 Motor wiring and Connector

Using a small amount of Silicone grease, coat the 'O' and position on the connector as shown in the photo below. Thread the connector wires through the Actuator housing and thread the Tube nut over them and tighten with a 10mm tube spanner.





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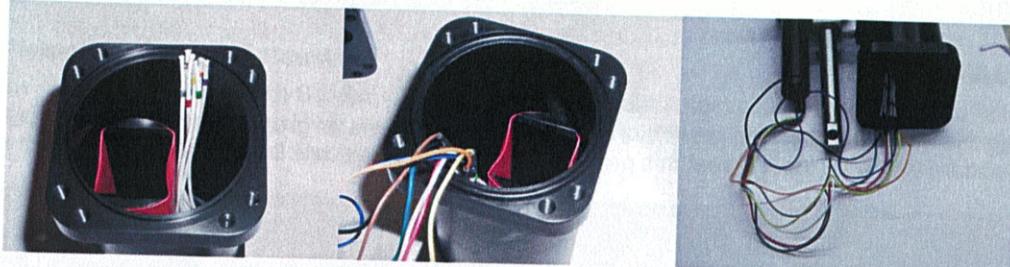
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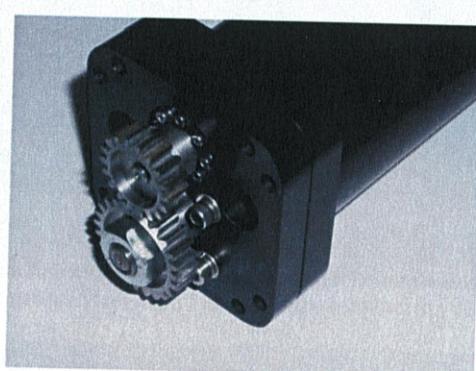
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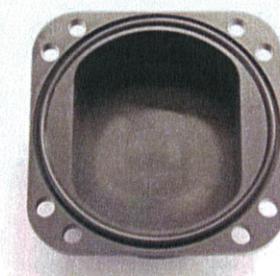
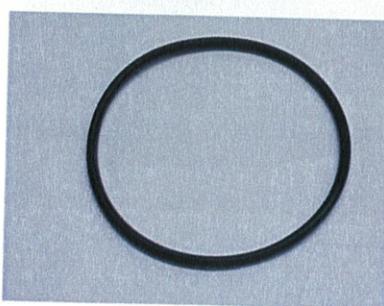
Make the electrical connections between the Motor and the Connector as detailed in Section 5, Electrical Connections. Ensure that the 'O' ring has been greased with a small amount of Silicone grease beforehand and that it is in position.

### 7.3.10 Actuator Assembly

Assemble the Motor and Gearbox assembly into the Actuator Housing, taking care not to trap the wires.



Ensure that the 'O' ring has been greased with a small amount of Silicone grease and that it is in position. Secure the End Cap to the rest of the Assembly using the 8 off Socket Head Cap Screws, Plain and Spring Washers.



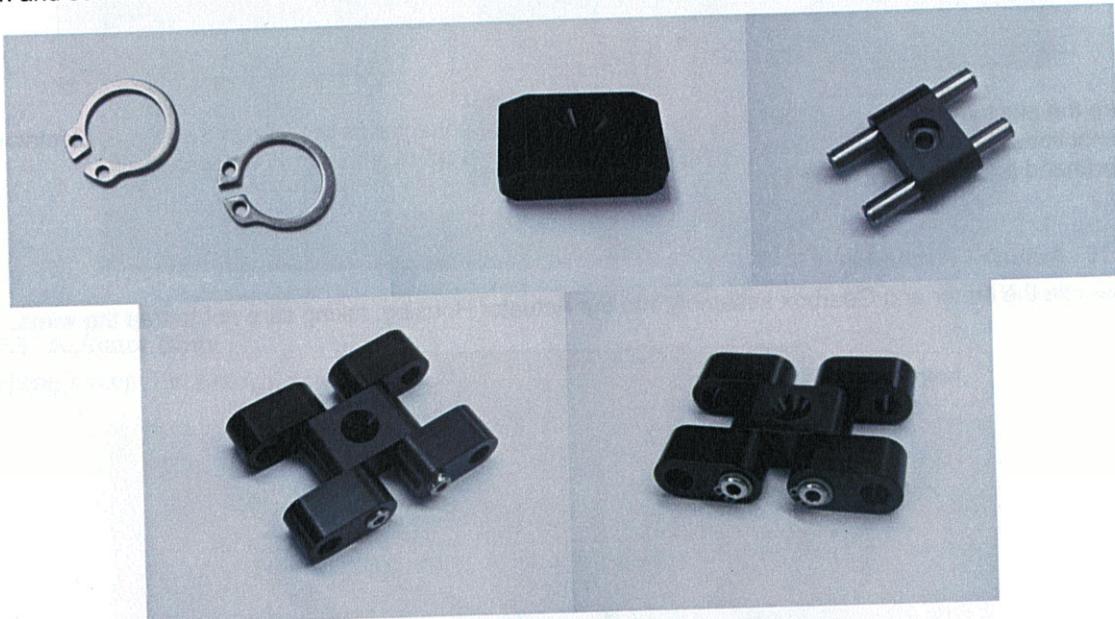


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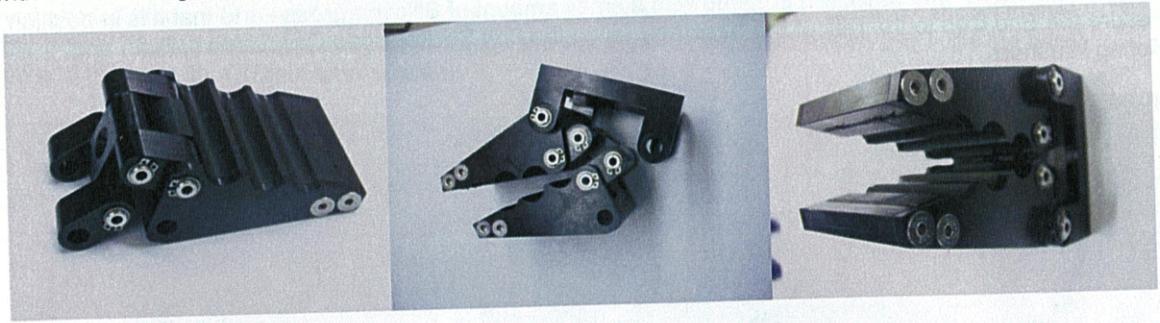
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#### 7.4 JAW ASSEMBLY

Assemble the Jaw Pins (Link) to the Piston Rod End with underwater grease. Slide a Jaw Link over the Pin and secure with a Circlip. Repeat this process for the other three Jaw links as shown below.



Assemble a Jaw Pin (Jaw to Link) with a Circlip and then grease with underwater grease, then assemble the Jaw Link to the Jaw Block and secure these with a Circlip. Repeat this process for the second Jaw Block. Assemble the Jaw Blocks to the Jaw Support Plate using the Jaw Pins (Pivot Pin) after greasing Block. Assemble the Jaw Blocks to the Jaw Support Plate using the Jaw Pins (Pivot Pin) after greasing Block and secure these with Circlips



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## 7.5 JAW ROTATE AND OPEN/CLOSE

### 7.5.1 Piston Rod and Drive Housing

Clean the Cage and the Nut with Solvent Cleaner paying particular attention to the four tapped holes. Assemble the Bearing and Thrust washer onto the Piston Rod and then push through into the Cage, then position the second Bearing and Thrust Washer.



Push the Nut into the Cage noting that there is a small 'centre pop' mark to align the Nut and the Cage to the correct orientation. This is critical as the tapped holes have been manufactured in such a way so as to allow the Guide Pins to screw through the Cage into the Nut, locking the Nut into the correct position.

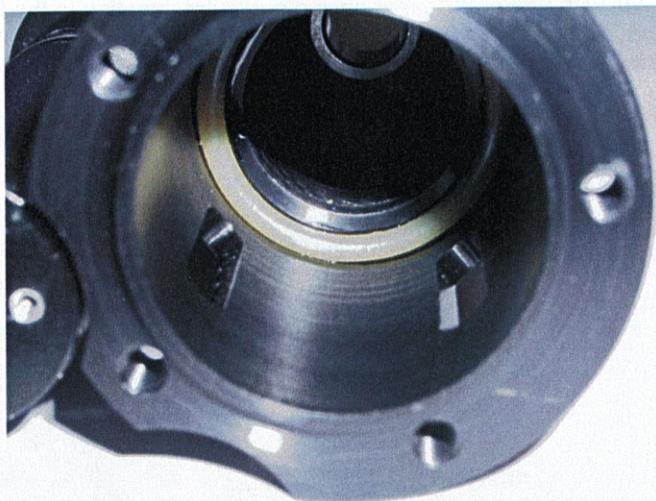




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Assemble the polyurethane 'O' Ring into the recess of the Drive Housing using Loctite 401 Super glue after increasing the surface roughness of the side to be glued with abrasive paper and cleaning thoroughly with a Solvent Cleaner.



Clean the Ball Screw with Solvent Cleaner, then Assemble into the Cage Nut taking care not to dislodge any of the ball bearings. Assemble the Piston Rod, nut and Cage assembly to the Cage Nut with Loctite 275 after cleaning with Solvent Cleaner.



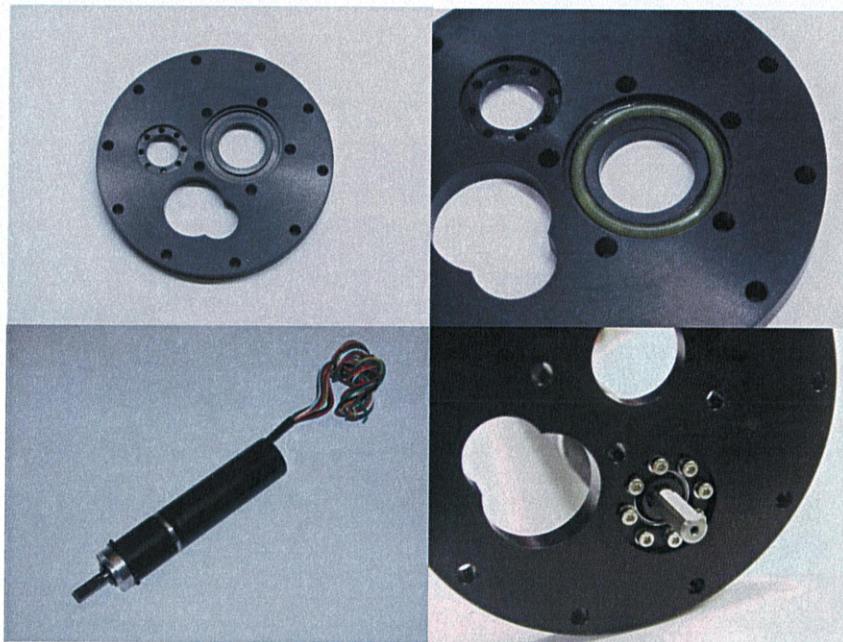


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### 7.5.2 Motor Mounting Plate

Clean the Motor Mounting plate with Solvent Cleaner. Assemble the polyurethane 'O' Ring into the end stop recess using Loctite 401 Superglue, after increasing the surface roughness of the side to be glued with abrasive paper and cleaning thoroughly with a Solvent Cleaner. Then bolt the Jaw Rotate Motor and Gearbox assembly to the Motor Mounting plate with 8off M2 x 8mm Socket Head Cap Screws, plain washers and spring washers.



Assemble the Motor Adaptor Plate to the Jaw Close Motor and Gearbox assembly with 8off M2 x 8mm Socket Head Cap Screws, plain washers and spring washers.





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Insert the Bearing into the Drive Housing and assemble the Motor Plate to the Drive housing using 4off Socket Head Cap Screws, plain washers and spring washers. The Motor Plate will retain the Bearing within the Drive Housing.





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Insert the Ballscrew and Piston Rod assembly into the Drive Housing. After cleaning the Guide pins with Solvent Cleaner, lightly screw them in and check for the smooth operation of the unit. If the unit functions correctly, remove the four Guide Pins and remove the Ballscrew and Piston Rod assembly. Clean the Ballscrew thread and the Nut with a solvent cleaner. Also clean the Four Guide Pins and their threads ready for reassembly.



Re-assemble the unit but using a small amount of Locktite 275 on the Four Guide Pins.

**Caution Note** Extreme caution to prevent surplus Locktite 275 gaining access to sliding parts and surfaces

With these in place assemble the Gear and Key to the shaft of the Ballscrew after cleaning with Solvent Cleaner, fit with Loctite 275 the Ballscrew Nut and tighten.



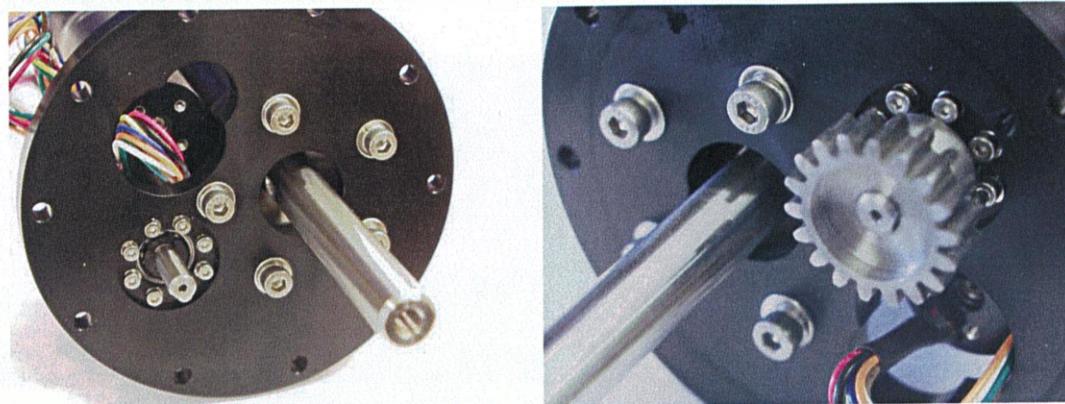
Once this nut has been tightened, check that the unit still operates smoothly then fit the Spur Gear to the shaft of the Motor using Loctite 275 after cleaning with Solvent Cleaner and tighten the Set Screw.



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Assemble the Motor Mounting Plate to the Drive Housing using 5 off Socket Head Cap Screws, plain washers and spring washers. Fit the Spur Gear to the shaft of the Motor using Loctite 275 after cleaning with Solvent Cleaner and tighten the Set Screw.



### 7.5.3 Universal Jaw Mount

Using a suitable blunteden tool, carefully push in the Wyclip outer scraper into the Universal Jaw Mount front face. Then Insert the two Quad Rings into the internal Quad Ring Grooves after greasing lightly with a small amount of Silicone grease.



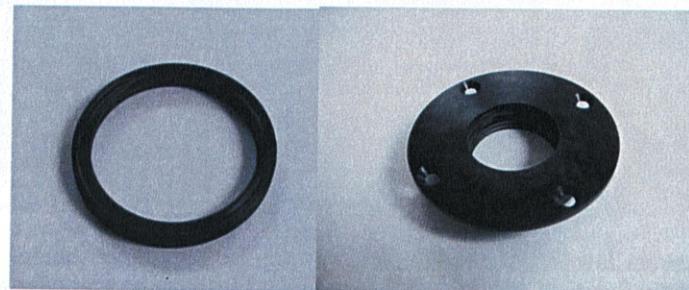


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#### 7.5.4 Bearing Housing

With a small amount of Silicone grease, grease the Seal Plate Quad Ring and assemble to the groove of the Seal Plate bore.



With a small amount of Silicone grease, grease the Composite Rotary Seal and assemble to the inner recess of the Seal Plate as shown below. Then also after lightly greasing with Silicone grease fit the outer 'O' ring to the Seal Plate.



Insert the outer Bearing into the Bearing Housing then place the Seal Plate Washer on top.

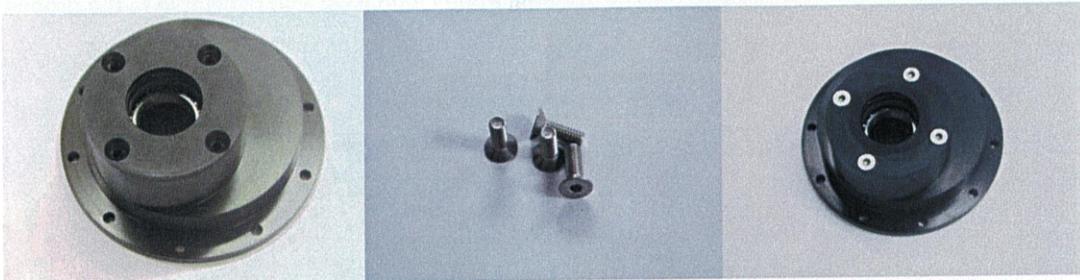




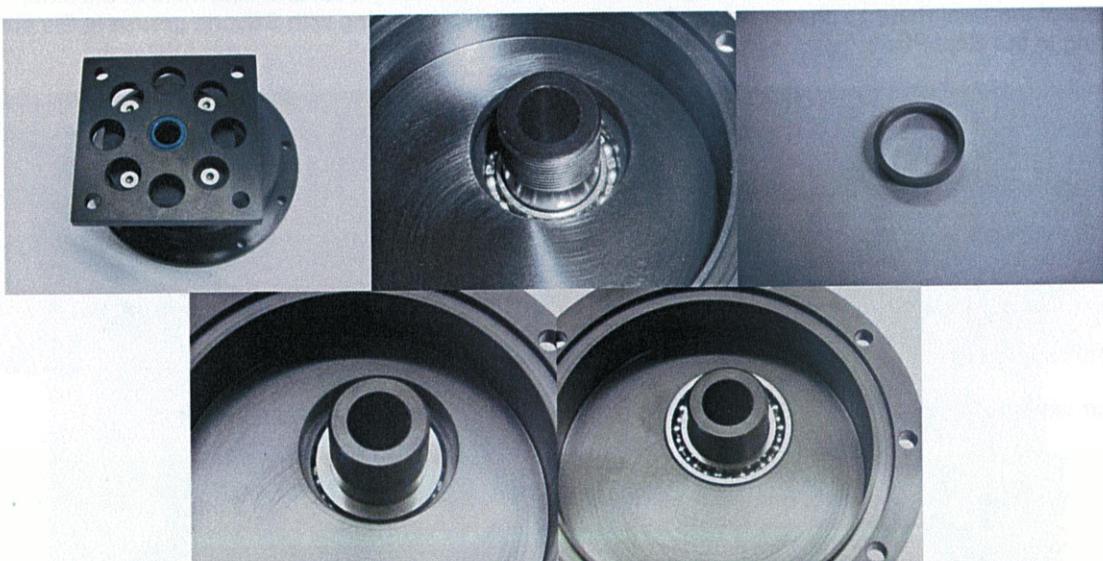
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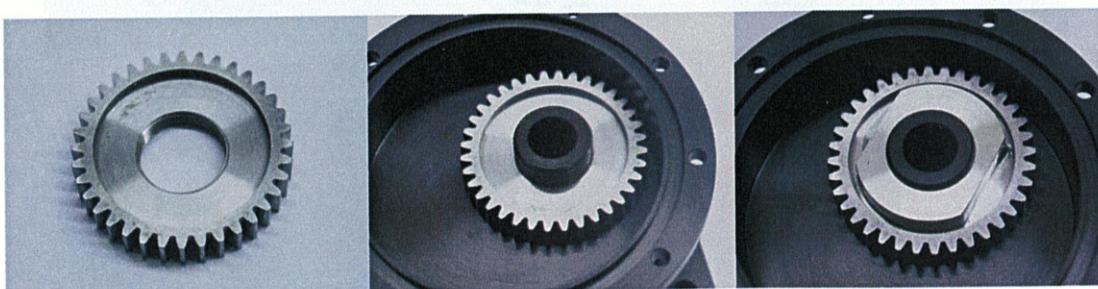
Fit the Seal Plate to the Bearing Housing and fix with the four Socket Head Countersunk Screws shown after coating with Barium Chromate jointing compound.



Carefully push the Universal Jaw Mount through the Seal Plate until it is fully seated. Clean the Universal Jaw Mount stub with a little Solvent Cleaner and then place the Bearing spacer over the Universal Jaw Mount spindle followed by the second Bearing.



Clean the Gear and its Locking ring with a Solvent Cleaner ensuring that all traces of grease are removed from the threads. Using a small amount of Loctite 275 assemble the Gear and Locking Ring and tighten.



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#### 7.5.5 Jaw to Bearing Housing Assembly

Carefully align the Bearing Housing with the Piston Rod and that the Gears are going to mesh as the two are gently pushed together. Do not push fully together as a spanner may be required to be inserted onto the flats of the Piston Rod to enable the Socket Head Countersunk Screw that holds the Piston Rod End to the Piston Rod to be tightened.



With a small amount of Silicone grease, grease the Housing 'O' ring and fit to the Housing 'O' ring groove. Carefully slide the Housing over the assembly and fix using the Socket Head Cap Screws with Plain and Spring washers shown below after being coated with Barium Chromate jointing compound.





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Fit the two Connectors to the Elbow Endcap using the 7/16<sup>th</sup> nuts. Ensure that the 'O' ring has been lightly grease with a small amount of Silicone Grease prior to assembly. A small length of heatshrink sleeving is used to bundle the wires together and to glue them to the Elbow Endcap.

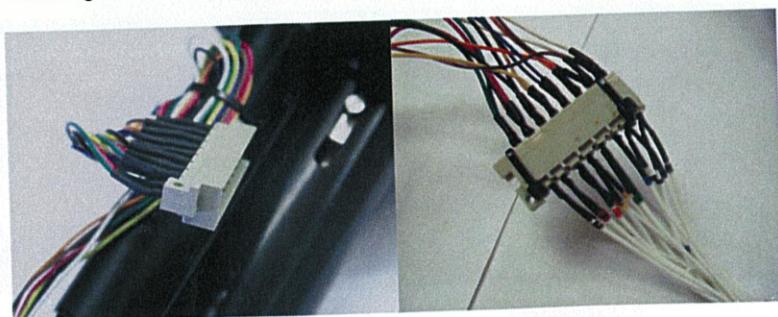


#### 7.5.6 Motor wiring and Connectors

The wiring connections of the Jaw Close and the Jaw Rotate Motors are set out in the table below. The wiring protocol can be found in Section 5

16 way internal Plug	Jaw Close 8 way (a)	Jaw Rotate 8 way (c)
Pin 1	1	
Pin 2		1
Pin 3	2	
Pin 4		2
Pin 5	3	
Pin 6		3
Pin 7	4	
Pin 8		4
Pin 9	5	
Pin 10		5
Pin 11	6	
Pin 12		6
Pin 13	7	
Pin 14		7
Pin 15	8	
Pin 16		8

The two halves of the connectors are held together by a small cable tie. This connector is the carefully pushed inside the housing ensuring that it will not become entangled within the gears.

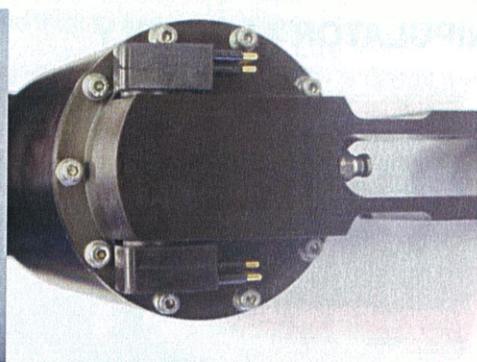




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Using the Socket Head Cap Screws with Plain and Spring washers shown below, coated with Barium Chromate jointing compound assemble the Elbow End Cap to the Body.





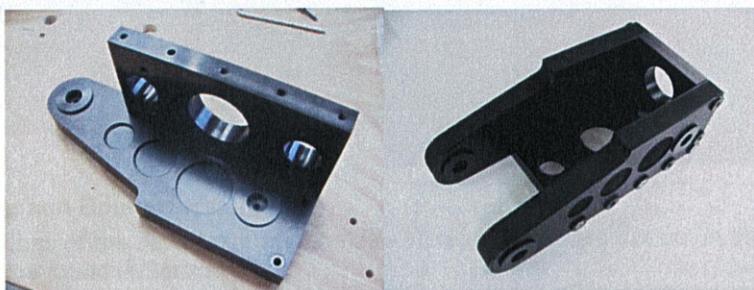
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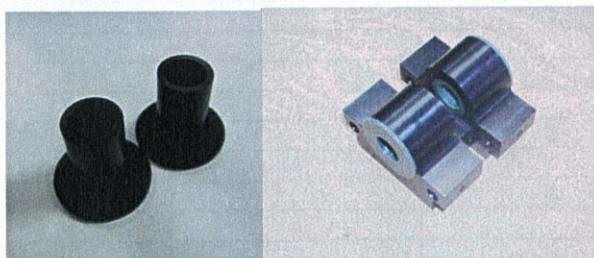
## 8. MANIPULATOR ASSEMBLY

**NOTE** Where possible, assemble non-moving parts with Barium Chromate jointing compound, taking into consideration that certain moving items require to be greased.

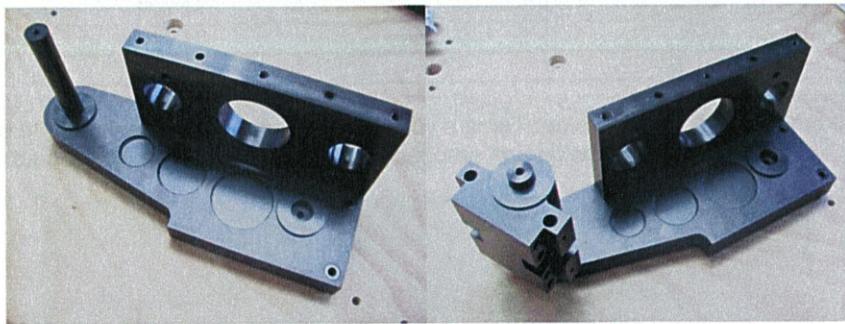
Assemble the Lower Shoulder Plates to the Spacer Block using the three Socket Head Countersunk Screws. Ensure that these are coated with underwater grease when assembled.



After lightly greasing with underwater grease, assemble the two Slew Bushes into the Slew Block



After lightly greasing the Slew Pin with underwater grease, assemble to the Lower Shoulder Plate using the Socket Head Cap Screw, Plain and Spring washer. Then assemble the Slew Block on to the Pin.

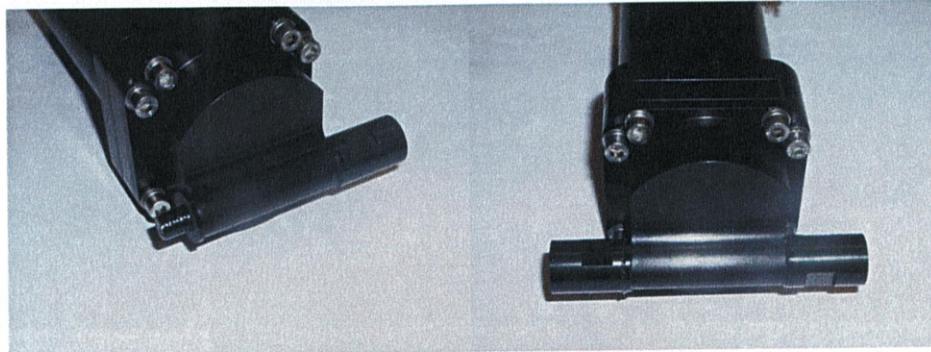




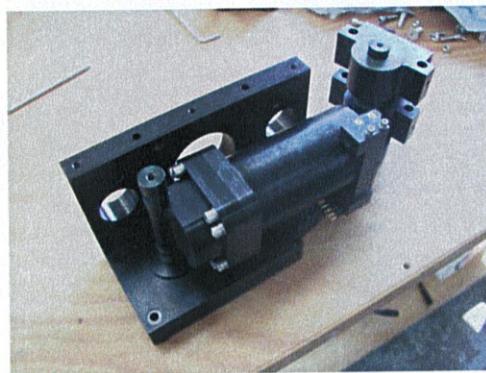
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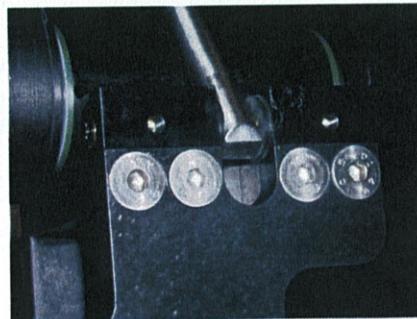
Grease with underwater grease the Actuator Pin. Assemble these to the Slew Actuator along with the two Acetal washers. Tighten the Actuator Pin taking care not to damage the Anodising. Ensure the Actuator Pin still rotates and that the Acetal washers are not too thick to prevent rotation.



Carefully position the Slew Actuator on the Lower Shoulder plate and then assemble the Upper Shoulder Plate to the Spacer Block using the three Socket Head Countersunk Screws. Tighten the assembly and check for correct operation. (Actuator not pinched between the plates and little sideways movement).



Grease the Slew Pin (Actuator Rod) with underwater grease, and assemble the Slew Pin (Actuator Rod), Acetal Washers, Slew Actuator Rod and the Slew Bracket together as shown below. Coat the Socket Head Set Screws with Barium Chromate jointing compound, and insert and tighten onto the Slew Pin (Actuator Rod) locating this in place.





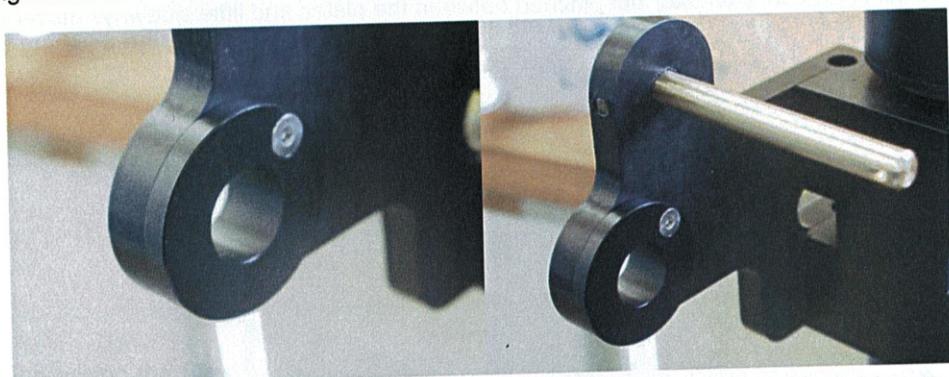
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Assemble the Right hand Slew Plate to the Slew Block with the Countersunk Head Cap Screws as shown below after coating with Barium Chromate jointing compound.



Grease the Shoulder Pin with underwater grease, and assemble the Shoulder Pin and Acetal Bush with its retaining screw as shown below.



Fit the Shoulder Pivot Pin through the Acetal Bush, then fit the Side Plate with its Socket Head Cap Screw, Plain and Spring Washers.

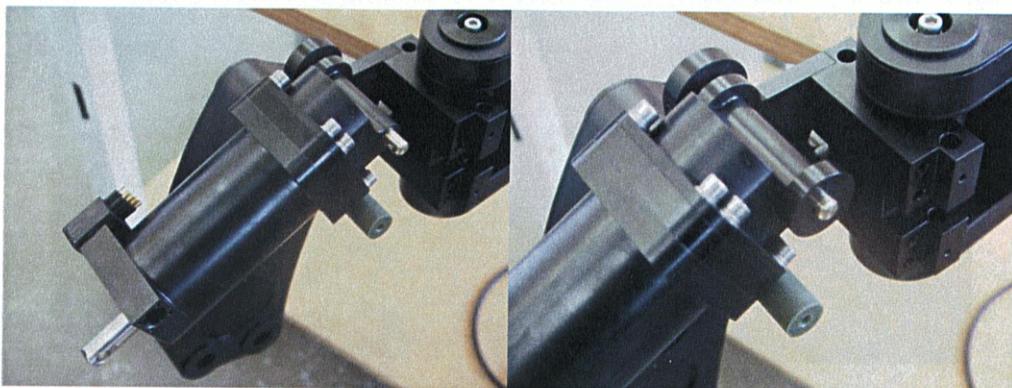




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Grease with underwater grease the Shoulder Pin and fit the Acetal spacer and the shoulder Actuator onto the Pin. Finally fit the other Acetal Spacer.



Grease with underwater grease the end of the Pin Assembly (Shoulder) and fix this to the Plate with a greased Socket Head Cap Screw, Plain and Spring washers. Grease with underwater grease the end of the Pin (Elbow) and fix this to the Plate with a greased Socket Head Cap Screw, Plain and Spring washers.



Grease with underwater grease the Actuator Pin. Assemble these to the Slew Actuator along with the two Acetal washers. Carefully tighten taking care not to damage the Anodising.





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Ensure that the Oilon Spacer has been fitted to the Pin (Elbow) then carefully push the Jaw Rotate and Close Actuator onto the pin, followed by the second Oilon Spacer.



Grease with underwater grease the Actuator Pin. Assemble these to the Slew Actuator along with the two Acetal washers. Tighten the Actuator Pin taking care not to damage the Anodising. Ensure the Actuator Pin still rotates and that the Acetal washers are not too thick to prevent rotation.

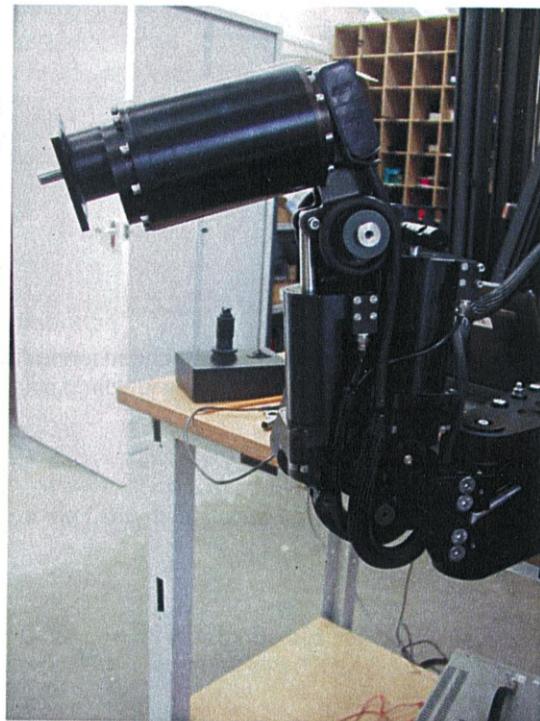


Assemble the Elbow Actuator to the Side Plate using the Socket Head Cap Screw, Spring and Plain Washer. Attach the Elbow Actuator Rod to the Jaw Rotate and Close Pivot using the Pivot Pin, Acetal washers, Socket Head Cap Screws and Washers. Assemble these with underwater grease.



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Fit the cables to each of the functions of the arm. Be aware that the cables are of different lengths, so that each actuator has a specific length cable. The application of a small amount of Silicone grease will aid the assembly when plugging them together. Ensure that the retaining strap is properly in place to secure the cable.



Assemble Right Hand Side Plate with Socket Head Cap Screws Spring and Plain coated with underwater grease.



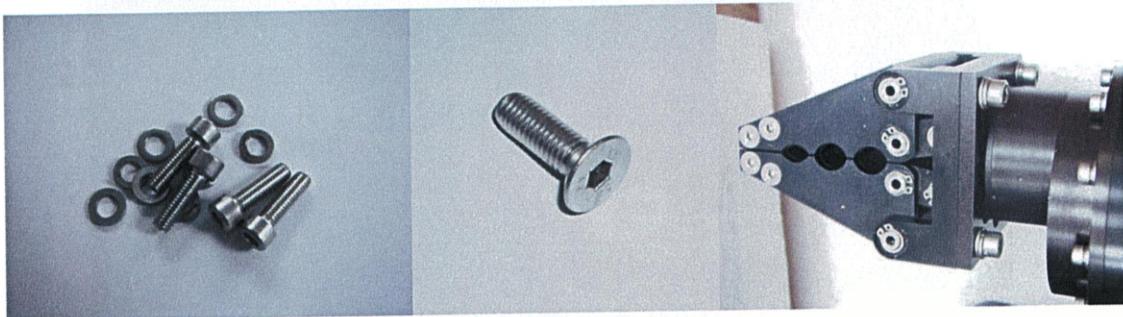


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Using the four Socket Head Cap Screws with Plain and Spring washers shown below, attached the Jaw Support Plate to the Universal Jaw Mount after being coated with Barium Chromate jointing compound. Coat with underwater grease then insert and tighten the centre Socket Head Countersunk screw. If there is difficulty tightening or undoing this screw, refer to Section 7.5.5.



Finally tidy the Actuator cables and secure to the Slew Assembly ensuring that they have sufficient room to flex and move.



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## 9. TROUBLESHOOTING

### 9.1 The Manipulator appears disconnected

- Check that the correct Port is being used.
- Check that the power is present and at the correct level.
- Check that the Communication cable is correctly attached and undamaged.
- Check the Windows Port settings

### 9.2 Software Connectivity

This situation is unusual but can happen when an incorrect port number is selected. See device manager in windows for more information.

### 9.3 Slow Manipulators response

This usually happens when windows is busy, we suggest you uninstall all products not supplied with your windows installation. Please also check task manager to ensure no miscellaneous processes are stealing memory.

### 9.4 COMMUNICATIONS

The following section describes the Comms/software details

- RS485
- 115200 baud rate.
- USB link, appears as COM port on PC, for details see windows device manger (control panel/System/hardware/Device Manager/Ports(COM & LPT)



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## 10 CONTACTS

For Product and Technical Support please contact in the first instance:-

Email :- [info@CSIP.CO.UK](mailto:info@CSIP.CO.UK)

Tel :- +44 (0) 1305 779020

Address :-      CSIP LTD,  
                        4 Granby Court,  
                        Granby Industrial Estate,  
                        Weymouth,  
                        Dorset,  
                        United Kingdom



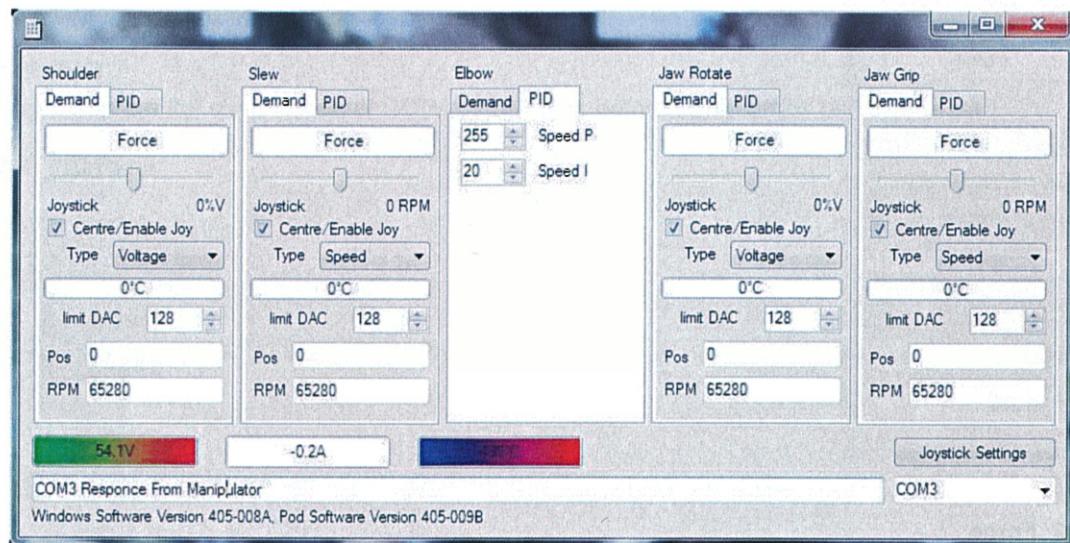
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## A1 Software Details

The software can be split into 4 main sections

- Motor control panel
- Master Feedback
- COMS settings
- Joystick Settings



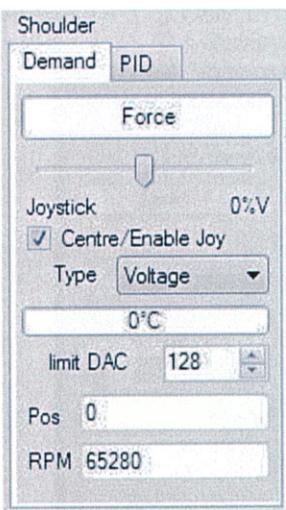
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## A1.1 Motor Control Panel

The motor control panel has 2 pages; Demand and PID.

### A1.1.1 Demand Page

The demand page is the main control page, from this page the operator can see the feedback from the motor driver as well as adjust the controls. The various parts are described below.



### A1.1.2 Force

Force is a display of the power consumed by the motor; it is for indication only and not calibrated to any meaningful units.

### A1.1.3 Joystick bar and centre/enable joy

This functionality allows operation with or without a joystick attached to the PC. The user can use the on screen track bar to command the joint; the on screen track bar always has priority over the handheld joystick. The Centre/Enable Joy makes the Joystick USB Surface Controller active if connected and causes the track bar to always return centre, should you not want the Joystick USB Surface Controller active then disconnect it.

### A1.1.4 Demand Type

In this mode you set the type of demand. Voltage mode sets the average voltage to the motor depending on joystick deflection (desired by human operators). Speed mode sets the Speed in RPM of the motor in a closed loop operation depending on joystick deflection (the end result is dependant on the gearbox ratios).

### A1.1.5 Temperature

If the temperature on any sensor reaches more than 60° continue with caution especially if the underwater electronics housing is not in water to provide cooling.

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#### A1.1.6 Current Limit DAC

This value is not scaled to any meaningful terms. It however allows a way to adjust the current supplied to any motor function, if the current needs to be limited to a given value, connect a calibrated amp meter to the manipulator, (carefully drive the actuator to the end of travel) and trim the DAC until you are within your power supply requirements. This has been set to a default setting of 50.

**WARNING** Setting the value above this may result in damaging the arm.

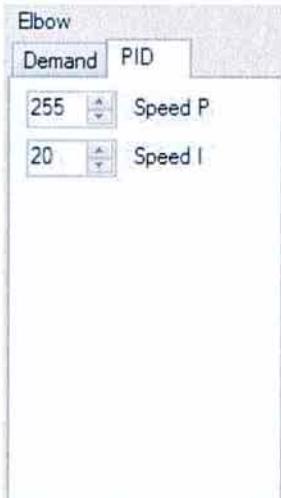
#### A1.1.7 Position

This display outputs the motor rotation pulse count derived by the motors hall effect sensors. At power up all the motor drivers are set to zero.

#### A1.1.8 RPM

This area displays the current speed in RPM of the motor before any gearbox ratios.

#### A1.1.9 PID Page



Some of the PID features are still in development, if you are not familiar with PID control theory please do not operate this section.

#### A1.2 Master Feedback

The master feedback displays sensors from the master card. These parts contain Master voltage, master Current and master temperature. These sensors are for approximation troubleshooting and are not calibrated for power supply setup.

If the temperature on any sensor reaches more than 60° continue with caution especially if the underwater electronics housing is not in water to provide cooling.

#### A1.3 Communication Settings

The Communication settings and feedback are used to select the PC comport for manipulator communication. In most cases the manipulators USB to RS485 converter will be sensed at start-up if it is plugged in however if this dose not happens please locate the manipulators port in the list.



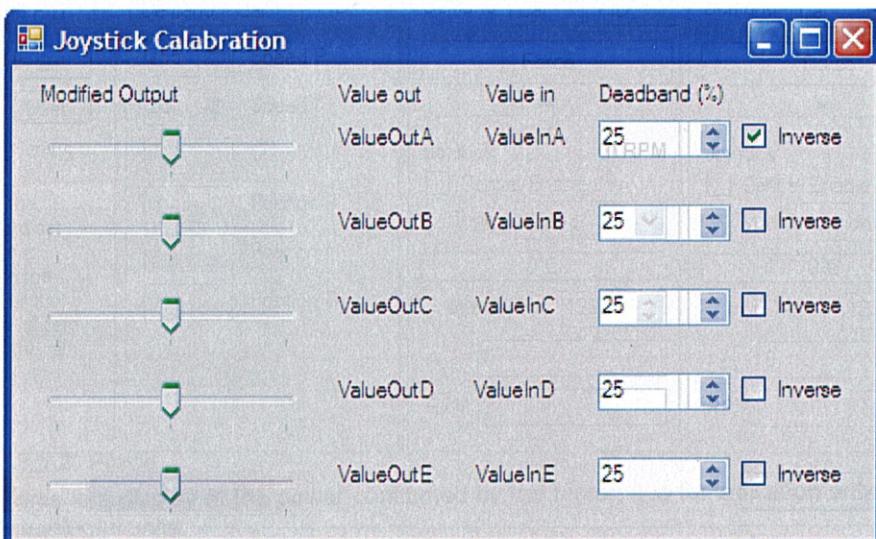
Note the display area will show diagnostic messages which can be helpful.

## A1.4 Joystick Settings

### A1.4.1 5E software calibration

This settings box can be used to remove a proportion of the centre of the joystick so that the arm cannot be moved in error.

To check the joystick is ok, slowly move up and down and release each joystick. If any joystick functions do not fall to the centre position on release then increase the Dead band percentage so that the onscreen joysticks fall centre. Note that setting the value higher than necessary will decrease the joystick accuracy.



### A1.4.2 Windows calibration

Windows 7 provides calibration for games controllers under its control panel. A calibration wizard is available. This calibration is not always required unless the joystick becomes problematic. Please follow windows help files for more information.

## A1.5 COMs

The following section describes the Comms/software details

- RS 485
- 115200 baud rate.
- USB link, appears as COM port on PC, for details see windows device manger (control panel/System/hardware/Device Manager/Ports(COM&LPT))

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### A1.6 Installation Notes

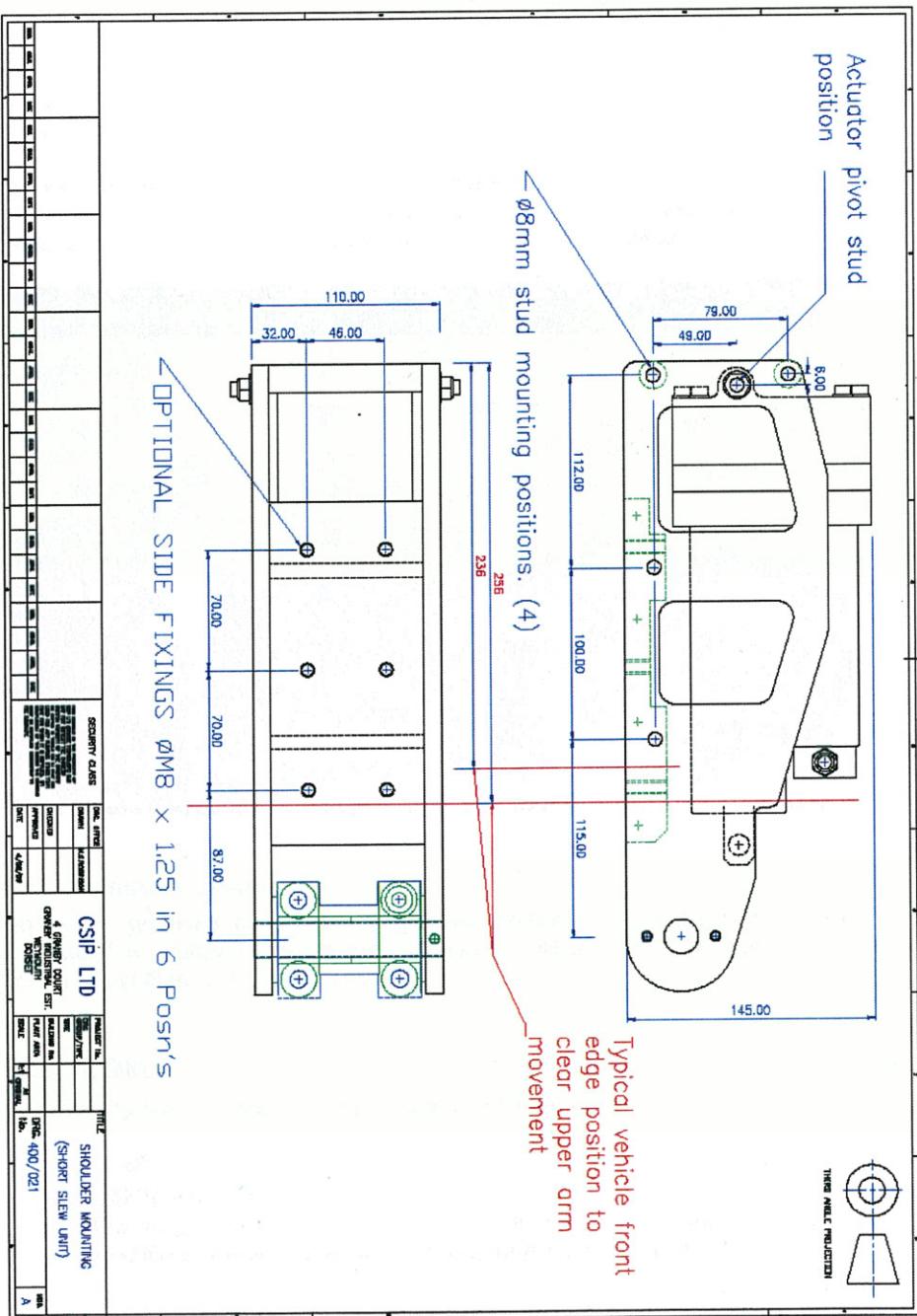
Note the software has been designed to run on a 32 bit Windows 7 machine, it may however run on other windows operating systems but has not been extensively tested.  
The Software has been pre-installed on the Laptop and will booted upon startup.



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## A2 Mounting



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### A3 Spares Packages

A3.1 A comprehensive range of spares are available upon request from the company, for example:-

Seal Kits  
Actuators