OCEANTOOLS USER MANUAL

DigiCP Digital Cathodic Potential Measurement System

REV 12

NOTICE

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VERSION CONTROL

REVISION DATE	REVISION NUMBER	EDITOR	APPROVED
12/07/2021	012	Kevin Parker	D Kane

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If you are unsure how to operate this system or require technical support, contact someone within your organisation who holds a Supervisory role or contact OceanTools using the details above.

If you need to use our technical support please have the following information to hand:

* Serial Number
* Fault Description
* Any remedial action taken

Introduction

This manual contains Operation and Maintenance information relating to the DigiCP Digital Subsea Cathodic Potential Measurement System manufactured by OceanTools Limited, Aberdeen, UK.

This manual is only intended to provide information and instructions to personnel suitably qualified to operate such equipment.

Please read this manual until you are familiar with the principles of operation of the equipment and you are sure in your own mind that you know how to operate it safely.

Safety

This unit, when connected correctly and according to these instructions, will have DC voltages within it.

Generally, DC voltages at these levels are non-hazardous but safety procedures should always be followed. These include but are not limited to the following:

- Read and understand this manual and all relevant company procedures.
- Make sure power is removed from the unit before cleaning or disconnecting any electrical connectors.
- Check the supply voltage is DC and not AC and is within specified limits.
- If the unit is damaged then consider returning it to OceanTools rather than undertaking repairs yourself.
- Be aware that if the unit should flood underwater it is possible that high pressure water may be contained within the unit. Follow appropriate procedures for reducing pressure BEFORE opening the equipment.
- Check the unit regularly for damages to any cables, connectors or anodising. If any damage is detected then seek advice from OceanTools or an OceanTools approved agent.
- Please also refer to Appendix 2: Risk of Serious Injury.

General

The OceanTools DigiCP system is available in three depth ratings:

- 300metres
- 4000metres
- 8000metres

The DigiCP allows Contact and Proximity CP readings to be taken by a Remotely Operated Vehicle (ROV) or a Diver. The DigiCP supports two types of CP measurement: Contact and Proximity. CP data

is digitised in the subsea housing and sent to the surface either via RS232 or via RS485 data transmission. As the data is digitised subsea, this has the following benefits to operators:

1. Improved noise immunity between subsea and surface
2. Ease of integration into data reporting systems
3. Does not require dedicated umbilical channels

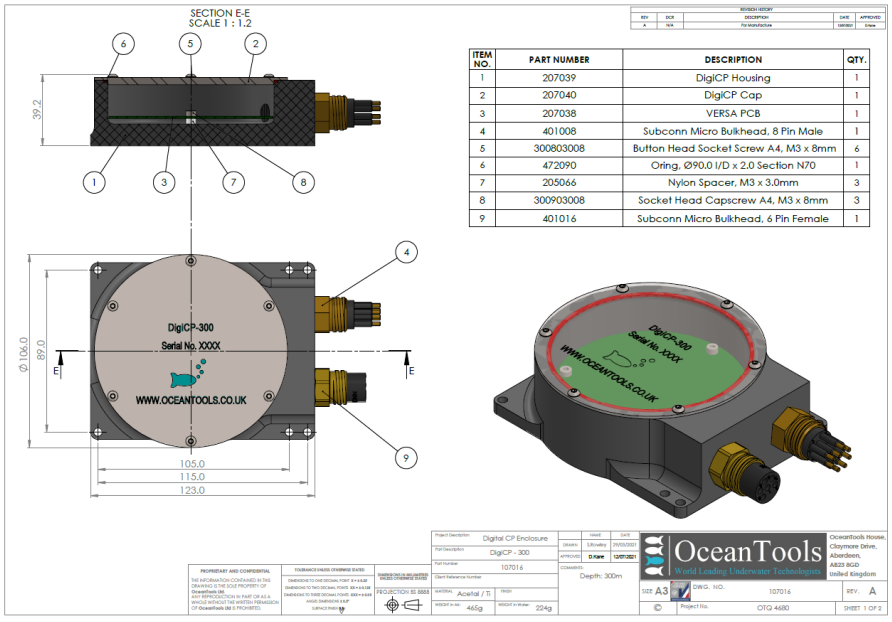
The unit is supplied as specified with either a Contact Probe to read Contact CP measurements or a Proximity Probe to read Proximity CP measurements. Certain systems may be supplied with both Contact and Proximity probes. Please make sure you know which type of probe you are using by consulting the documentation supplied with the system and ensure you configure the unit appropriately.

The DigiCP is effectively a galvanically isolated Digital Voltmeter. The actual voltage displayed in each case will have the correct modulus, some like to see it as a positive value some as a negative value even though the actual physical value is negative. The probes supplied with the system are from Buckleys – see Calibration Procedures Section. The polarity of the values output by the DigiCP is in line with the Buckleys test procedure providing a positive reading on a zinc test block in the range of 1.00 to 1.05V.

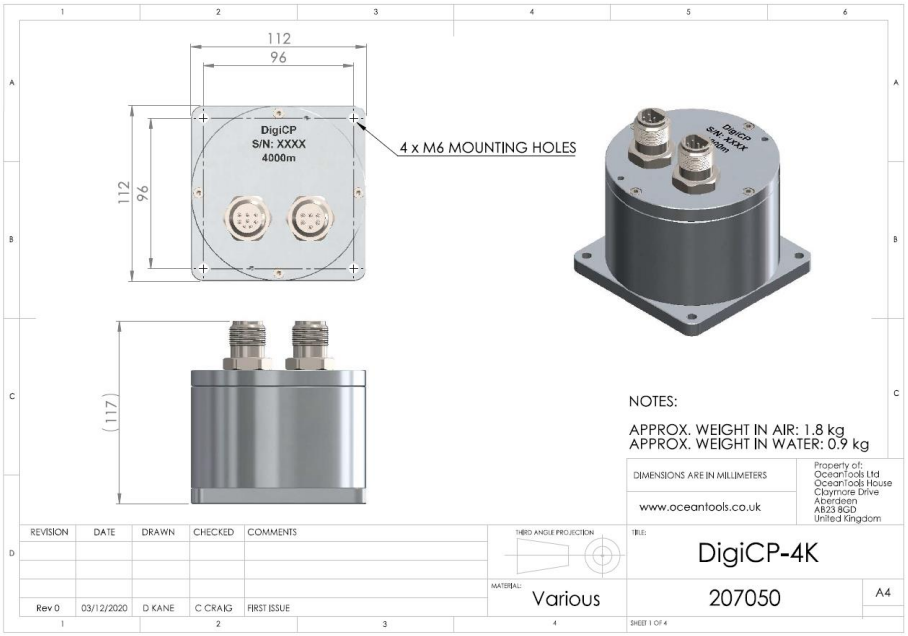
Installation

The main DigiCP body unit should be securely attached to the ROV – taking great care not to damage the anodised aluminium housing - using 5mm screws in the provided 5.5mm mounting holes.

The CP probe may be held in the ROV manipulator jaw using the optional T-bar or Fishtail mounts.



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	207039	DigiCP Housing	1
2	207040	DigiCP Cap	1
3	207038	VERSA PCB	1
4	401008	Subconn Micro Bulkhead, 8 Pin Male	1
5	300803008	Button Head Socket Screw A4, M3 x 8mm	6
6	472090	Oring, Ø90.0 I/D x 2.0 Section N70	1
7	205066	Nylon Spacer, M3 x 3.0mm	3
8	300903008	Socket Head Capscrew A4, M3 x 8mm	3
9	401016	Subconn Micro Bulkhead, 6 Pin Female	1



Depth rating

The DigiCP may be supplied in 300m, 4000m or 8000m depth rated housings. The depth rating and serial number will be engraved onto the DigiCP end cap.

Ensure you are aware of the depth rating of the unit and NEVER exceed the maximum depth rating. If the depth rating is exceeded, contact OceanTools in the first instance for technical advice.

Underwater connectors

CONNECTOR 1. Eight pin bulkhead (MCBH8M on DigiCP-300, Glenair 5507-1508 on DigiCP-4k & 8k)

PIN NUMBER	FUNCTION
1	24VDC from ROV
2	0VDC from ROV
3	RS232Tx
4	RS232Gnd
5	RS485A (Data +)
6	RS485B (Data -)
7	Proximity -ve (from surface via ROV umbilical)
8	N/C

CONNECTOR 2. Six way bulkhead (MCBH6F on DigiCP-300, Glenair 5507-1508 on DigiCP-4k & 8k)

PIN NUMBER	FUNCTION
1	Contact / Proximity +ve
2	Contact -ve
3	Proximity -ve (via special cable assembly)
4	Contact Probe Select
5	Probe Common
6	Proximity Probe Select

MATING CABLE ASSEMBLIES

DCP-6-CO	Contact Probe with pins 4 & 5 shorted to enable Contact mode
DCP-6-PR	Proximity Probe with pins 5 & 6 shorted to enable Proximity mode

Note

Only OceanTools supplied Contact or Proximity probe assemblies should be used in conjunction with the OceanTools DigiCP systems. Use of other probes may cause severe damage to the systems and may produce erroneous readings.

Operation

These notes are intended as a user guide and are not a definitive guide as to the operation of a CP measurement system. Consult company Operational Procedures if in any doubt as how to conduct a CP survey.

DigiCP Software

Use the left-hand dropdown list to select the name (e.g. COM1) of the serial port that has a DigiCP connected. The adjacent on-screen LED will flash green when messages are received, and the CP analogue voltage will be displayed. If the voltage exceeds the range where the specified accuracy is defined, the message 'Voltage Over Range' is also displayed.

The software can also retransmit the received DigiCP messages, for example to surveyors. Use the right-hand dropdown list to select the name (e.g. COM2) of the output serial port. The adjacent on-screen LED will flash green when messages are transmitted.

A short ASCII output string is generated automatically about twice per second:

CP+1.234V<cr>

This is a fixed length string, always with CP at the start and V then <cr> (carriage return) at the end. The sign before the voltage is normally + or - but can also be > or < if the measured voltage is outside the range where specified accuracy can be achieved. For example CP<4.680V if an unusual out-of-range voltage of -4.68V was measured. After the sign character, the number representing the voltage is always one digit then a decimal point then three decimal place digits.

Contact measurement

- Ensure that an OceanTools Contact CP probe is connected to the DigiCP main housing.
- If necessary, calibrate the system per the sub-section of this Manual entitled “Contact Probe Routine Maintenance”.
- Once you are satisfied the system is functional and calibrated then deploy according to your company’s Operational Procedures.
- Note: it is suggested that the pipeline or structure to be inspected is cleaned by a suitable method (such as a rotary wire brush) before a contact measurement is made.

Proximity measurement

These notes are offered for general guidance only and your Company’s Procedures must be followed in preference to these notes.

It should be noted that Proximity Measurement is significantly more complex than Contact Measurement. When using Proximity Measurement, the Negative side of the measuring system MUST be connected to the Remote Ground. This is connected via Pin 7 on Connector 1 if taken through the ROV umbilical. However, it is possible to use a special cable assembly that includes a one way underwater connector to allow the Proximity negative to connect via Pin 3 on Connector 2 via a trailing wire if it is not possible to take it through the ROV umbilical.

Typically, the Remote Ground is e.g. an oil production platform that directly connects to the entity to be measured e.g. a subsea pipeline. Connection to the Remote Ground can be a difficult process involving trailing long lengths of a conducting wire through expanses of water. An Indirect Connection is made by connecting a trailing wire from the Remote Ground and bringing this to the DigiCP Pod via the ROV umbilical. A

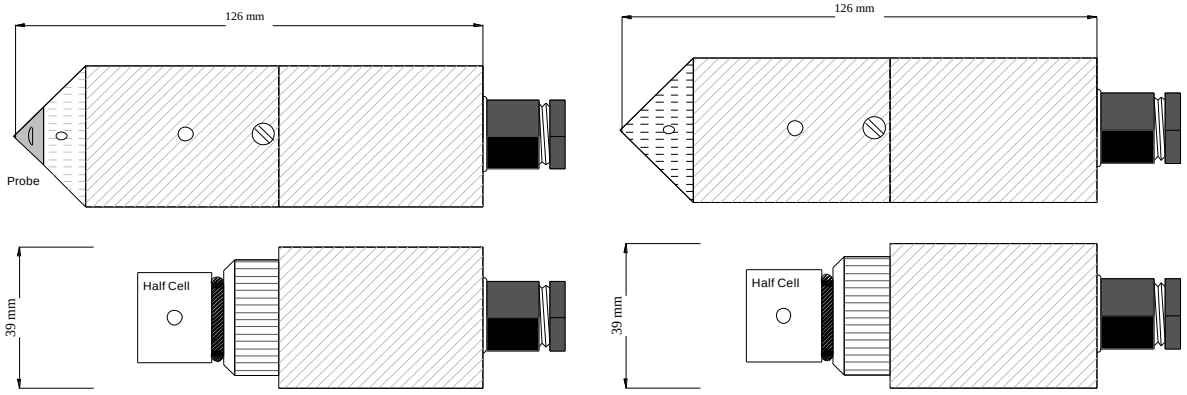
It is very important that the Remote Ground is not grounded anywhere else other than on the remote Reference Structure. If is it grounded elsewhere then incorrect readings will be taken.

From the above, you will appreciate that there are many considerations including length of trailing lead, how to connect the trailing lead to the Remote Ground, health & safety considerations, risk of catching the trailing lead in a propeller or thrusters etc. Appropriate procedures that are not part of this document and that are the responsibility of others MUST be followed.

Calibration procedures

The OceanTools DigiCP uses Buckleys UCP 1A and 1B UCP probes. This section of the Operators Manual is included with kind permission from Buckleys. Their website is www.buckleys.co.uk.

There are two types of UCP probe, the 1A Contact and the 1B Proximity.



UCP 1A **UCP 1B**

Both types use the same type of replaceable Silver / Silver Chloride Half Cell. The connection to the half-cell and probe tip (UCP 1A) is 1 metre of cable colour coded white and black. The white lead is connected to the half-cell and the black lead is connected to the Probe Tip (no connection on the UCP 1B).

1. VERIFICATION OF UCP HALF-CELL

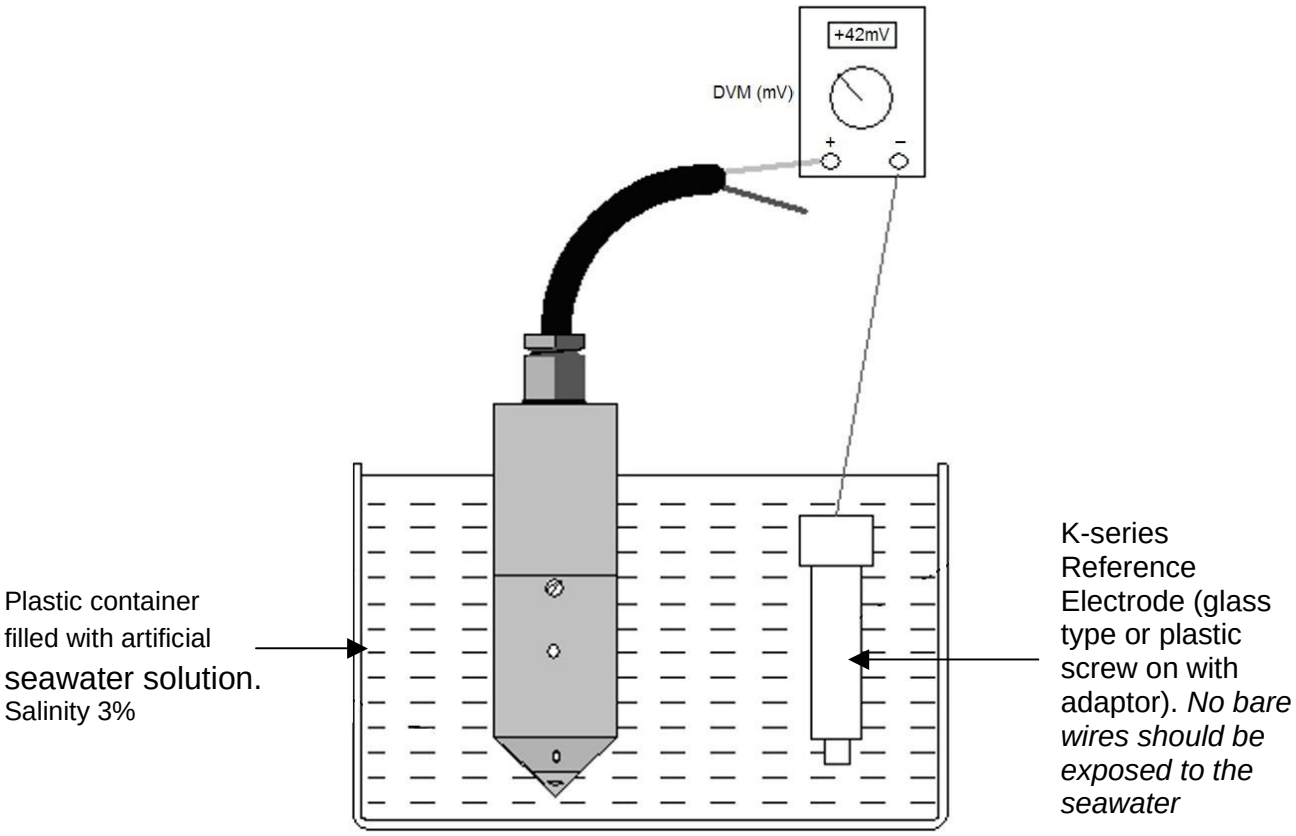


FIG 1

1.1 Screw the Adaptor Lead (H16) onto the Reference Electrode (plastic screw on type) Submerge the UCP and Reference Electrode in the seawater solution.

1.2 Connect the white lead from the UCP to the Positive terminal of the DVM (see Fig 1 above).

1.3 Connect the lead from the K series Reference Electrode to the Negative terminal of the DVM.

1.4 Allow the electrodes to reach a stable temperature and potential (15 - 30 minutes).

1.5 The voltage difference between the Reference Electrode and the internal Silver/Silver Chloride Electrode can be read directly off the DVM display.

NOTE:

The values recorded for the Silver/Silver Chloride Electrode are dependent upon the Salinity and Temperature of the Seawater at the time of measurement.

MEASUREMENT RESULT

Verify a nominal potential of **+42mV ± 5mV**.

NOTE 1:

The values recorded for the Silver/Silver Chloride Electrode are dependent upon the Salinity and Temperature of the Seawater at the time of measurement.

2. TEST USING ZINC TEST BLOCKS

A quick check of the operation of the UCP 1A can be carried out using a Zinc test block. Connect the white lead from the UCP to the positive terminal of the mVolt meter, and the black (UCP 1A only) to the negative. Potential measurements taken should be logged to check if any significant variation occurs. Differences in the order of 10mV or so between readings are quite possible and will mainly be caused by variations in water salinity at different locations or due to changes in water temperature.

As a guide, readings taken in a 3% salt solution at ambient temperature of 25°C are as follows:

Zinc (Zn) = 1.00 - 1.05V

Soak the UCP 1A for 2 hours in a Sea water solution. The salt concentration has a great effect on the readings, so does the state of the test block. A tarnished block will give a lower reading than clean one. Do not leave the test block in the seawater – remove it after use.

For the UCP 1B connect the white lead from the UCP to the positive of the mVolt meter and negative to a zinc block. The readings should be as above.

3. LONG TERM STORAGE

LAYING UP

Flush well in clean seawater to remove any contamination from the Nose Cone and allow to dry. If salt encrustation is seen on the Nose Cone, remove the Ag/AgCl half-cell and briefly wash in fresh water but immediately after thoroughly rinse in Salt water (3% salt solution)

RE-COMMISSIONING

a) Soak the UCP for 2 hours in a seawater solution.
b) Carry out calibration checks, see calibration (section 1).

4. MAINTENANCE

Very little maintenance is required apart from keeping the unit clean and ensuring that the holes in the case are kept clear of any obstructions such as dirt or marine growth etc.

If the unit has been used in a dirty environment it should be flushed with clean sea water to remove any contamination which would shorten the life of the reference cell.

When changing the probe tip of a UCP1A, the condition of the “O” Ring should be checked and, ideally, replaced at the same time.

5. REPLACEMENT OF THE SCREW IN REFERENCE ELECTRODE

a) Remove the two nylon screws holding the nose section.

b) Carefully remove the nose section, on the UCP1A there is a lead connection to the probe tip.
c) Carefully unscrew the Reference Electrode.
d) Ensure that there are no foreign bodies in or around the seat of the Reference Electrode and the "O" Ring.
e) Smear the "O" Ring and the thread on the new Reference Electrode with Silicone Grease.
f) Screw in the new Reference Electrode until the "O" Ring just seats, then tighten half a turn and no more. Over tightening the Reference Electrode could snap the thread.
g) Replace the nose section, ensuring that there is no debris or foreign matter around its seat.
h) Replace the two nylon screws to hold the nose section.

General maintenance

The DigiCP subsea Enclosure should be considered as generally maintenance free provided that the following routines are adhered to whenever the Enclosure is recovered from deployment or opened for any reason.

1. After recovery, always wash the enclosure down with fresh water, preferably under pressure. This is especially important at the interface between the End Caps and Housing Tube and around the counterbores for the End Cap retaining screws.
2. Whenever refitting retaining screws, apply a liberal smear of anti-galling compound having first removed all traces of any previously applied compounds.
3. Whenever removing the Enclosure End Caps ensure that all possible handling aids are available. Obviously, the End Caps and Housing Tube comprise substantial masses of material and any mishandling can easily result in material or personnel damage!
4. Whenever the Caps are removed, always inspect the sealing 'o' rings and their fitting surfaces and grooves for damage. Any suspect seals should always be replaced. Any damage to metalwork surfaces should be addressed prior to re-assembly.
5. Before refitting 'o' rings, clean the 'o' ring and its groove thoroughly and apply a thin, even smear of silicon grease to the 'o' ring. Never apply excessive grease to the 'o' ring and never attempt to apply the grease to the groove.

Never exceed the specified depth rating. If the unit has or is suspected of exceeding its depth rating then the integrity of the housing is questionable and guidance should be sought from OceanTools.

INTRODUCTION

This document aims to set out the necessary precautions which should be taken to avoid serious injury in the event of recovering an item of equipment, comprising an atmospheric enclosure that is suspected of suffering an ingress of water, the following precautions shall be observed.

Additionally, Personal Protective Equipment (PPE) shall be provided as per Directive 89/686EEC as amended by Directive 93/95/EEC, 93/68EEC and 96/58/EC. In particular, Eye Protection shall be worn, Work Gloves shall be worn and it is advisable to wear Latex Gloves under Work Gloves as any leakage from enclosures may be corrosive.

DO NOT:

* Remove end cap retaining screws without reference to the section regarding this procedure.

DO:

* **Securely clamp down item of equipment such that the end is facing away from all personnel, preferably towards a solid wall or such like. When releasing any threaded components endeavour to avoid placing any part of the body 'across' the component. Consider also, when dealing with threaded connectors, that under high pressure, once rotation has commenced it is possible for the pressure to continue the rotation if the thread is well lubricated.**

  Due consideration should also be given to the possibility that the air being released maybe poisonous, explosive or both.

If the equipment is fitted with a vent plug that is pulled flush onto a spot face:

* Undo the plug, 2 or 3 turns, to pull the face seal free of the spot face. Using a paintbrush or similar, apply a generous amount of slightly diluted washing-up liquid around the plug and observe for the appearance of any bubbles. If any appear, leave the equipment to stand until there are no more bubbles. If necessary re-apply more washing-up liquid. Undo the plug a little more and re-check. The plug is fitted with a retaining nut internally, but a slow approach is advised until convinced that there is no trapped air within.

If the equipment is fitted with a vent plug that is not flush with a spot face, or there is no spot face present (A taper thread):

* Follow the above procedure but commence with less turns of the plug each time. Leave to stand until it is no longer showing signs of venting.

If the equipment is not fitted with a vent plug, the above checks will have to be achieved via a connector. If possible, obtain a data sheet for the connector and establish the location and quantity of seals in the connector body. Then the following applies:

* Flanged connector, face seal only: Remove one screw to establish the length of thread engagement in the end cap. Replace the screw finger tight, 'crack' the remaining screws and commence turning each screw equal amounts 2 or 3 turns at a time. Again, apply diluted washing-up liquid and check for bubbles as the seal begins to 'break'. Leave to stand until it is no longer showing signs of venting.

* Flanged connector, face and piston (barrel) seal: Establish the gap necessary between the flange and the end cap to bring the piston seal to the upper edge of the bore. Remove one screw to establish size, thread rate and engagement length in end cap. It will be necessary to obtain one or possibly two sets of longer screws to ensure that it will be possible to maintain sufficient engagement as the connector is withdrawn. Remove 2, diagonally opposed screws and replace with screws that will have full engagement and reach the flange when the other 2 screws have at least 0.5D engagement. Remove the 2 shorter screws and replace with 2 screws that will fulfil the same function as above for the first pair of longer screws. Repeat this procedure until the piston seal has reached a point where it is just able to vent. Again, apply diluted washing-up liquid and

check for bubbles as the seal begins to 'break'. Leave to stand until it is no longer showing signs of venting.

* Threaded connector, face seal only: 'Crack' the thread and slowly turn until the face seal begins to 'break'. **Do not continue turning.** Again, apply diluted washing-up liquid and check for bubbles as the seal begins to 'break'. Leave to stand until it is no longer showing signs of venting.

* Threaded connector, face seal and piston (barrel) seal or piston (barrel) seal only: **Check with OceanTools as it may not be possible to turn the connector a sufficient number of times to 'break' the seal due to internal wiring.** If this is the case it will be necessary to release the end cap seal. Remove 1 end cap screw to establish size, thread rate and length of engagement. Replace screw. **Check with OceanTools to determine how far the end cap will need to be released to allow the seal to 'break', and how many seals there are.** Obtain a range of screw lengths to allow 50% of the total number of end cap screws to maintain 1D of engagement. Remove every alternate screw and replace with the next size up. **Consider that even if the end cap does not 'want' to release, it is not a guarantee that there is no internal pressure as the seals may have 'stuck' due to internal corrosion.** A generous amount of diluted washing-up liquid should be applied around the end cap/body tube interface. Continue up-sizing screws as described above until the last seal 'breaks' Leave to stand until it is no longer showing signs of venting.