VORTEX SUBSEA SOLUTIONS

Ashtead Technology

Anchor Boss

Suction anchor pump.

Operations manual.

October 2016. Rev: 2. Specifications are subject to change without notice.

VORTEX DREDGE SYSTEMS
www.vortexdredge.com

Introduction

YOUR SAFETY IS YOUR RESPONSIBILITY.
PLEASE ASK IF YOU ARE UNSURE ABOUT ANYTHING.

Introduction

- **This suction anchor pump is physically larger than some other pumps. This is a result of a deliberate decision to create the highest possible water flow with the least restrictive flow paths with high capacity suction and relief valves to match very high water flow rates.**
- Task specific water flow meter integrated into pump unit to accurately measure water flow in both directions of flow.
- Filtered suction into pump
- Hard faces sealing arrangement and erosion resistant pump materials are resistant to high levels of sediment entrainment in product stream, improving reliability.
- High flow mechanical / spring operated suction and pressure relief valve module to ensure maximum safety from exceeding pd max. on caisson.
- Software / solenoid operated water pump emergency shut off valve for maximum asset protection.
- Data feedback redundancy via topside laptop, Perry UCD and analogue gauge.
- Real time Perry UCD Subsea display showing caisson pressure differential and water pump flow along with data logging topside laptop to allow clear picture of anchor installation/removal scheduling.
- Easy mounting with supplied Perry XLX mounting frame to clip on rear of ROV.
- Pump graph data gathered under real world conditions in pressure vessel blown down to 10bar (340ftsw)
- Pump pressures -10 bar to +10bar (-145psi to +145 psi) Can be configured to 15bar.
- Data recording pump RPM, Water flow (both directions) and water pressure, plus ROV hydraulic flow.

Anchor Boss Suction Anchor Pump

Benefits to the customer:

Reduce vessel time: very high water flow (up to 240m3/hr) can significantly reduce suction pile install and removal times. Known flow figures give the ability to estimate install time on lump sum jobs.
Performance of 15 bar water pressure differential at approximately 100m3/hr with 165l/min and 3500psi hydraulic input.

Structural safety: High flow suction and relief pressure valves to protect pile integrity. The ability to risk review by being able to monitor in real time actual pressure against a given maximum pressure not to be exceeded.
Water pump shut down emergency valve dumps all pressure for ultimate in asset saftey.

Data display: Sub sea real time water flow in both directions and pressure in both directions.

Data logging: Topside laptop real time data logging of pump rpm, water flow in both directions, pressure in both directions and ROV hydraulic flow.

Measure and manage quality: Understand in real time the quality of your installation by measuring and displaying actual data to give the client a post install report on factors surrounding the pile install.

Suction Pump Performance and Installation Comparisons

	VORTEX Anchor Boss	AZ-10	AZ-20
Pump performance	Figures based on ACTUAL flow testing against Ultrasonic flow meter under pressure in test vessel at 334ft depth.	Pump data testing unknown	Pump data testing unknown
Pump performance continued Anchor Boss can be supplied with all motor and impeller combinations shown here to suit almost any host ROV or just one combination to suit a particular host ROV. Performance of 15 bar (217psi) water pressure differential at approximately 100m3/hr with 165l/min (43gpm) and 241bar (3500psi) hydraulic input. Call for details.	Anchor Boss configured to suit 180lpm (47gpm) hydraulic flow @ 250 bar Water flow = 240m3/hr @ 5.2 bar (75psi) Pressure = 10.7 bar (155psi) @ 50m3/hr Anchor Boss configured to suit 100lpm (26gpm) hydraulic flow @ 206 bar (3000psi) Water flow 180m3/hr @ 2.6 bar (38psi) Pressure 6 bar (87psi) @ 35 m3/hr Anchor Boss configured to suit 70lpm (15gpm) hydraulic flow @ 250 bar Water flow up to 150 m3/hr at 3bar (43psi)	70lpm (15gpm) hydraulic flow Water flow up to 80 m3/hr at 7.5 bar (108psi) Pressure up to 9 bar (130psi)	145lpm (38gpm) hydraulic flow Water flow up to 185 m3/hr at 5 bar (72psi) Pressure up to 9 bar (130psi) at 10 m3/hr
Pump assembly tested under pressure at over 300ft depth	YES	UNKNOWN	UNKNOWN
Real time pressure differential and water flow meter mounted subs sea standard kit	YES	NO	NO
Suction relief valve standard kit	YES	YES	YES
Pressure relief valve standard kit	YES	NO	NO
Data logging capabilities standard kit	YES	NO	NO
Run pump in air for extended periods during deck checks	YES	NO	NO

Specifications.

Operating Limits

The operating limit for the Vortex Anchor Boss is 3000 mtr plus.

The limitation being the ability to safely deploy and recover the ROV system with the Vortex Anchor Boss attached. Care must be taken whilst during launch and recovery operations to prevent damage to all components of the Anchor Boss and the ROV.

Vortex Anchor Boss Capacity.

Pump can be configured to suit host ROV supply from 50lpm / 150 bar to 180lpm / 250bar.

*Based on actual flow readings running pump at ambient depth of 10bar (340ftsw)

Performance:	Anchor Boss configured to suit 100lpm (26gpm) hydraulic flow @ 206 bar (3000psi)
	Water flow 180m3/hr @ 2.6 bar (38psi)
	Pressure 6 bar (87psi) @ 35 m3/hr. (Variable by changing in hydraulic input).
Electrical:	RS232 connection going to ROV is an 8 pin Burton connector.
	2 pins for power (Ground and +24 Volts DC)
	3 pins for RS232 comms (Tx, Rx, and Ground)
Misc data:	Connections: 3” ID hose

Weight in Air: Complete unit in frame = 150 kg approx. (330lb)

Weight in Fresh water: Complete unit in frame = 105 kg approx. (230lb)

Weight in Fresh water with flotation: Complete unit in frame = 12 kg approx. (5.4lb)

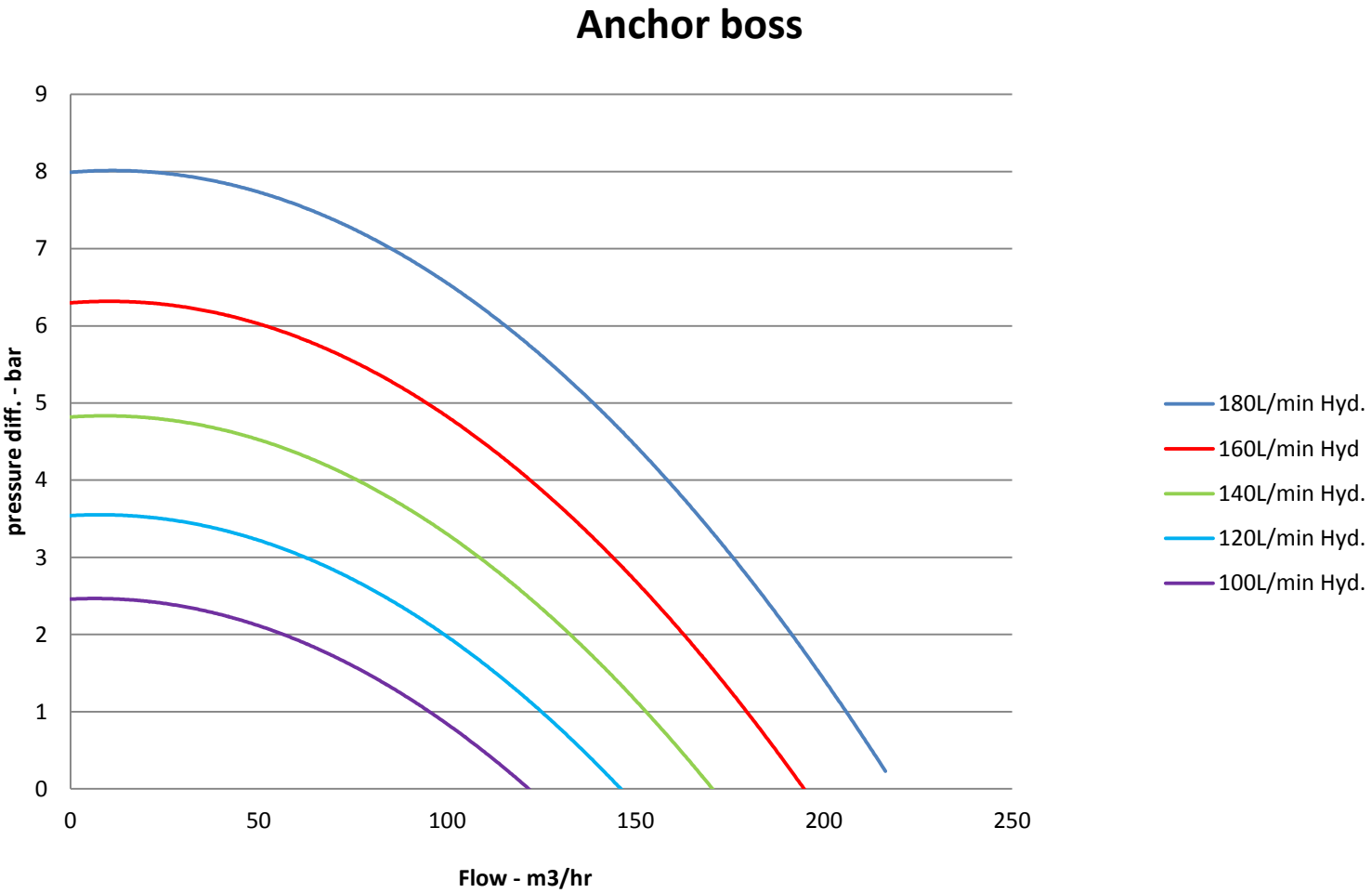
Materials of construction:	Stainless Steel
	Alumium
	Thermoset Epoxy Resin

Coupling compensator:	NO
Hydraulic motor overrun valve std:	YES
Hydraulic motor direction run valve std:	YES
Operate pump in air:	YES
Flotation provided in kit:	YES 3000mtr rated Flotation provided = 209lb (94kg) of lift

Specifications

Water pump flow chart

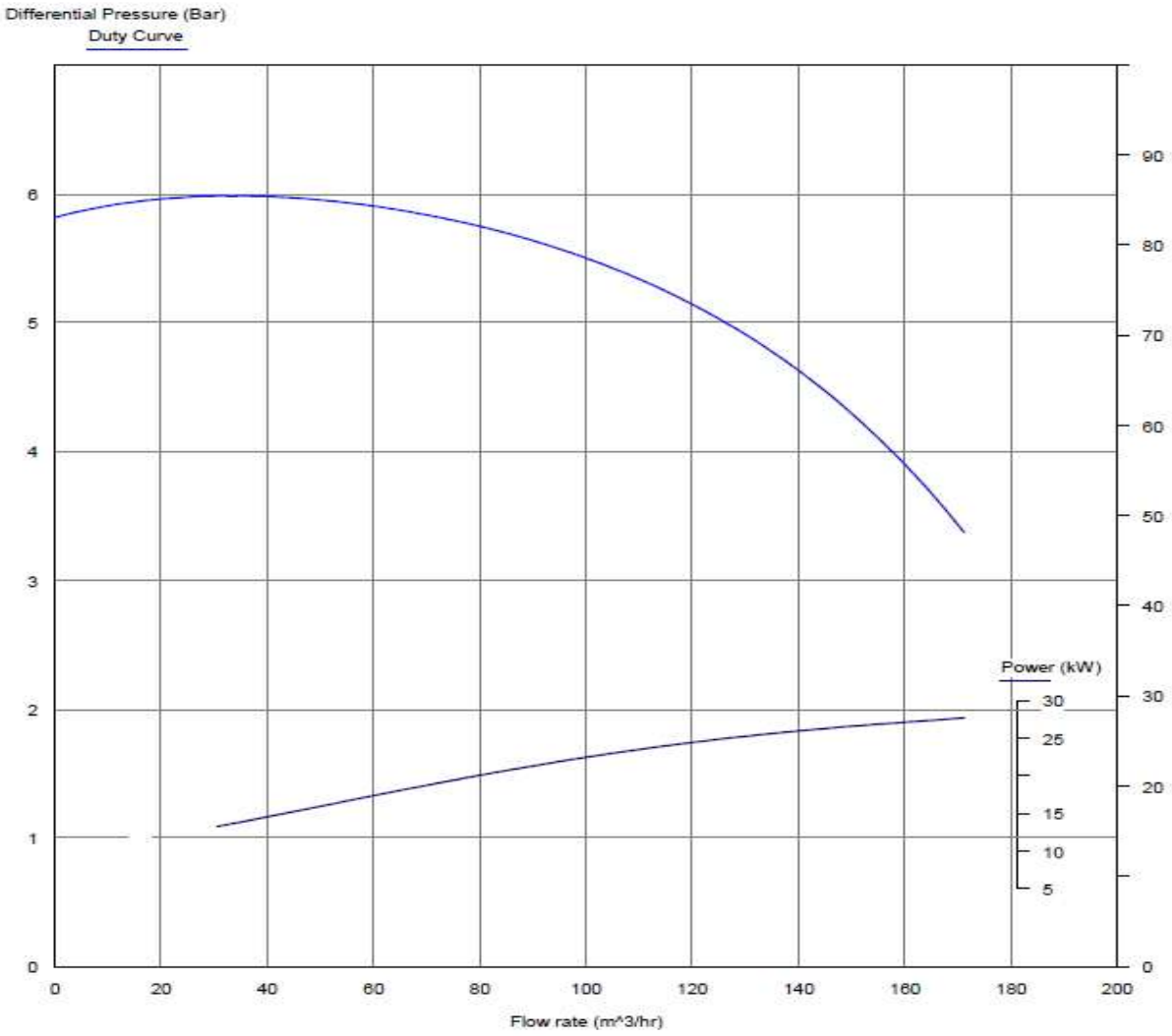
Pump graph data shown was gathered under real world conditions in pressure vessel blown down to 10bar (340ftsw) using 34cc hydraulic motor. Pump graphs can be changed to suit individual applications with graph performance optimized to each host ROV tooling supply using selection of hydraulic motors and pump impellers supplied with kit.



Pump Performance Graph

focussed on optimum water flow of 180m3/hr at 2.5bar using hydraulic input of 100lpm and 206bar.

VORTEX	ANCHOR BOSS		TECHNIP
		Power Abs 27.25 kW Motor Size 0 kW Pump Speed 3858 RPM Imp Diameter 160.0 mm	
Ref	VORTEX TECHNIP		



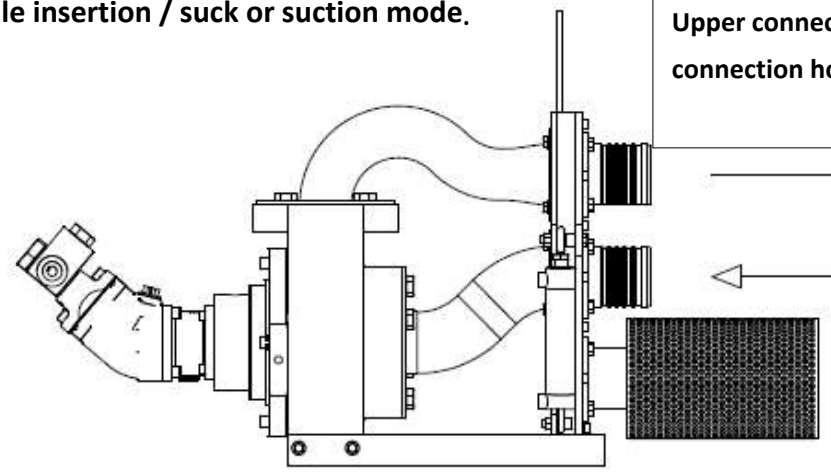
Operation

flow path of water in suction and pressure modes with slide valve.

Design consideration focused on least restrictive water flow paths.

Pile insertion / suck or suction mode.

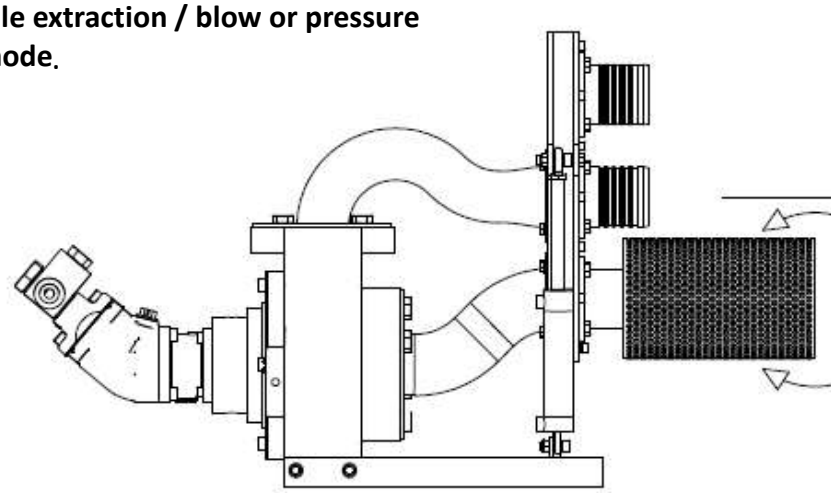
Notes:
Upper connection exhaust discharges away from ROV. Middle connection hoses to hot stab / pile connection



Discharge to ambient.

Suction from pile via hot stab.

Pile extraction / blow or pressure mode.



Discharge to pile via hot stab.

Suction from ambient.

Slide / reversal valve allows water flow reversal from pump suck (pile installation) to pump blow (pile extraction) by activating cylinders to shift alignment of hot stab hose between pump inlet and outlet ports.

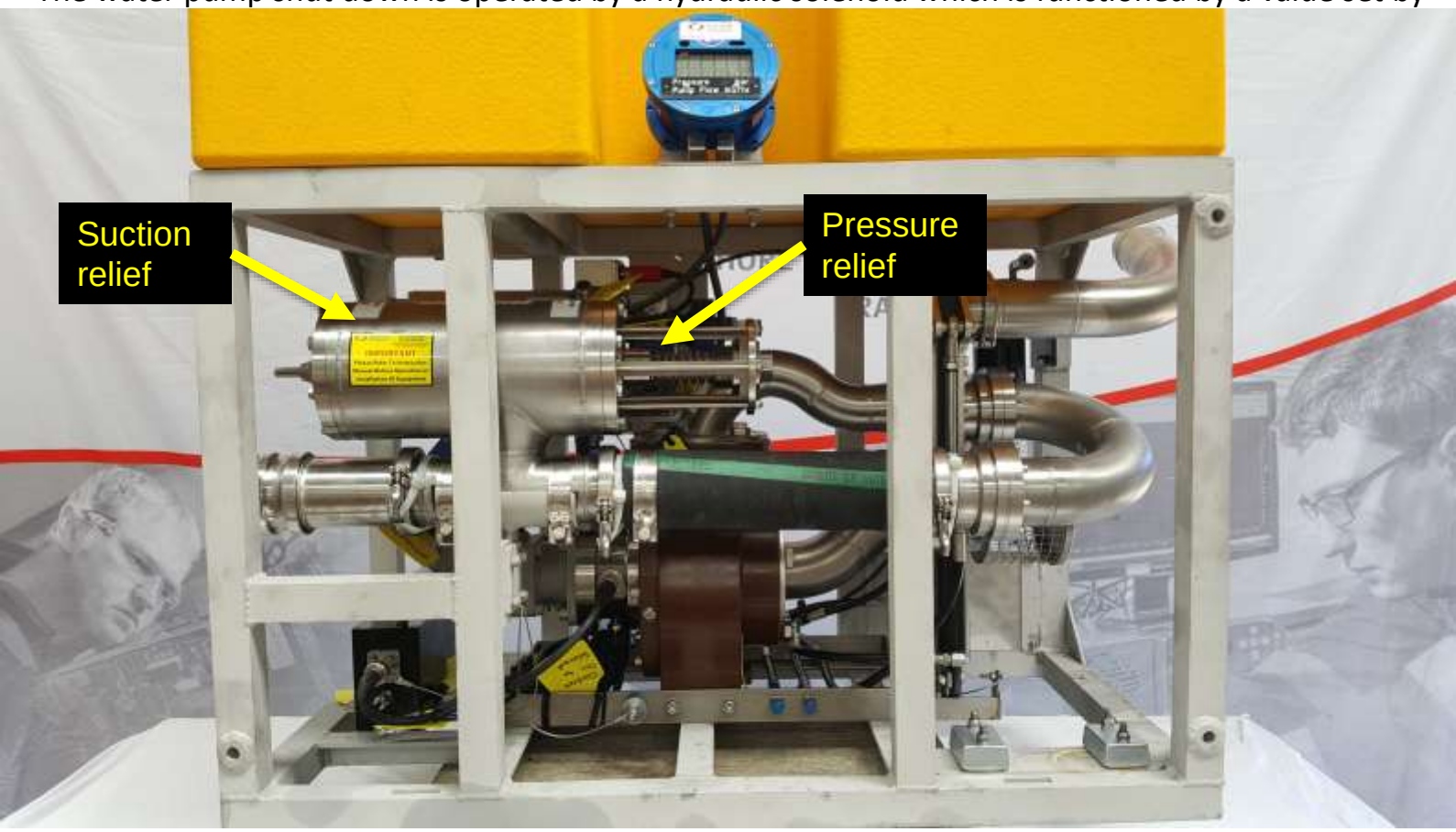
Relief Valves:

Suction, pressure and emergency water pump shut down.

These are large relief valves designed to flow large amounts of water with low hysteresis for maximum pressure control and pile structural safety.

Relief valves: Spring adjustable from 0.2bar to 8.0 bar (up to 15bar on request)
There are two identical, high flow relief valves in the Anchor Boss. One acts as a suction relief whilst the other acts as a pressure relief. They are interchangeable in all components.

Water pump shut down: Software adjustable from 0 to 10 bar
The water pump shut down is operated by a hydraulic solenoid which is functioned by a value set by



Relief Valves:

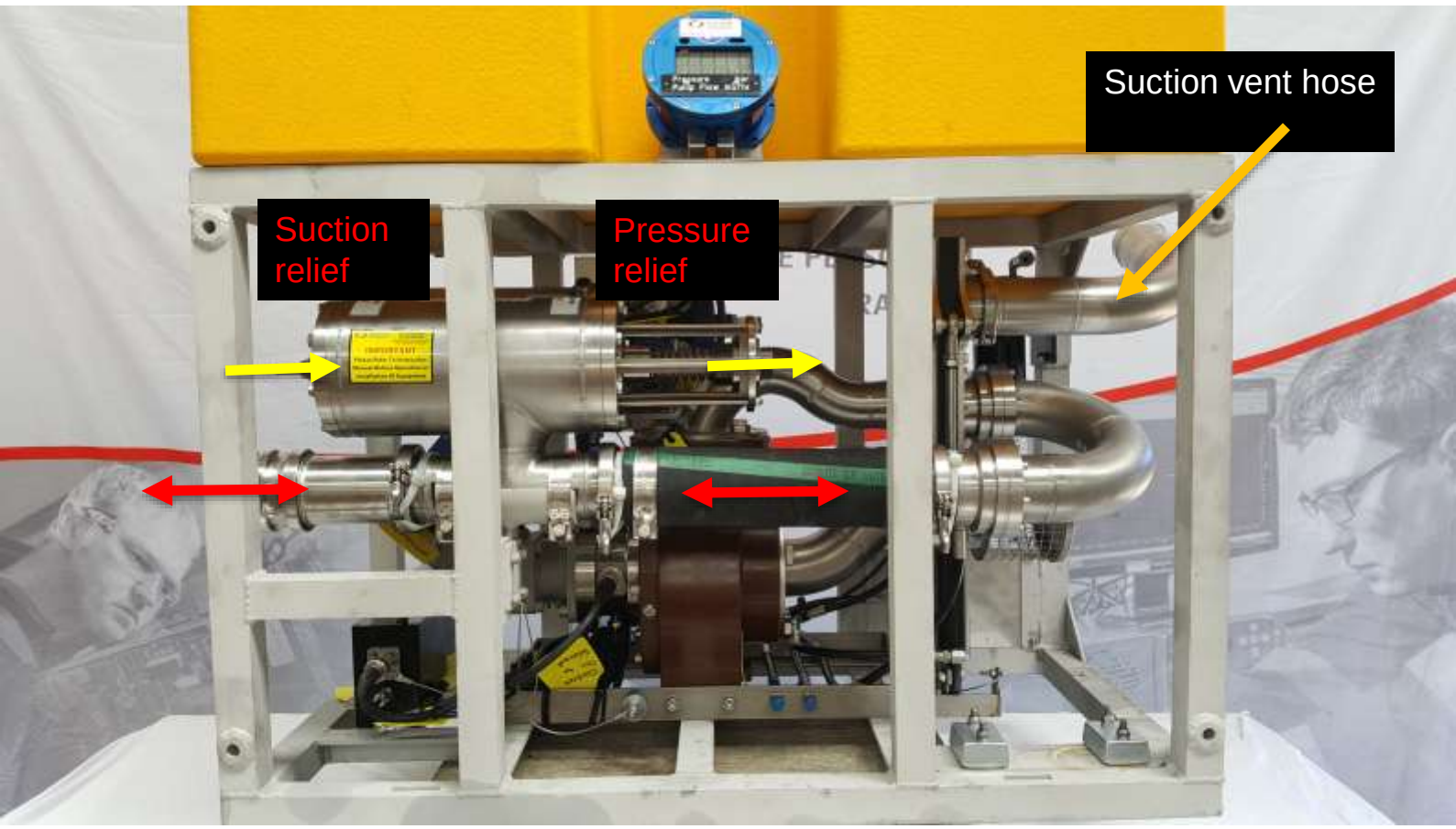
Flow paths

These are large relief valves designed to flow large amounts of water for maximum pressure control and pile structural safety.

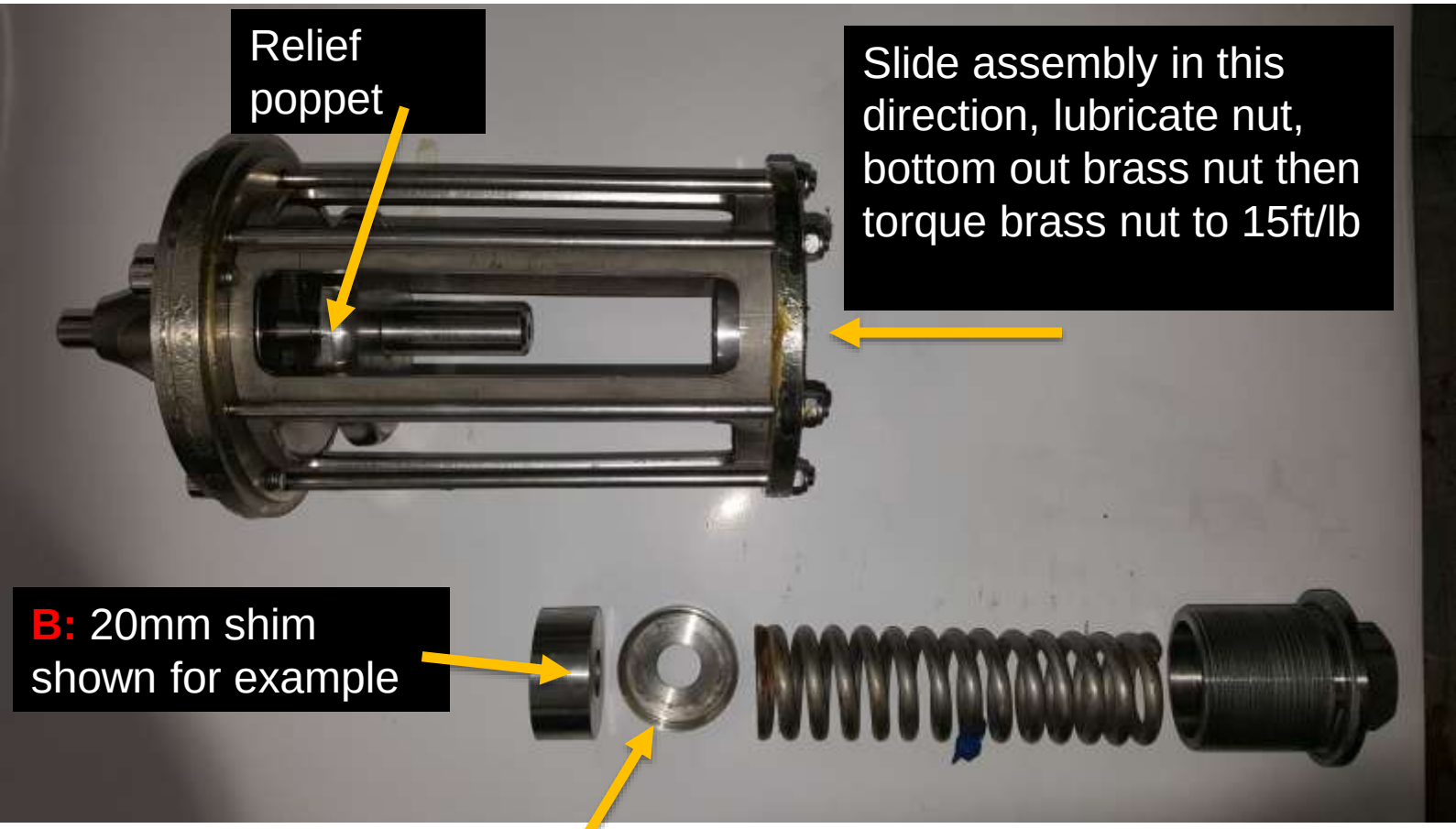
Relief valves: Adjustable from 0.2bar to 8.0 bar

There are two identical, high flow relief valves in the Anchor Boss. One acts as a suction relief whilst the other acts as a pressure relief. They are interchangeable in all components.

The yellow arrows show the flow path of water through the suction and pressure relief valves while the red arrows show the path of water in suction / pressure mode to and from the hot stab.



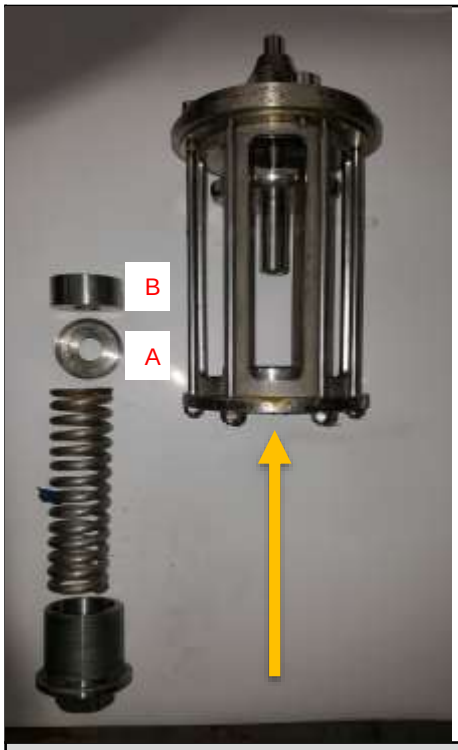
Relief Valves:



Shim spacers are stamped with numbers referring to their thickness in mm. There are two of each shim.
Both relief valves are identical. Only the springs and shim thickness change.
20, 10, 8, 6, 5, 4.1, 4, 3, 2.6, 2.5, 2.4, 2.3, 2.2, 2.1, 2, 1mm

Relief Valves:

With all assemblies the A: Brass nut base washer, and B: Spring base washer are not considered to be part of the shim spacer stack. They are a permanent part of the assembly. Only the individual shims comprise the shim spacer stack.



Bar relief suction and pressure	Total thickness of shim stack mm	spring selection
0.2	6.1	1
0.3	11	1
0.5	20.9	1
0.75	33	1
1	45.5	1
1.5	10.4	2
2	15.3	2
2.5	20.2	2
3	25.1	2
3.5	30	2
4	13.2	3
4.5	15.3	3
6	17.4	3
7	21.6	3
8	25.8	3

Notes:
With all stack assemblies the spring base A should always be in place and is not considered to be a part of the shim stack B measurement.

Notes: 1 = light spring
Notes: 2 = med. spring
Notes: 3 = heavy spring

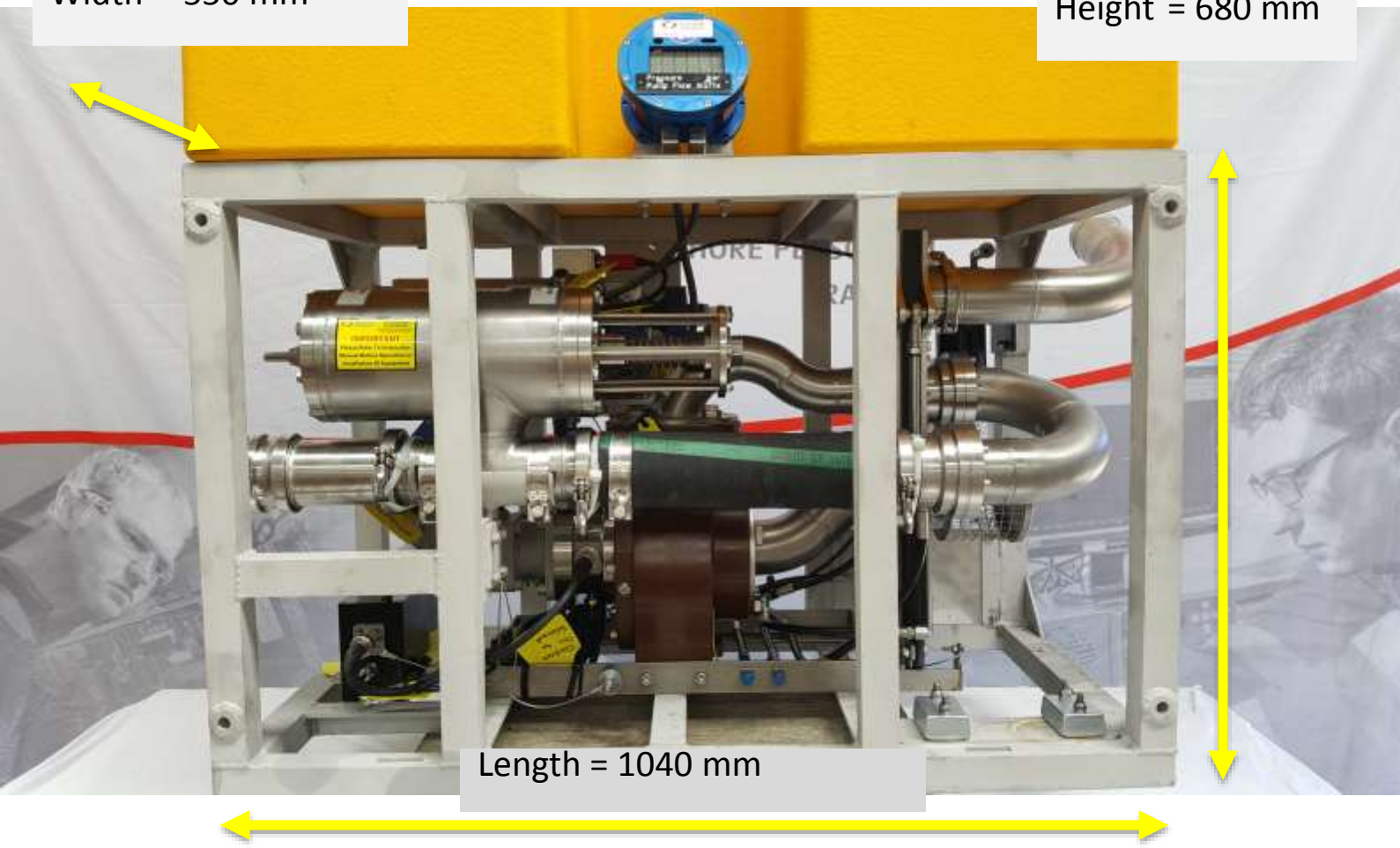
Water pump shut down valve.

Software controlled solenoid valve operates emergency water pump shut down closing off hydraulics to the water pump.

Oil filled and compensated.

Installation

– Frame Configuration



Weight in Air: Complete unit in frame = 150 kg approx. (330lb)

Weight in Fresh water: Complete unit in frame = 105 kg approx. (230lb)

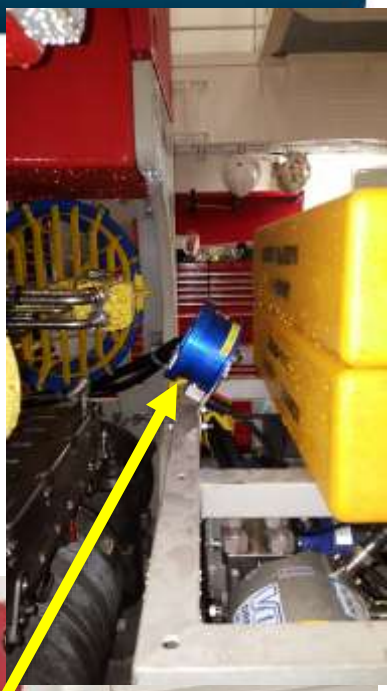
Weight in Fresh water with flotation: Complete unit in frame = 12 kg approx. (5.4lb)

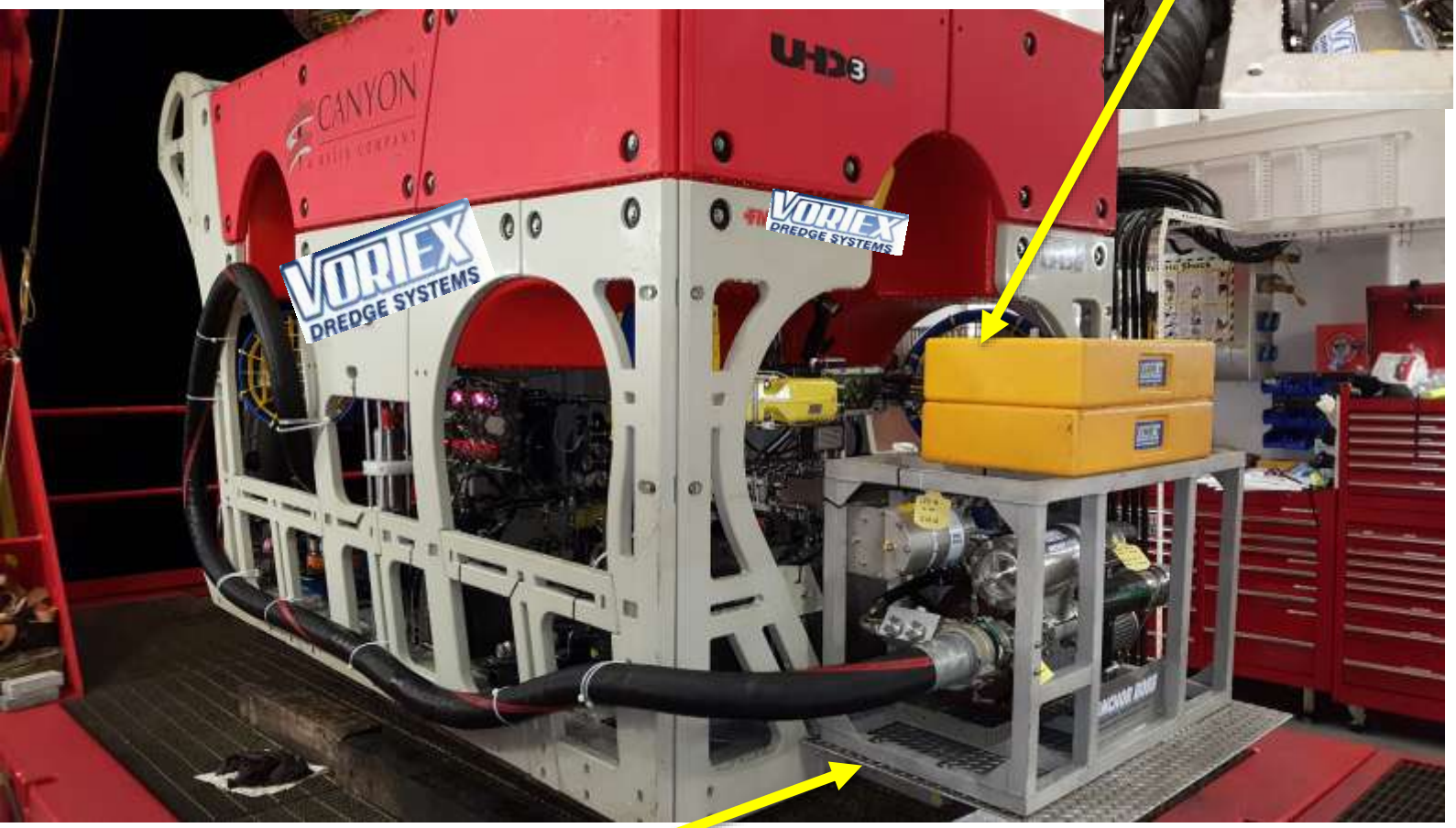
Installation: Flotation.

Shown mounted on rear of Schilling UHD-3 with Perry display mounted in view of the rear view camera.

Orient the frame and bolt it in place to suit your ROV or use the supplied Perry XLX or Shilling HD / UHD mounting kit.

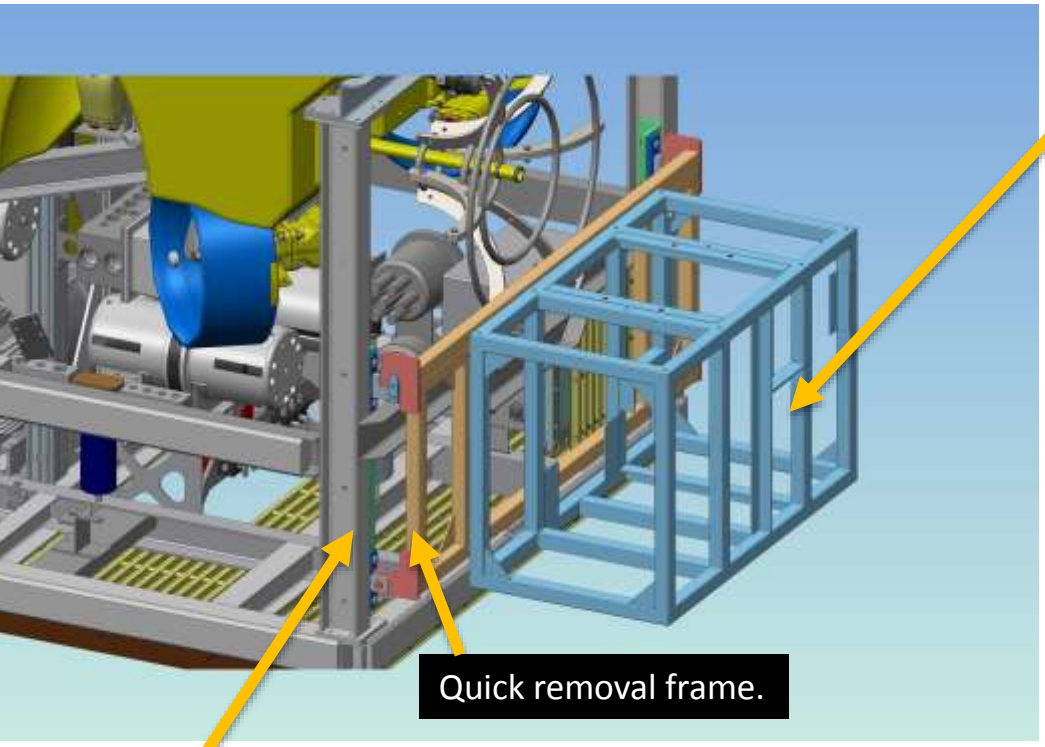
One block of flotation totaling 209lbs (94kg) of lift is supplied with kit.





Vortex supplied HD / UHD frame slots in rear of ROV, Anchor Boss frame bolts to this frame.

Installation: Quick removal frame. Perry XLX shown

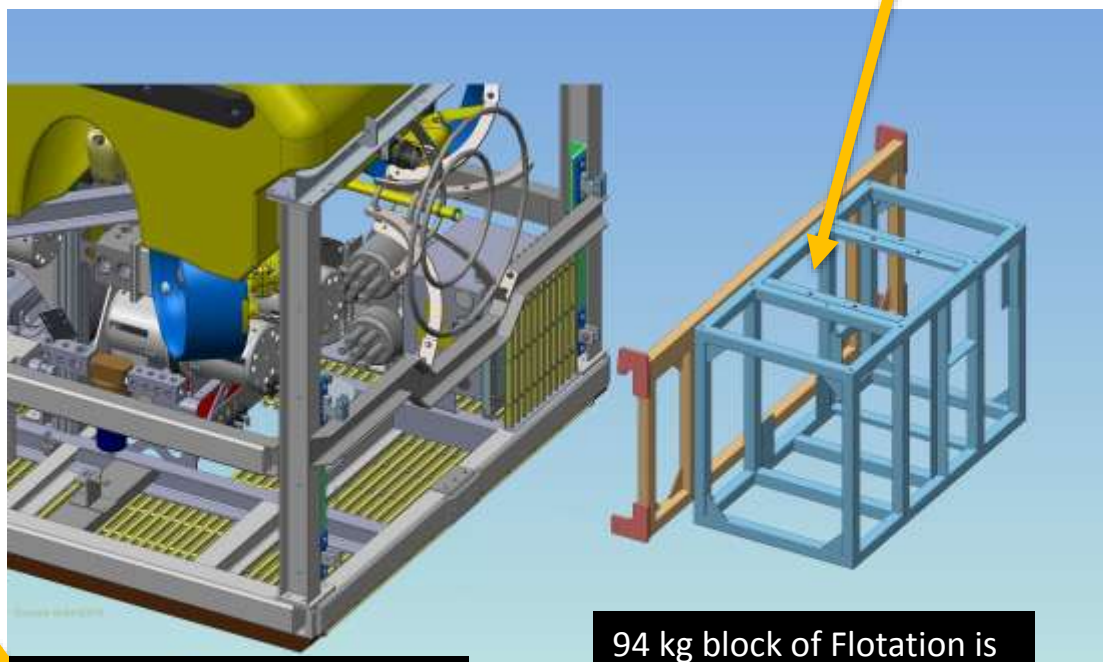


Anchor Boss frame.

Quick removal frame.

The entire tool and quick removal frame combination un-clips in a matter of minutes.

Hydraulic quick connect fittings also available on request.

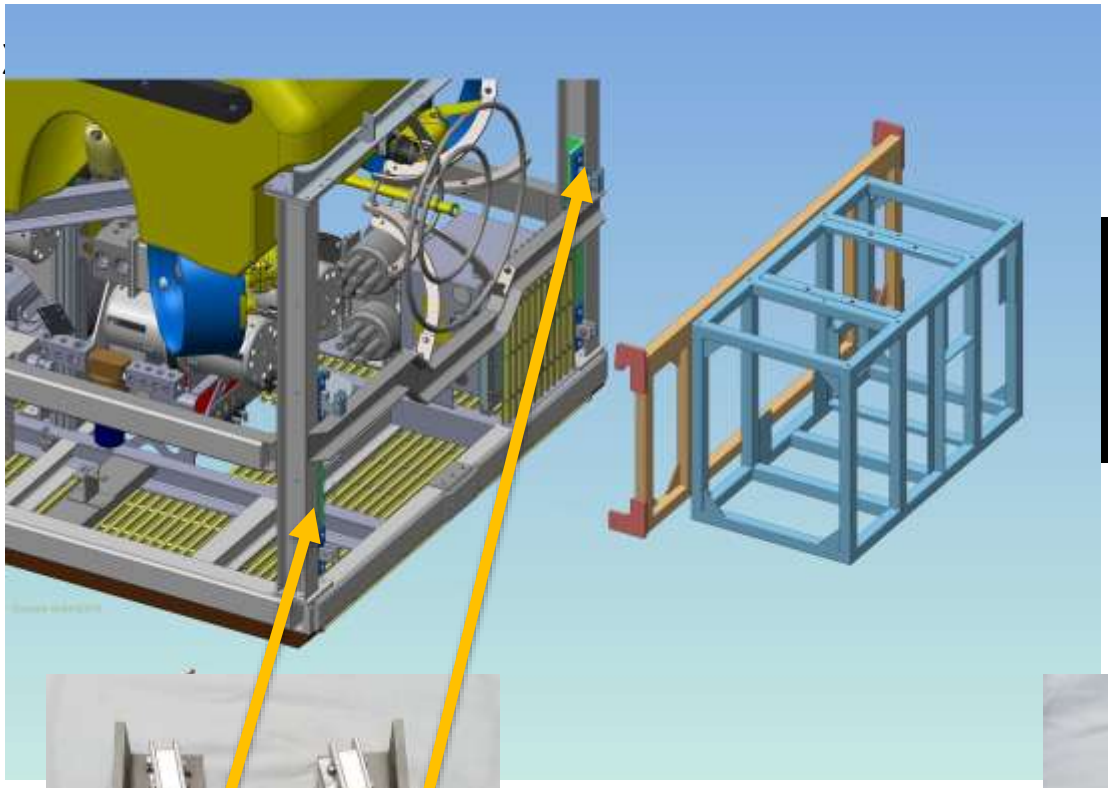


Use existing holes in ROV frame to attach sub frame angle brackets.

94 kg block of Flotation is provided but not shown

Remove rear bumper bar.

Installation: Quick removal frame – sub frame angle brackets . Perry

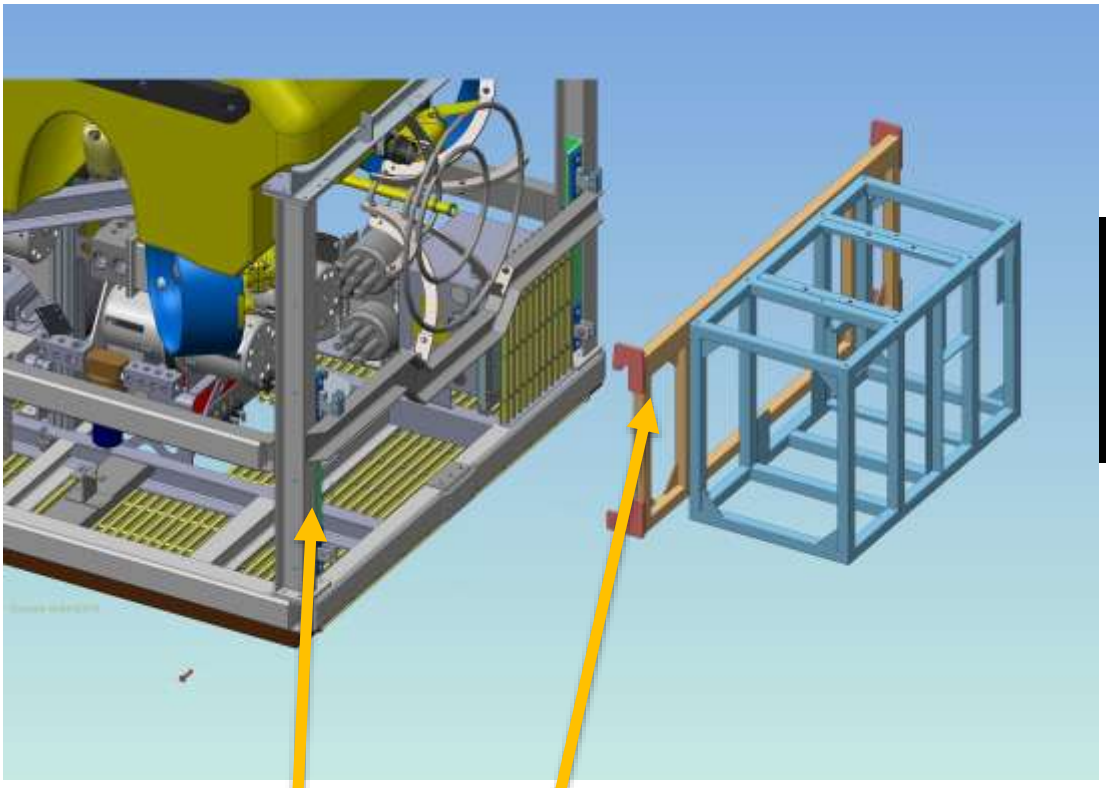


Vortex Base frame bolts to ROV using existing ROV frame holes.
Drill into Vortex Base frame to align holes if needed.

Adjust bolts and brackets to suit and line up with quick removal frame .

Slot these holes or drill this bracket to suit the ROV frame.

Installation: Quick removal frame. Perry XLX shown

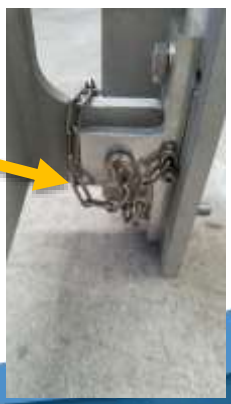


Vortex Base frame bolts to ROV using existing ROV frame holes.
Drill into Vortex Base frame to align holes if needed.

This bracket bolts to ROV. Drill holes in this bracket to suit existing ROV holes.

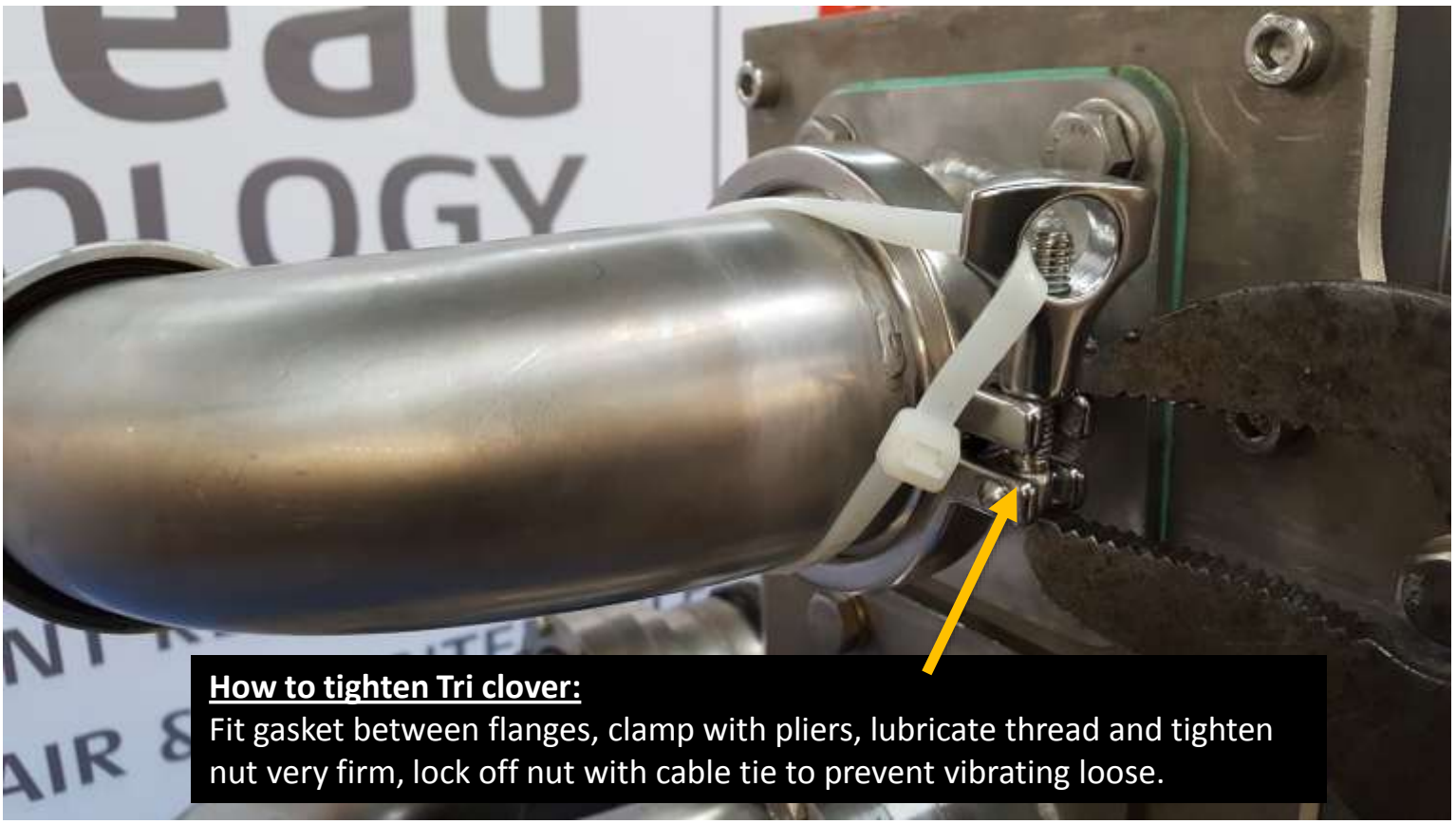
This bracket bolts to ROV.

Bottom pin locks tool to ROV.

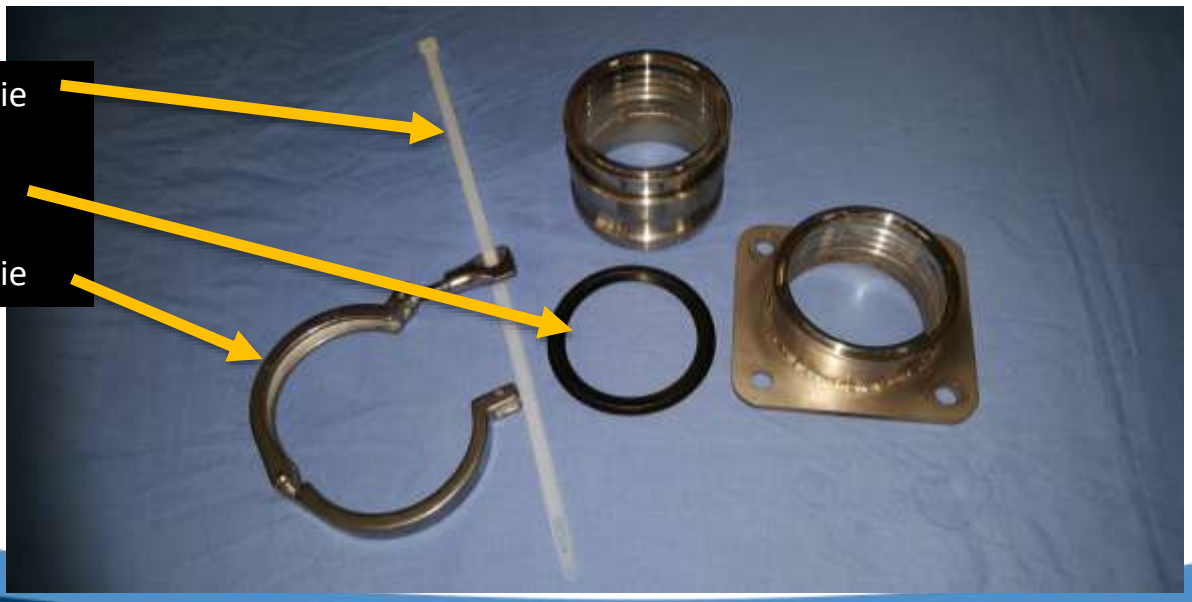


Installation: Pipe clamps

TRI clover clamps are used throughout to reduce time reconfiguring hoses and pipework.



How to tighten Tri clover:
Fit gasket between flanges, clamp with pliers, lubricate thread and tighten nut very firm, lock off nut with cable tie to prevent vibrating loose.



Hydraulics: Vortex Anchor Boss

Hose Connectors for motor:

3/4” Pressure	Hydraulic Hose -12	JIC male fitting
3/4” Return	Hydraulic Hose -12	JIC male fitting
3/8” Case Drain	Hydraulic Hose -6	JIC male fitting

Hose Connectors for slide cylinders:

1/4” A / suck	Hydraulic Hose -4	JIC male fitting
1/4” B / blow	Hydraulic Hose -4	JIC male fitting

Hose Connectors for solenoid:

1/4” Pressure	Hydraulic Hose -4	JIC male fitting
3/8” Tank return	Hydraulic Hose -6	JIC male fitting

Hydraulic requirements for water pump:

Minimum hydraulic pressure: 60bar (870 psi)

Max Hydraulic Pressure (Hyd motor): 350 bar (5076 psi)

Minimum hydraulic flow: 70 lpm (18.4 gpm)

Optimum hydraulic flow: 100 lpm (26 gpm)

Maximum hydraulic flow: 180 lpm (47.5 gpm)

Hydraulic requirements for slide cylinders:

Minimum hydraulic pressure: 105bar (1500 psi)

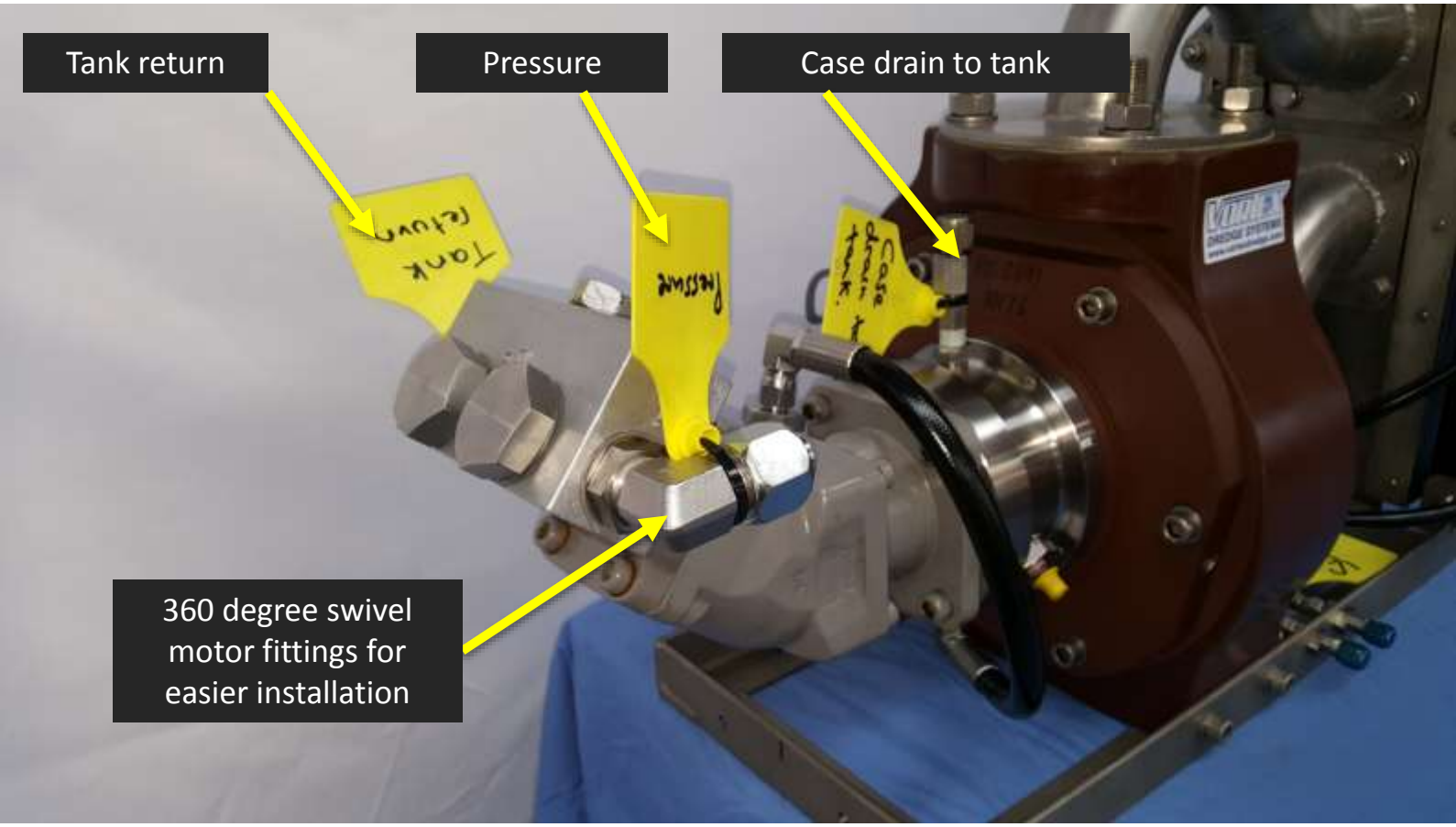
Max Hydraulic Pressure (Hyd motor): 220 bar (3200 psi)

Fill hydraulic motor and case drain cavity with clean oil before start up.

Pump can also be run in air for prolonged periods during deck checks

Hydraulics:

Anchor Boss motor connections.
Motor over run block fitted as standard kit to allow motor to slowly run down in the event hydraulic supply is suddenly stopped.



Hydraulics:

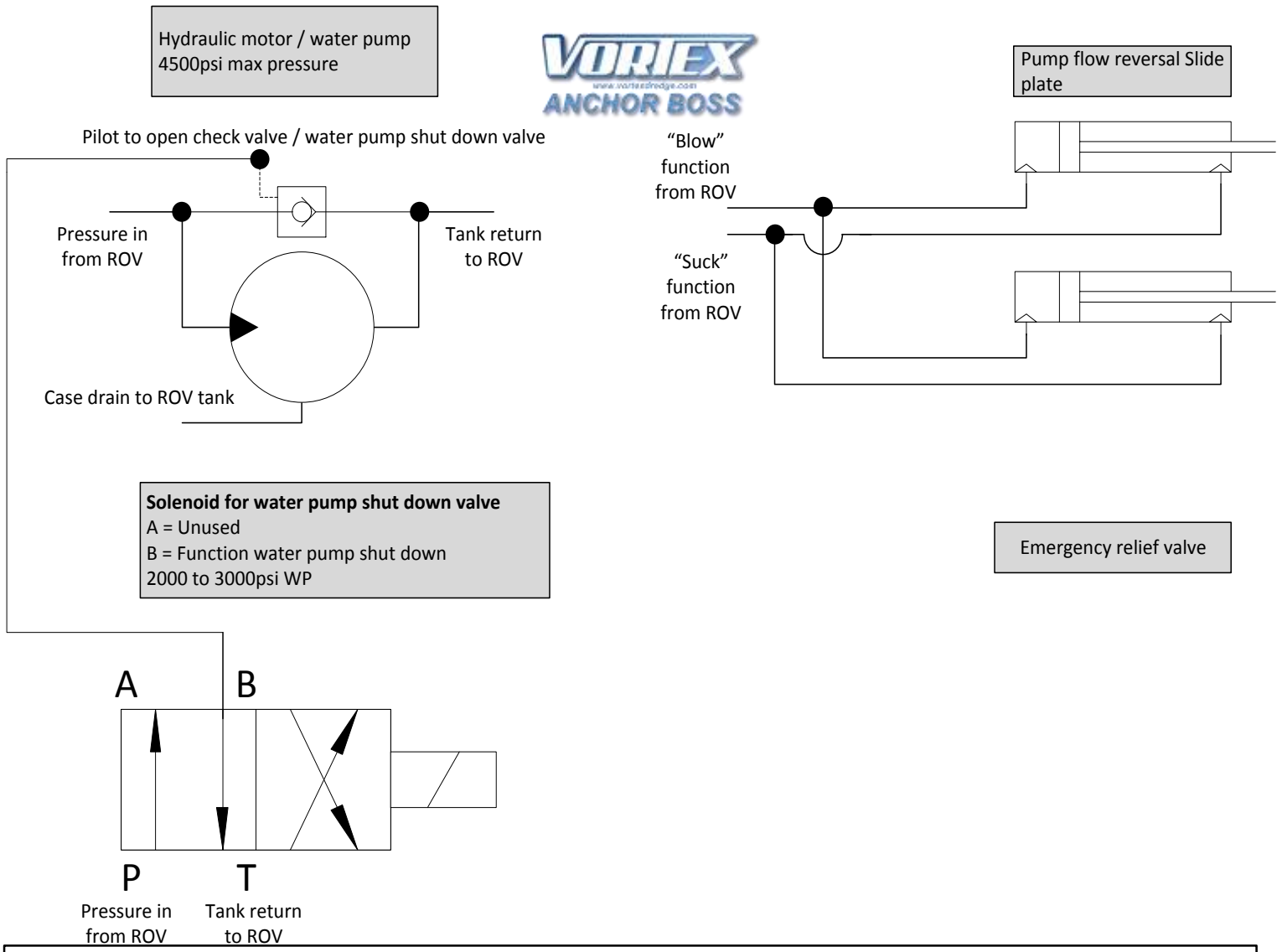
Anchor Boss connections. Slide / reversal valve.

All fittings clearly marked

Slide / reversal valve cylinders

Connect ROV solenoid valves here to activate slide valve into SUCK / BLOW mode

Hydraulics: Schematics Drawing Vortex Anchor Boss



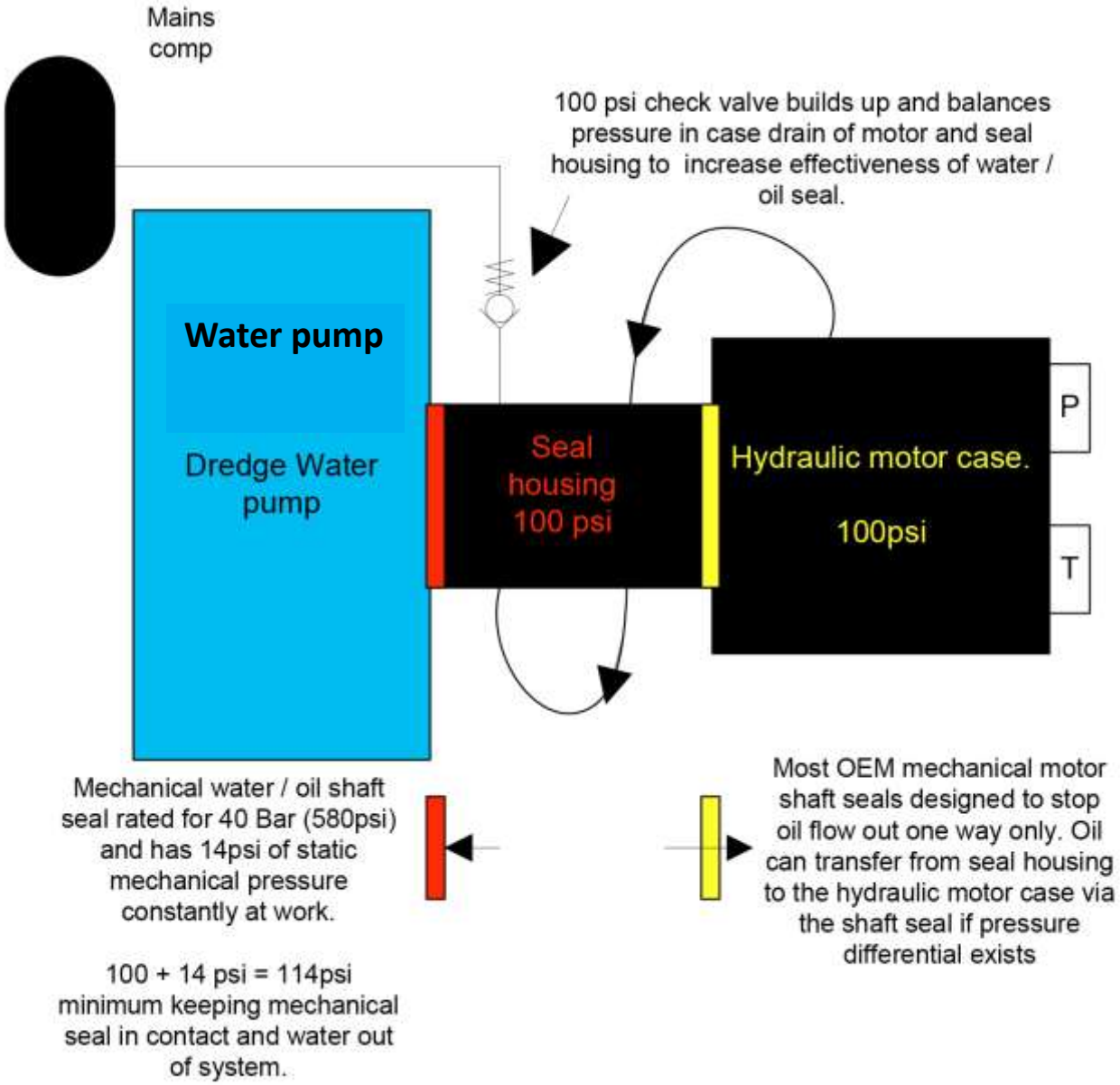
IMPORTANT:

ALWAYS bleed air from motor and hydraulic hoses prior to running pump above idle speed.

Failure to do this can cause hydraulic motor failure. Always ensure a high standard of cleanliness when connecting and disconnecting hoses.
Try to avoid using quick connect fittings.

Hydraulics:

Vortex Anchor Boss case drain.

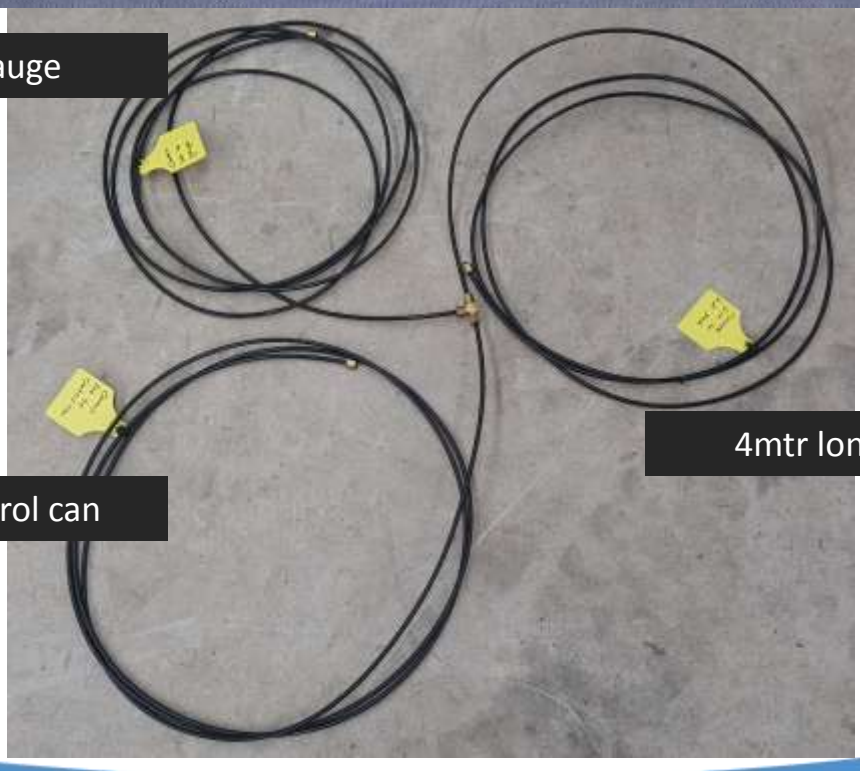


Control line to Hot Stab, gauge and Control can:

Pressure differential line to hot stab:

Connect 6mm control line from port shown to the hot stab to measure pressure differential.

Fittings are 1/8” BSPT to 1/4” hose ferrule.



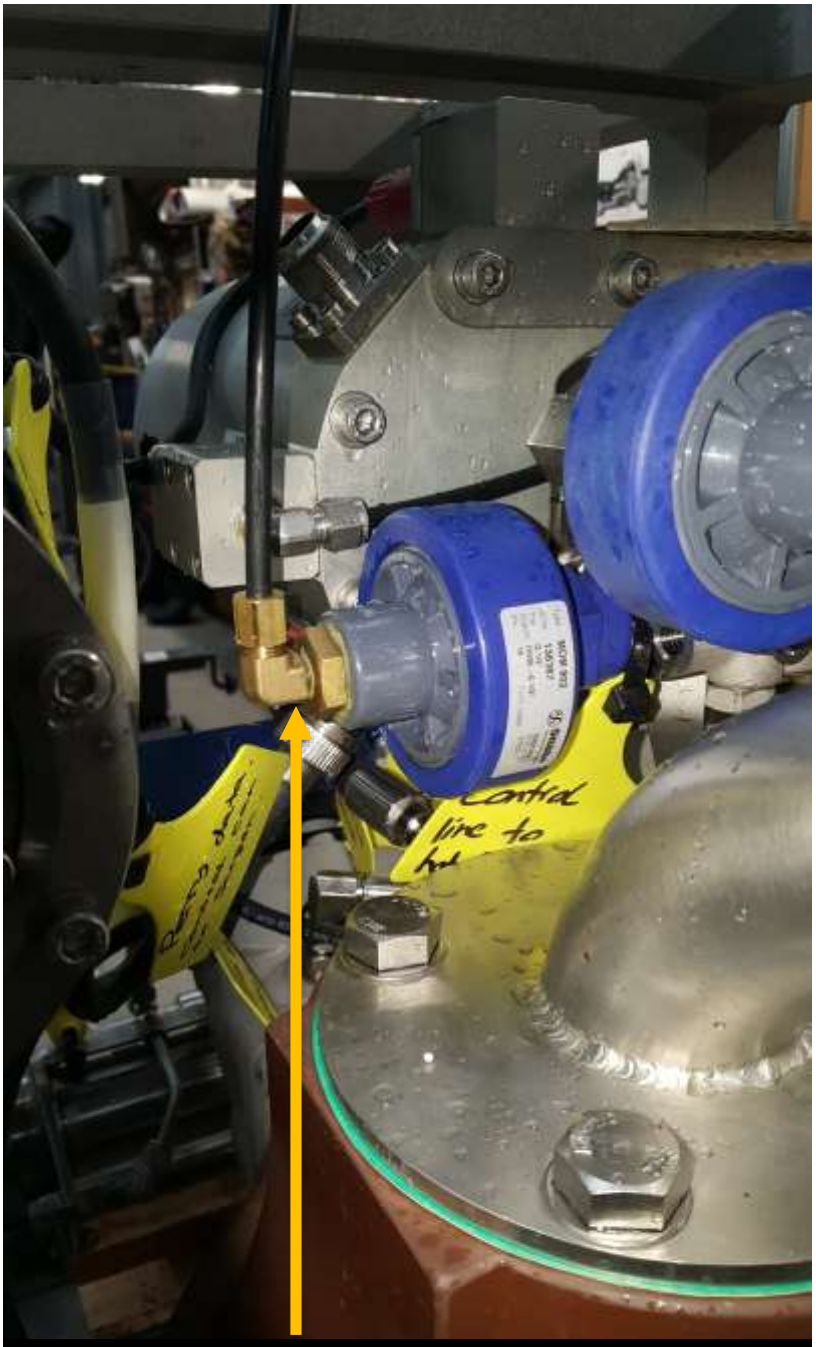
5mtr long to gauge

4mtr long to hot stab

4mtr long to control can

Control line to hot stab:

Pressure differential line to hot stab:



Connect 6mm control line from port shown to the hot stab to measure pressure differential.

Electrical:

Anchor Boss Cables

RPM Sensor to control can cable.

Seacon part #:MC-S062-0295

MCIL3F/MCDLSF on feet of cable to MCIL3F/MCDLSF

Pin 1 Input Voltage 5V	Pin 1 BLACK
Pin 2 Common	Pin 2 WHITE
Pin 3 Output Voltage	Pin 3 GREEN

Anchor Boss control can cable to ROV

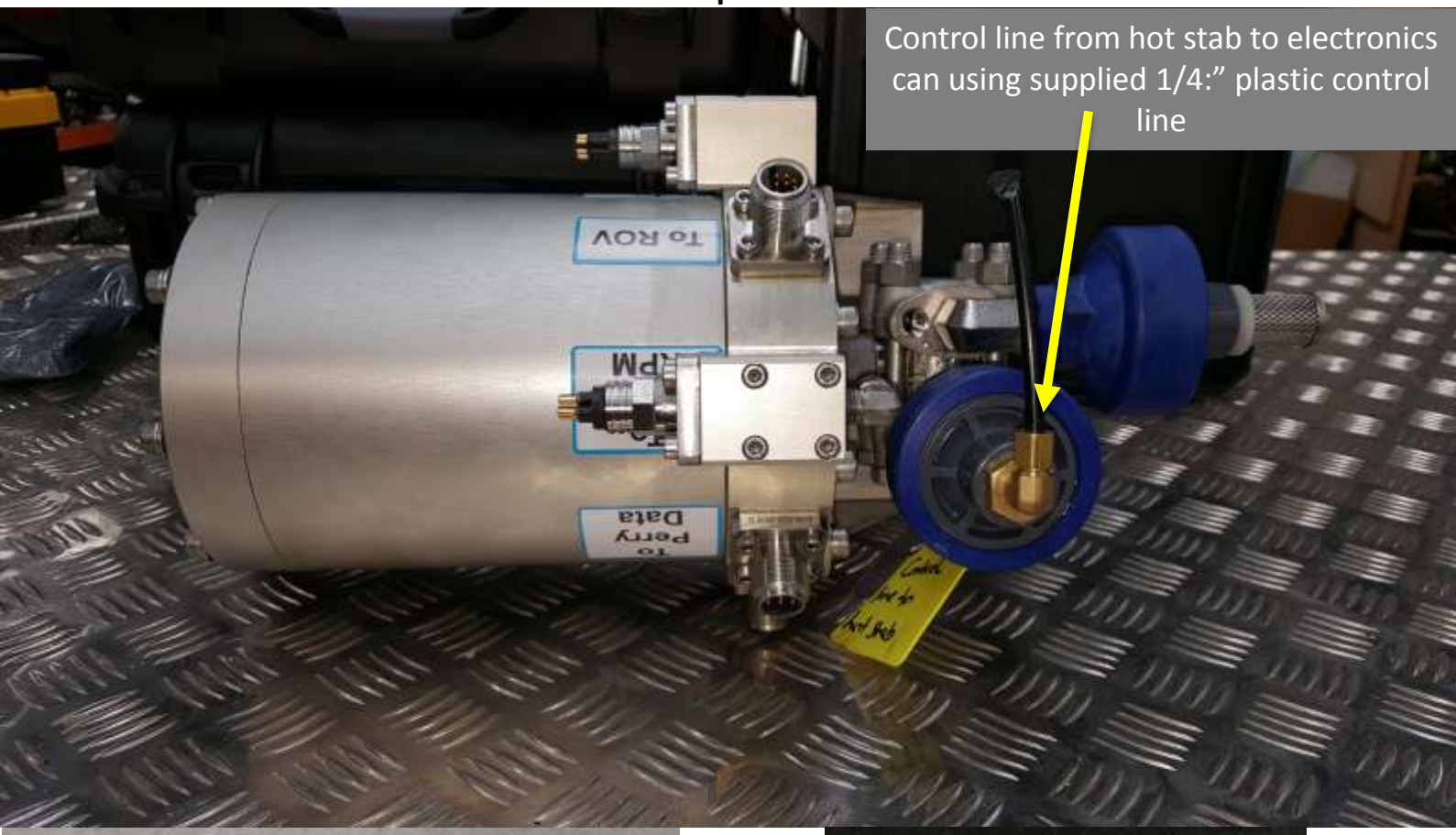
Burton 8 pin connector

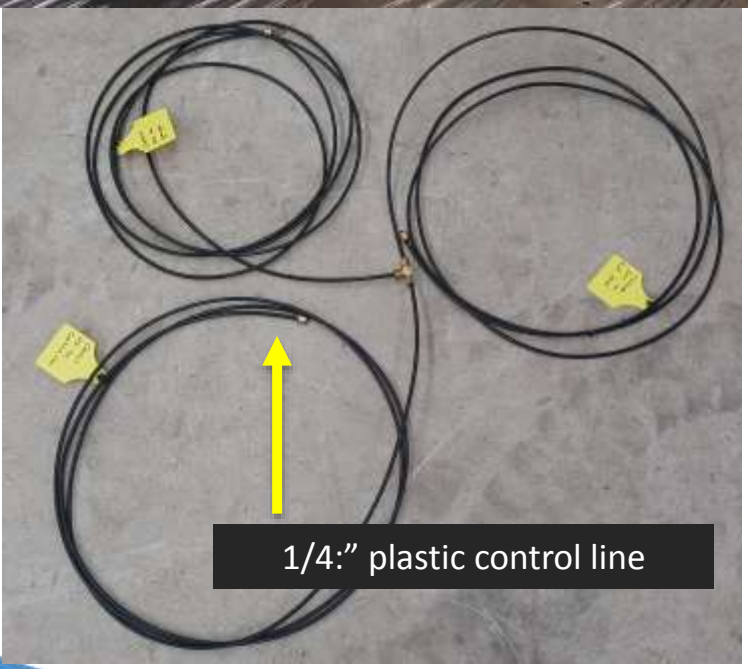
Description	
Pin 1 0V	Black
Pin 2	Shield
Pin 3 +24V	Red
Pin 4 Rx	Green
Pin 5 Tx	Orange
Pin 6 GND	Blue
Pin 7	White with black stripe
Pin 8	White – not used

Topside computer cable to ROV output

RS232 Serial	**Colour**
Power 0V	
Not Used	
Power 24V	
D9 Pin 2	WHITE
D9 Pin 3	GREEN
D9 Pin 5	BLACK

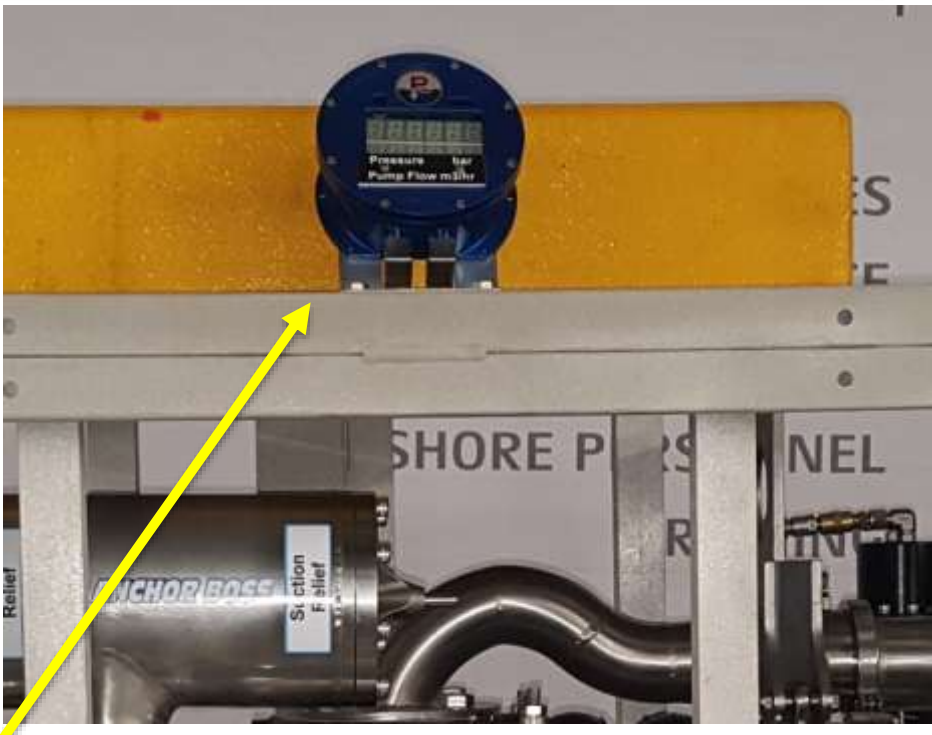
Electrical: Anchor electric components. CONTROL CAN

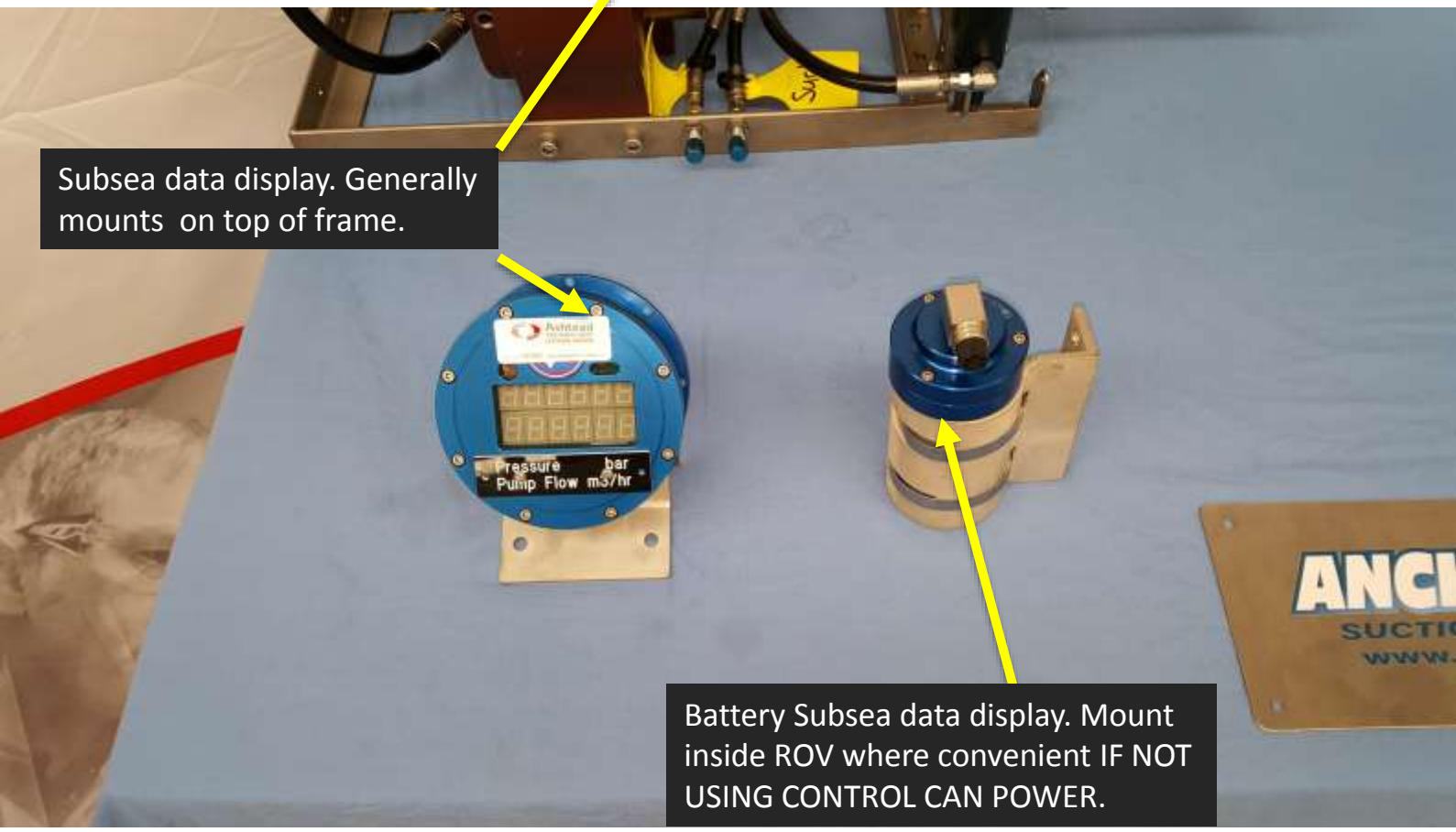




Electrical:

Perry screen.

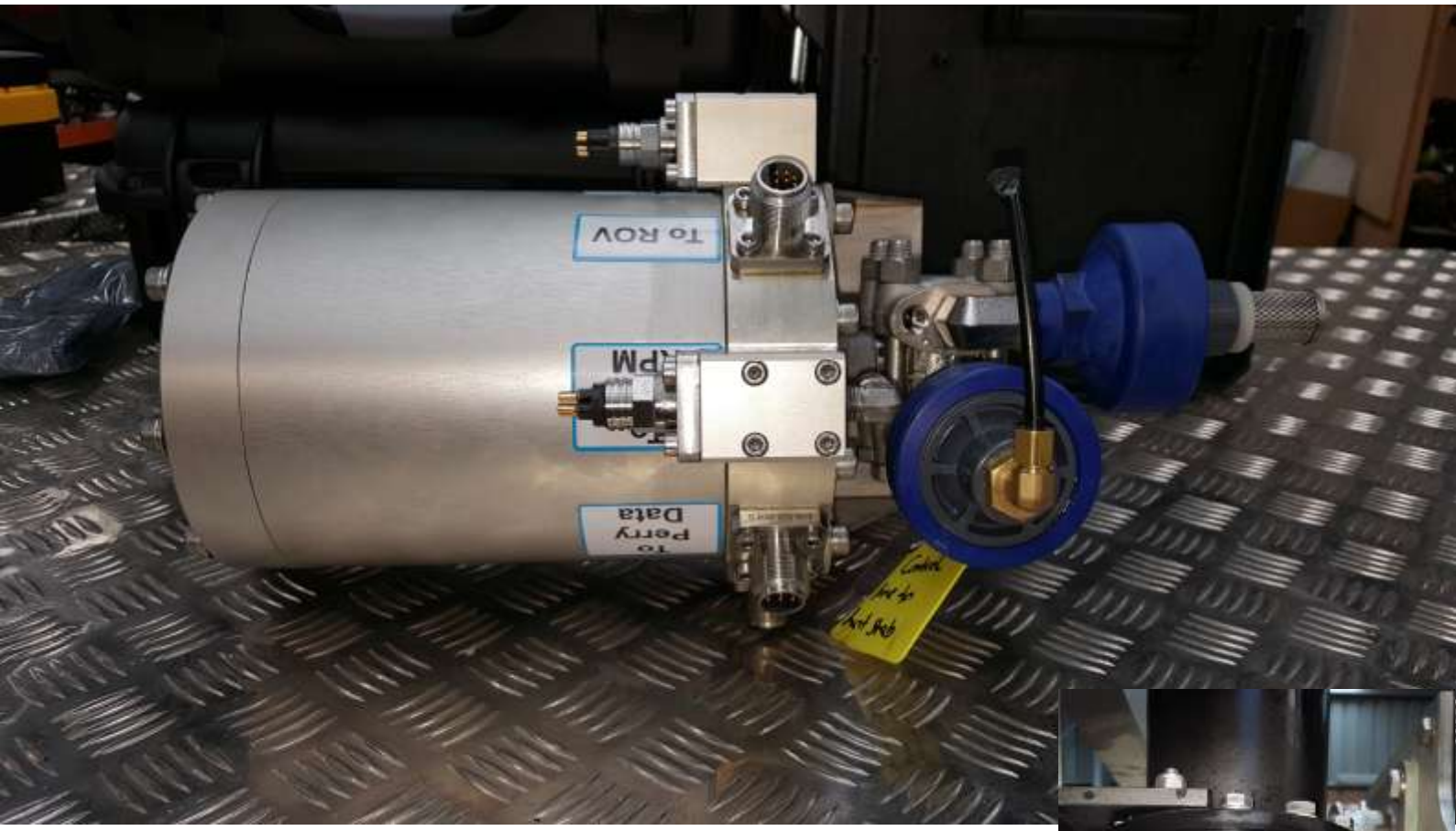




Subsea data display. Generally mounts on top of frame.

Battery Subsea data display. Mount inside ROV where convenient IF NOT USING CONTROL CAN POWER.

Electrical: Control can and oil compensator.



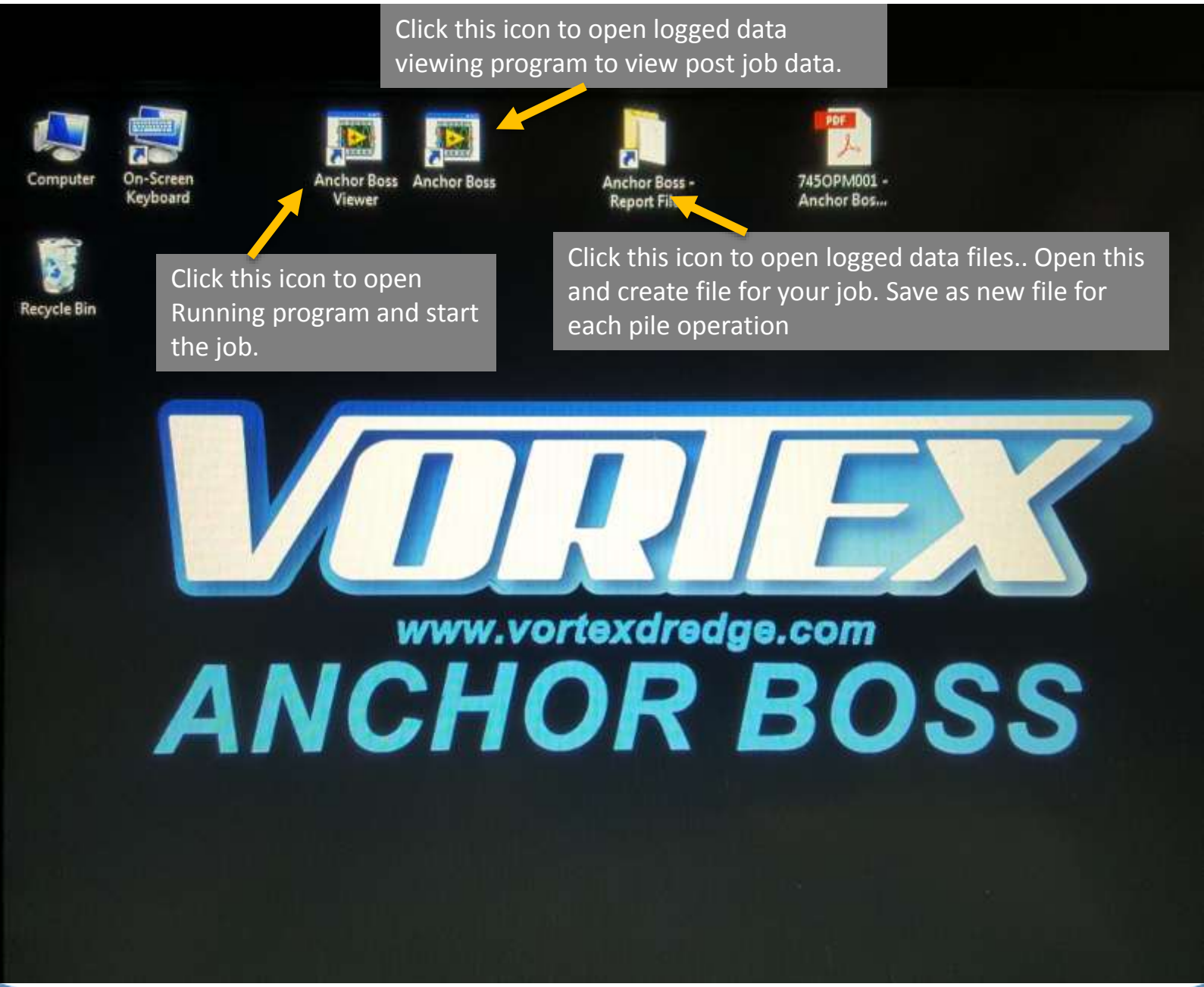
Control can clearly marked for connections of:

- **To Perry data** (data from Perry screen)
- **To Perry power** (power to Perry screen
- **To solenoid** (power to trigger solenoid)
- **To Pump RPM** (to sensor mounted between water pump and hyd motor)
- **To ROV** (data feed to topside)

Control can and solenoid box are oil filled and compensated.
Fill compensator to half way with CLEAN hydraulic oil.
Connection to compensator is Swagelok SS-QC4-B-4MT

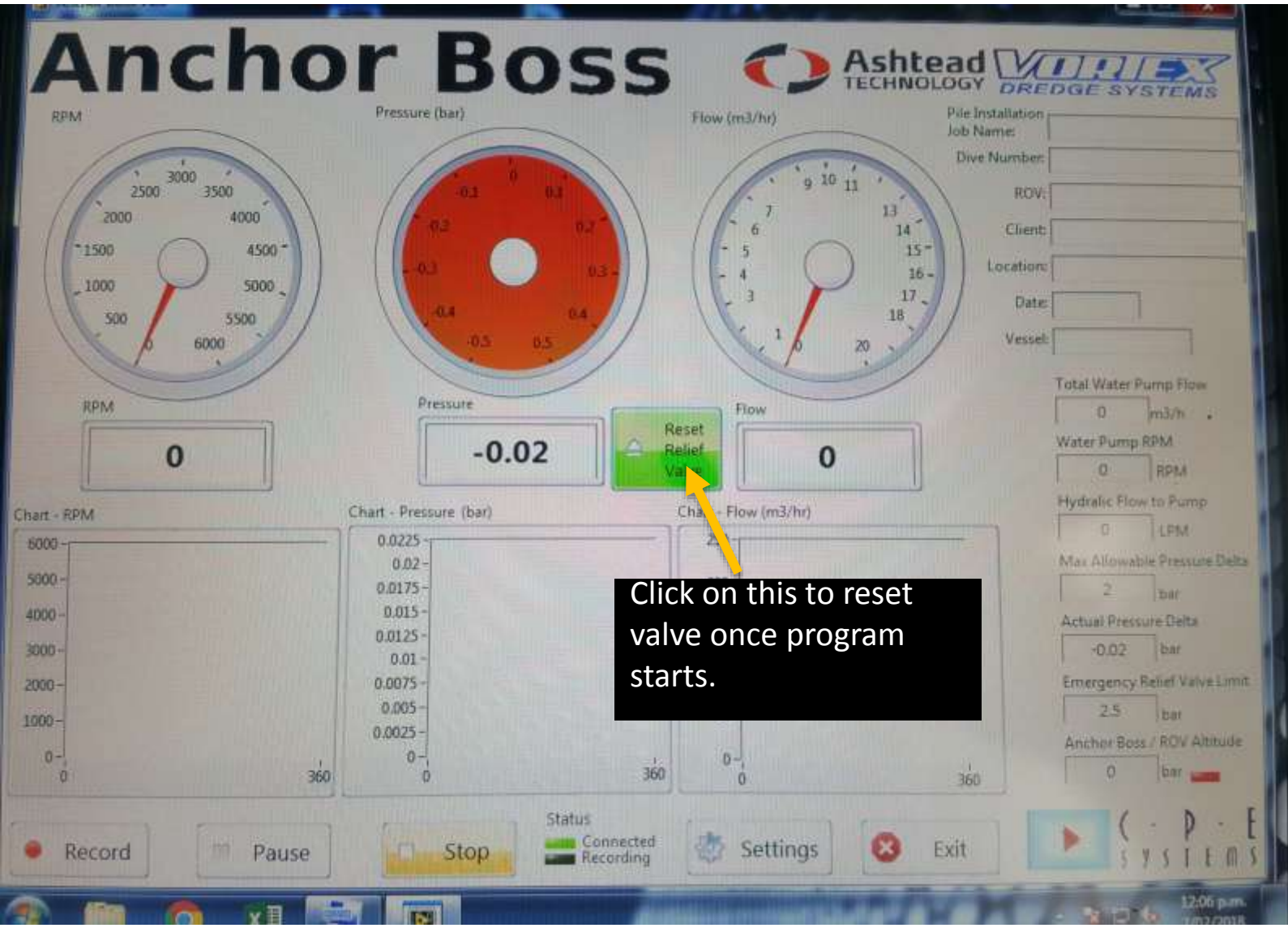
Software: Please read supplied manual

Data logging. Opening the programmes on supplied topside computer.



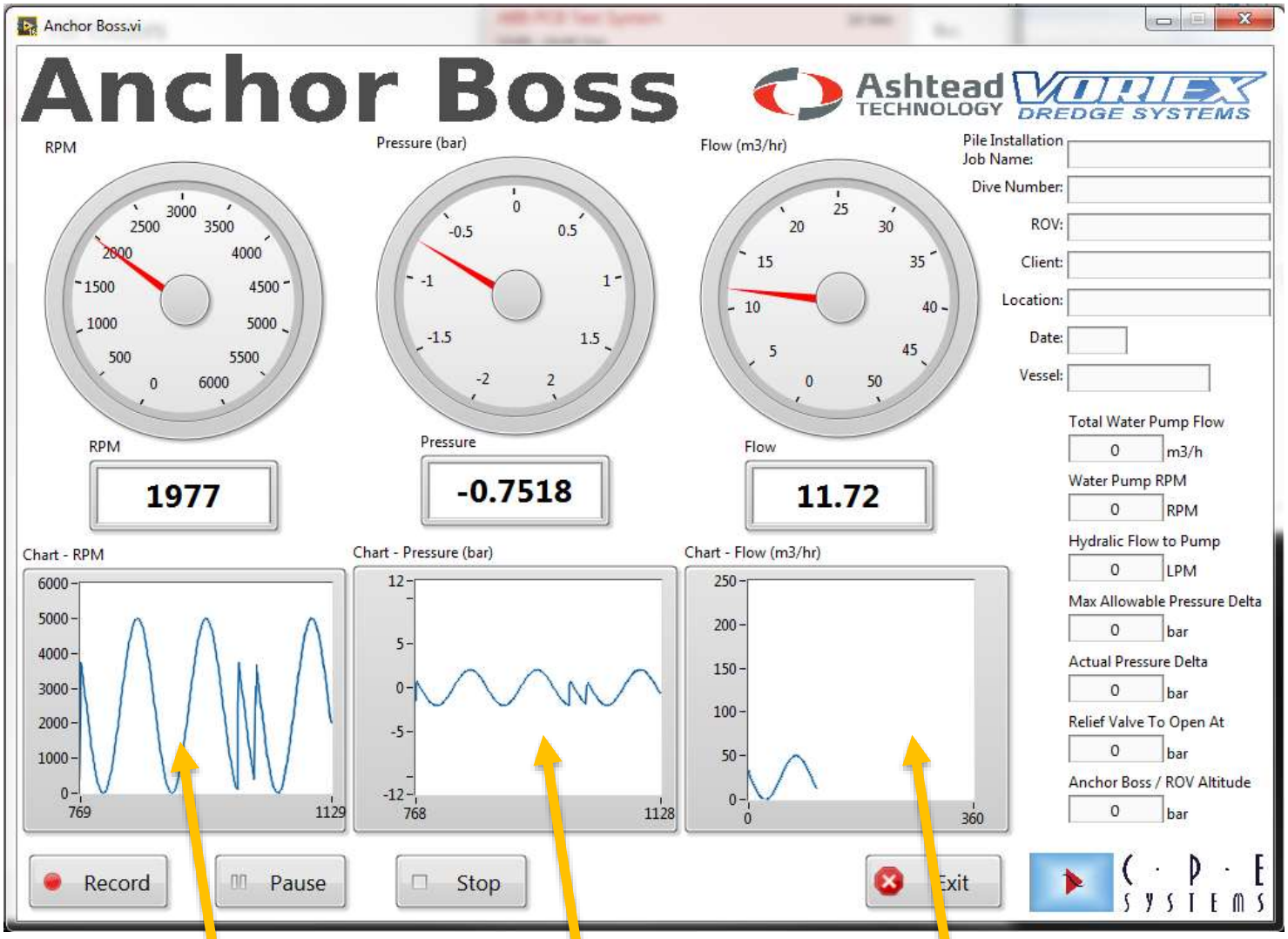
Software:

Upon start up home screen will likely look like this. Click on reset to begin setting up for your job



Software:

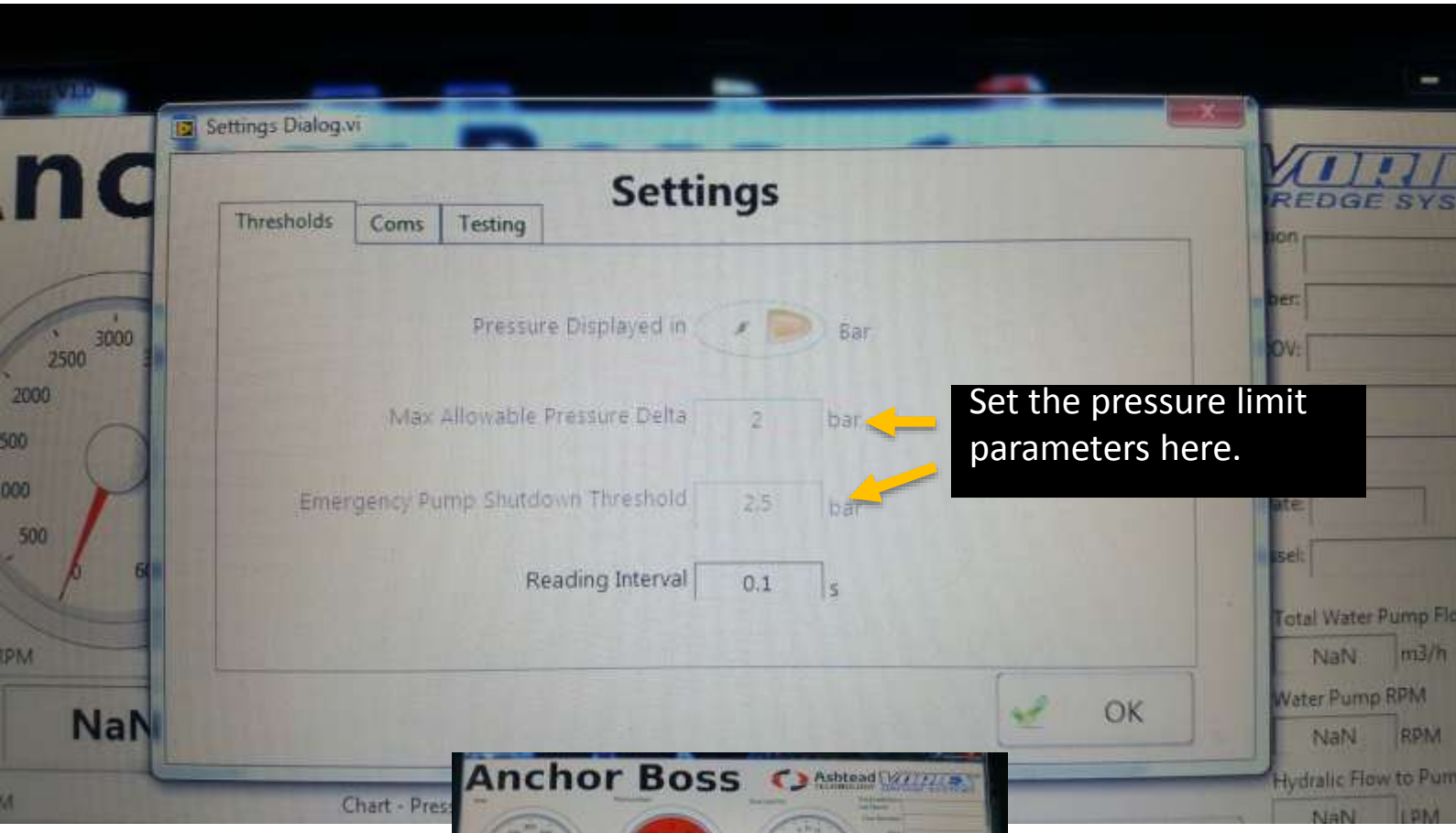
Data logging. <u>Running program</u> showing real time data points in gauge and plot points.



Software:

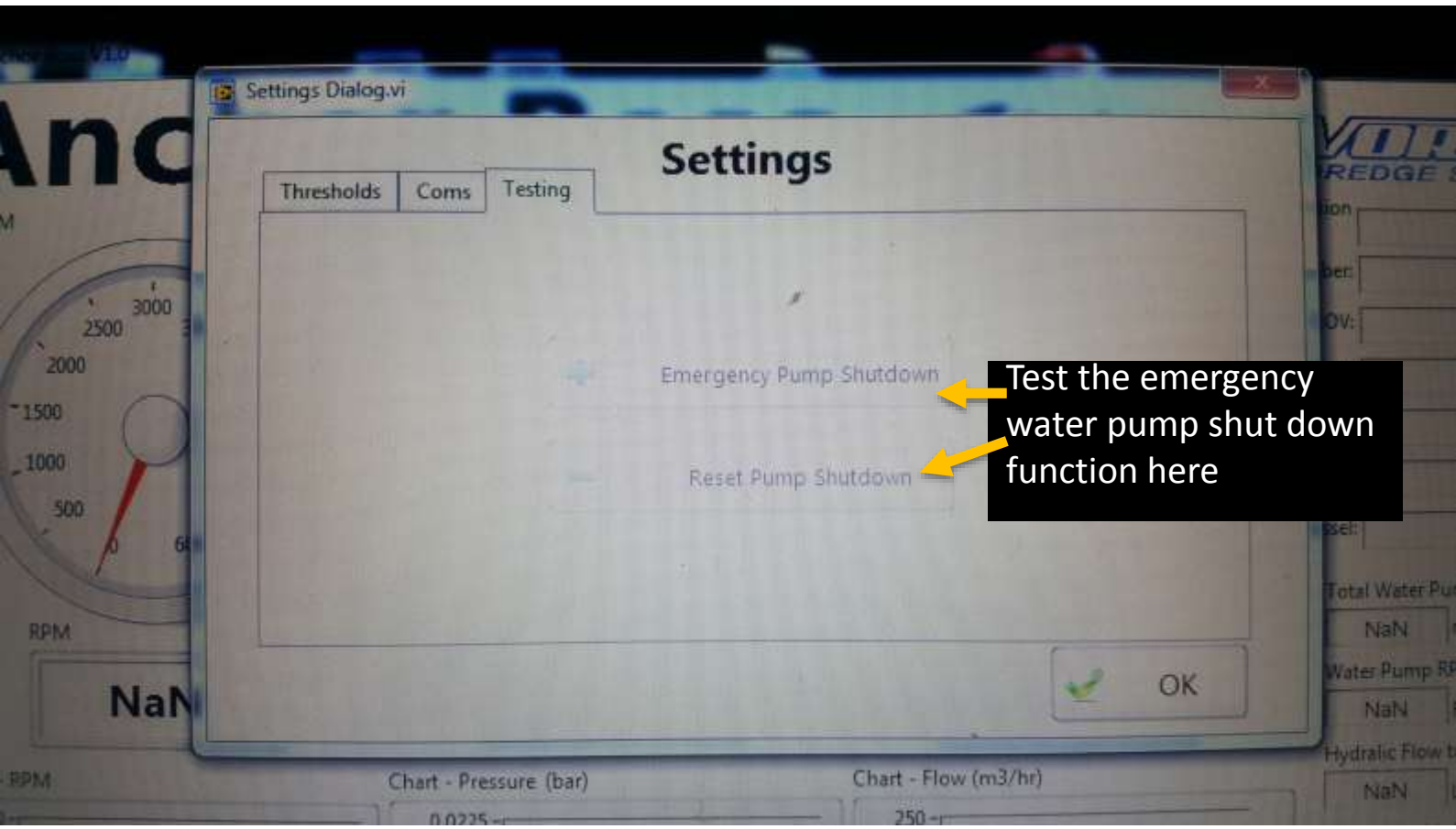
Click settings to set MAIMUM ALLOWABLE PRESSURE DELTA which will give visual warning on centre pressure dial on topside (as seen below) of approaching your setting.

EMERGENCY PUMP SHUTDOWN THREASHOLD will function the solenoid to shut down pump at this pre set figure.



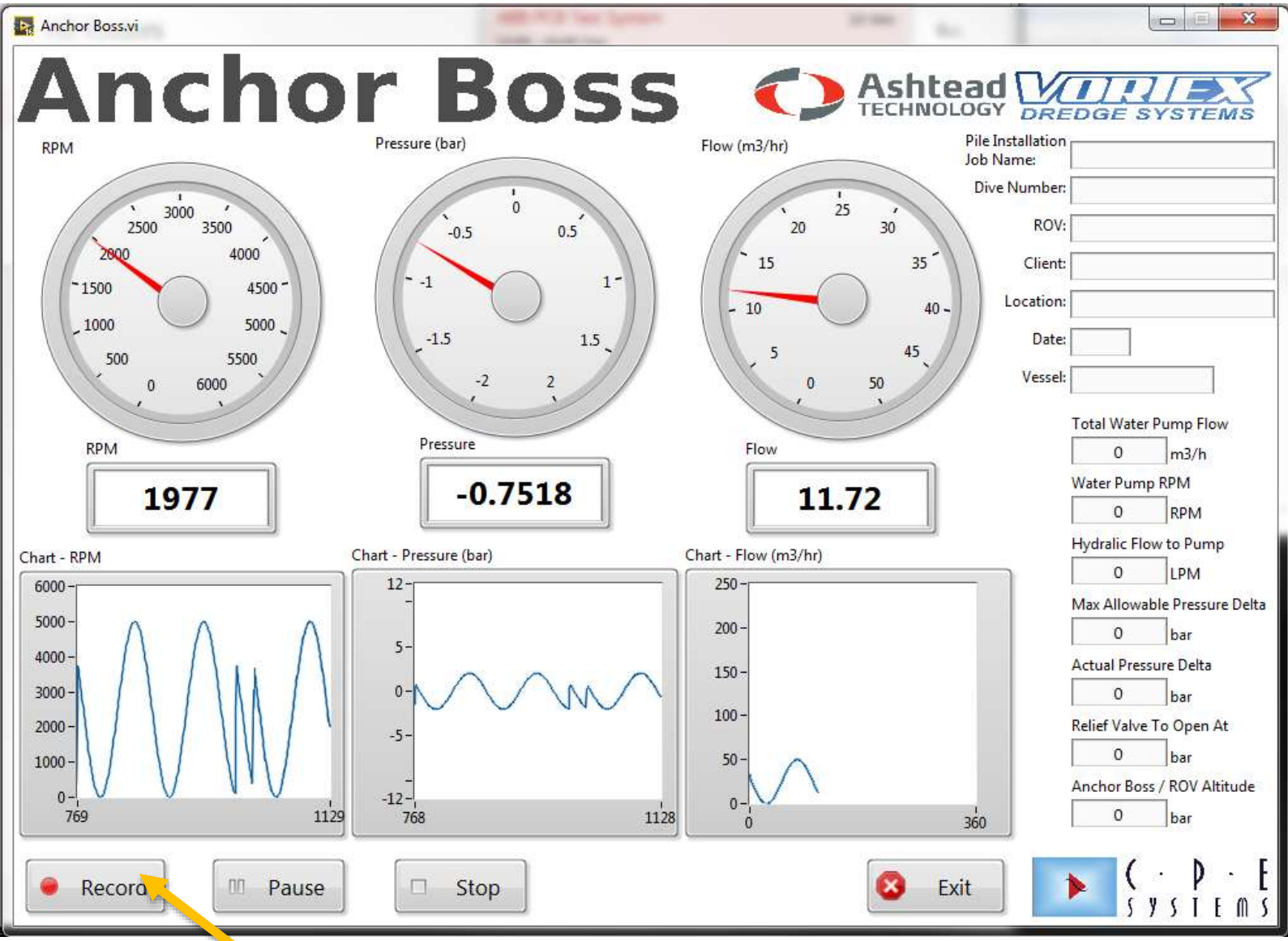
Software:

Operator can test the water pump shut down solenoid by running pump on deck (AFTER BLEEDING AIR) then running up the pump, click on EMERGENCY PUMP SHUT DOWN, look for dope in pressure going through tool and immediate drop in RPM, click RESET PUMP SHUT DOWN then continue parameters set up.



Software:

Press RECORD to go to next step and input job and client particulars.



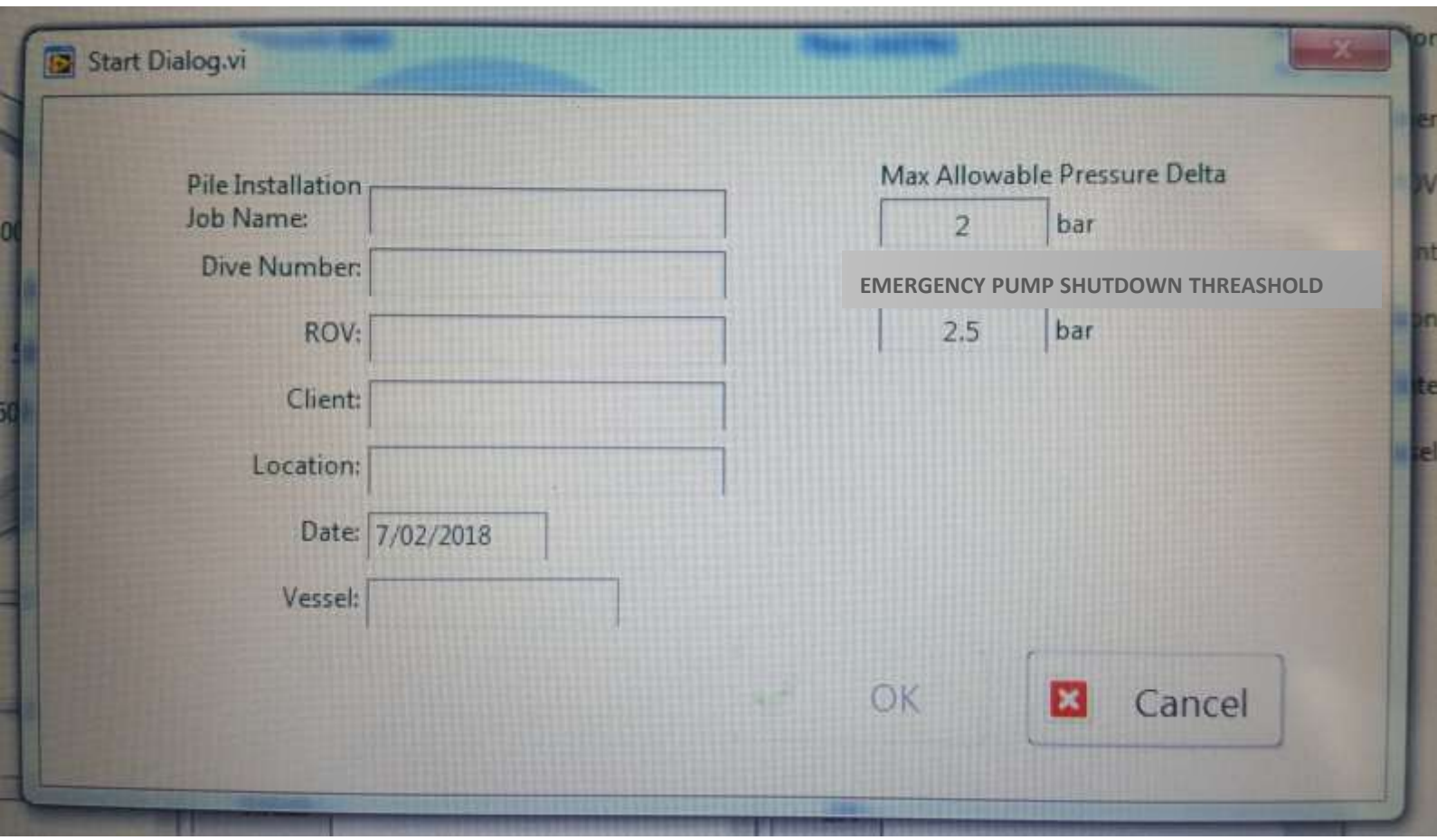
Press to go to next step

Software:

Input job and client particulars plus where you want to set your pressure MAIMUM ALLOWABLE PRESSURE DELTA which will give visual warning on centre pressure dial on topside (as seen below) of approaching your setting.

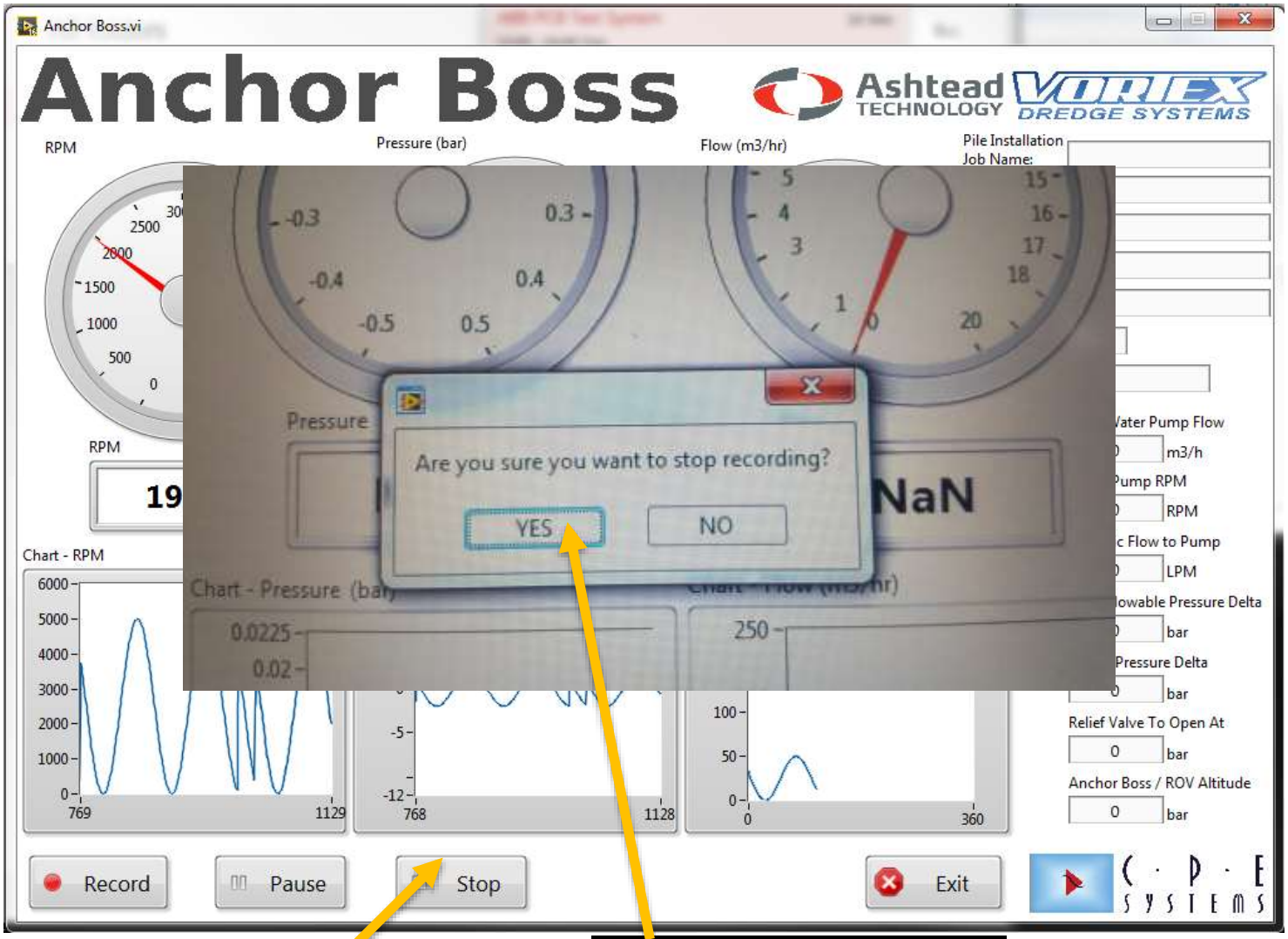
EMERGENCY PUMP SHUTDOWN THREASHOLD .

Click OK to start recording job.



Software: Finishing logging.

Closing out of this page will complete the logging and store the run in the file you created earlier in ANCHOR BOSS REPORT FILES on the desktop.



Push stop when job is complete

Press yes to continue to finish job and go to page showing graph of run just recorded

Software:

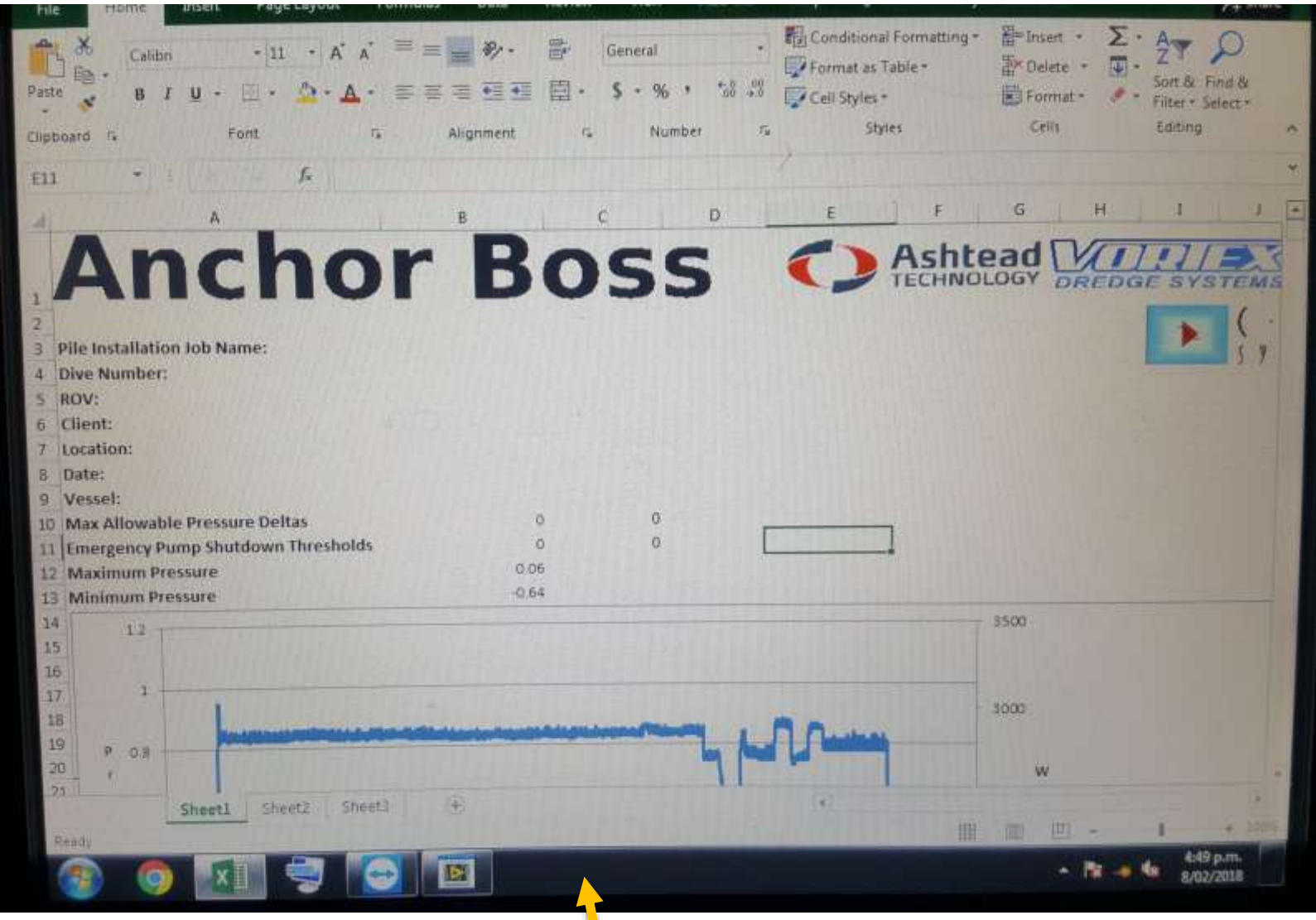
This graph shows the logged data over the last run over a time scale that can be dragged left and right to look for any anomalies.

This data can be opened in Excel for further look at all recorded data points.

Click here to view all data in Excel

Software:

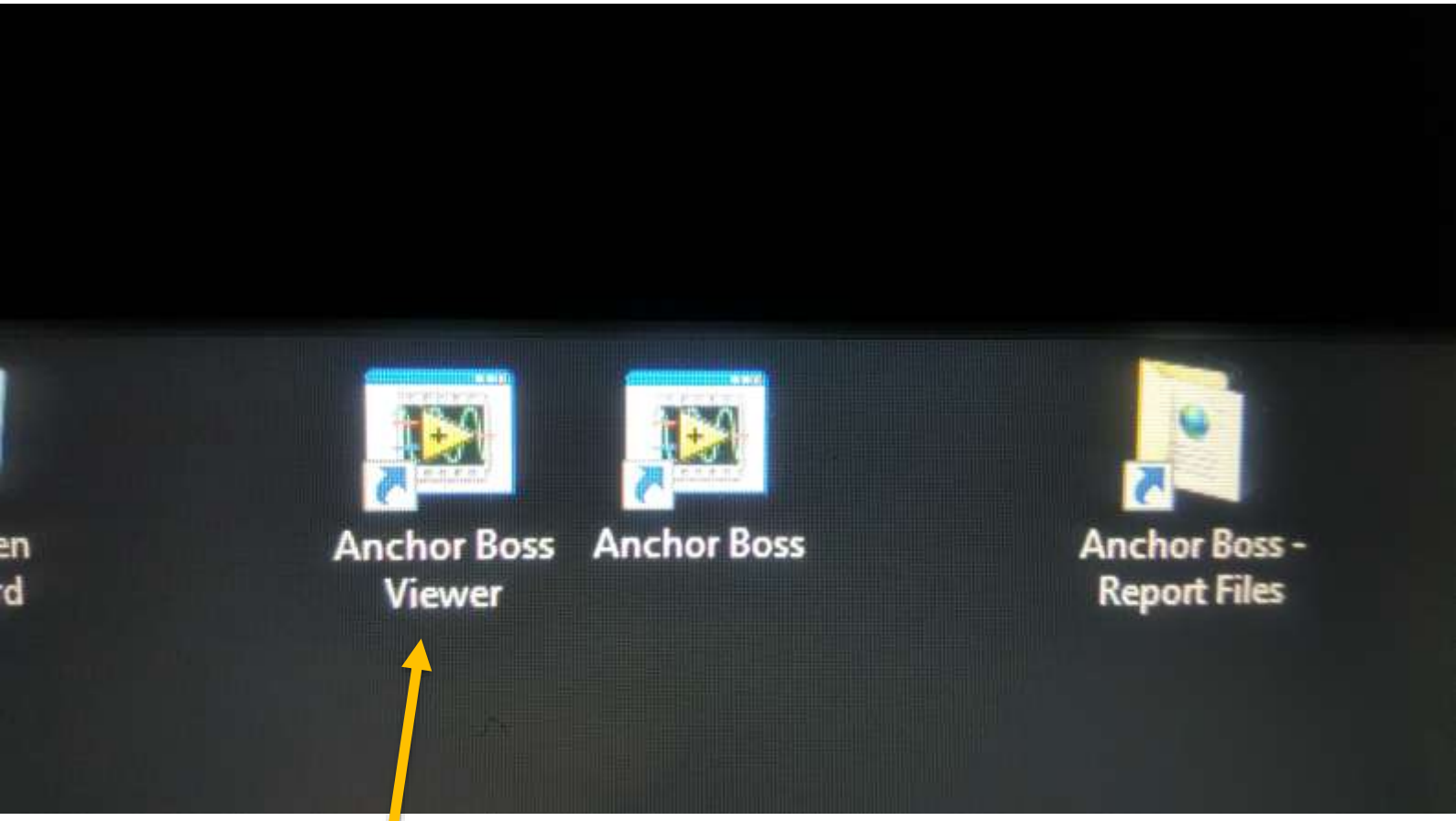
Entire run open in Excel for further look at all recorded data points.



Click here to view all data in Excel

Software:

To look back at the last run or other runs click on ANCHOR BOSS VIEWER on the desk top.

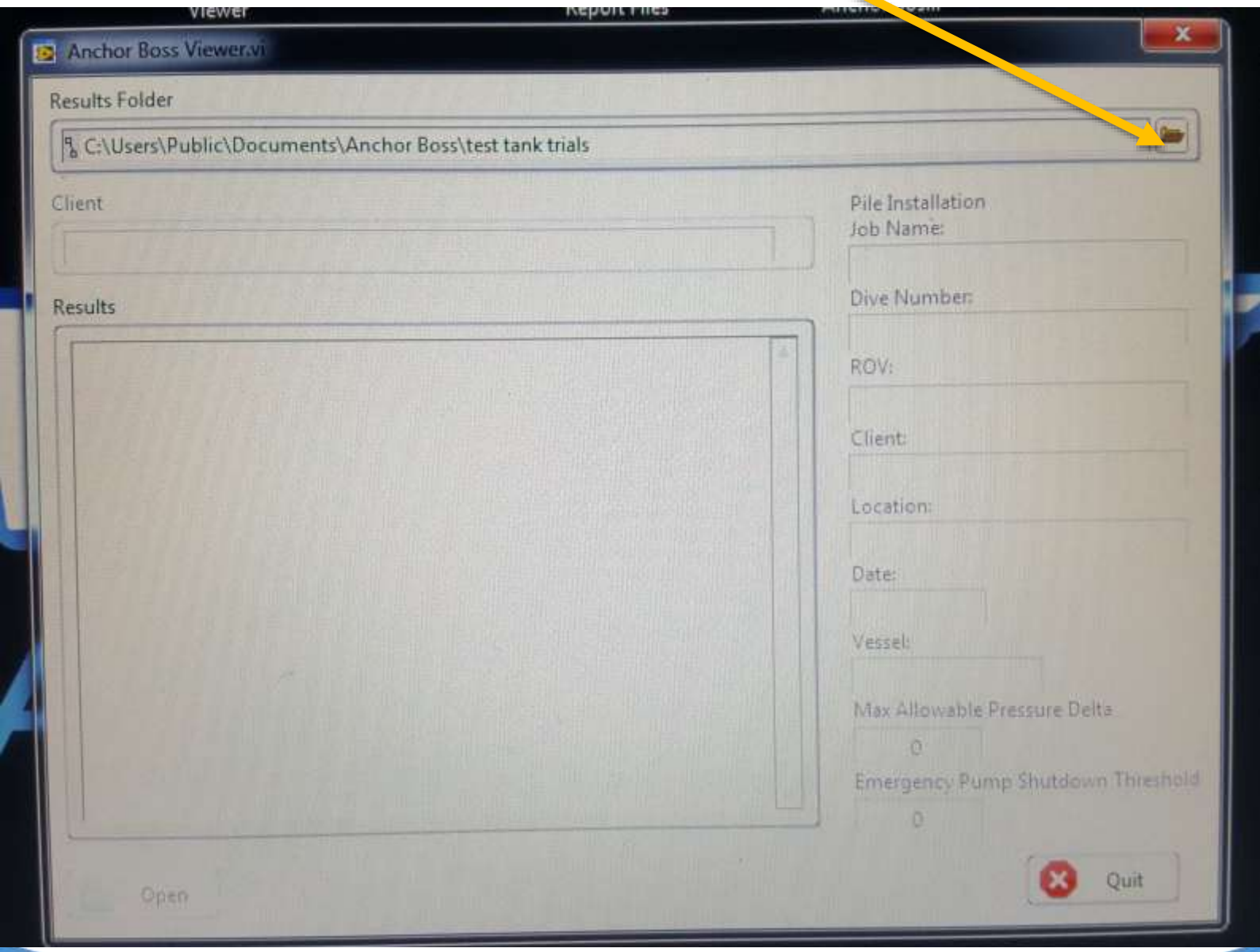


Click this icon to open recorded run viewing program.

Software:

To look back at the last run or other runs follow these steps.

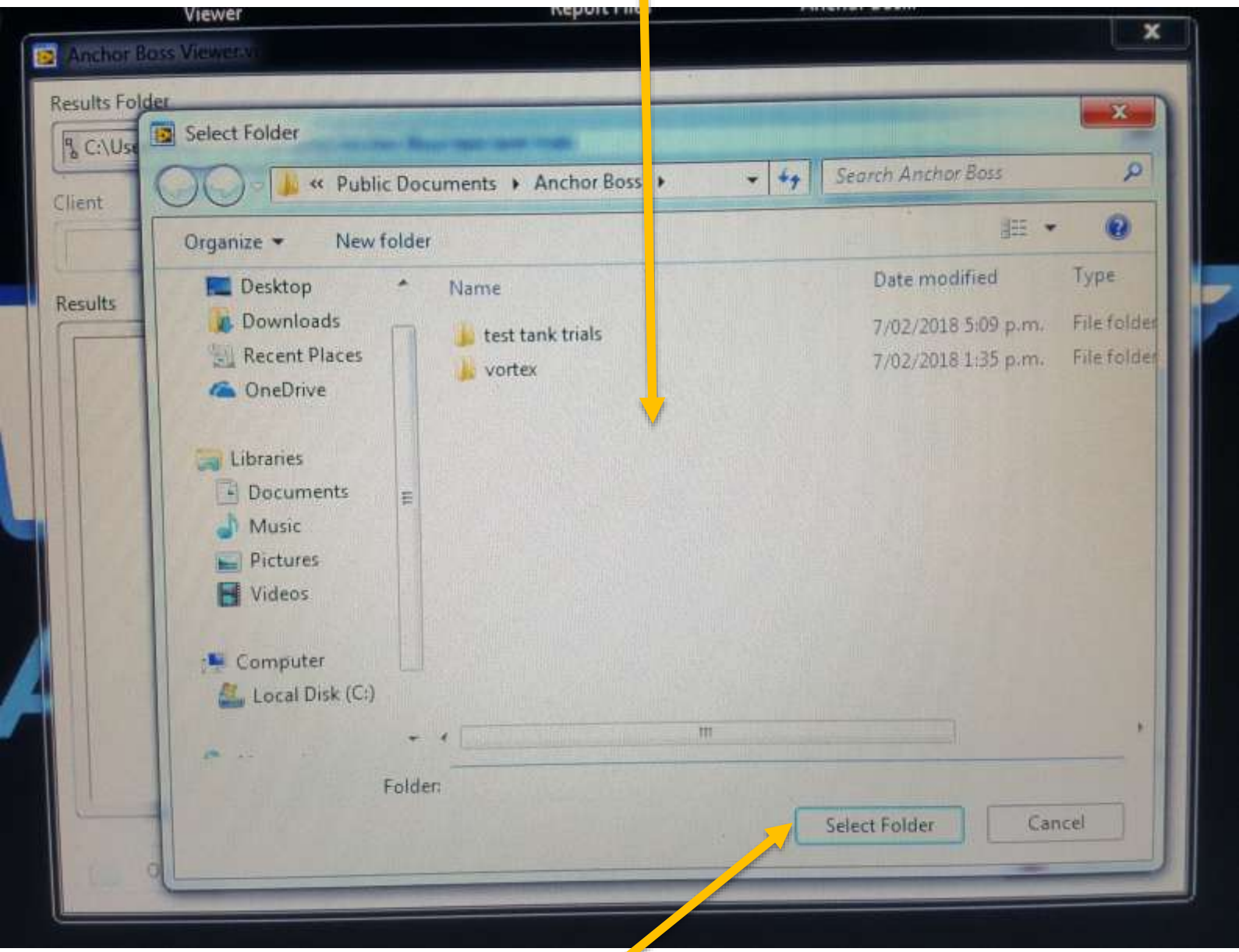
Click this icon to open logged files in Anchor Boss report files



Software:

To look back at the last run or other runs follow these steps.

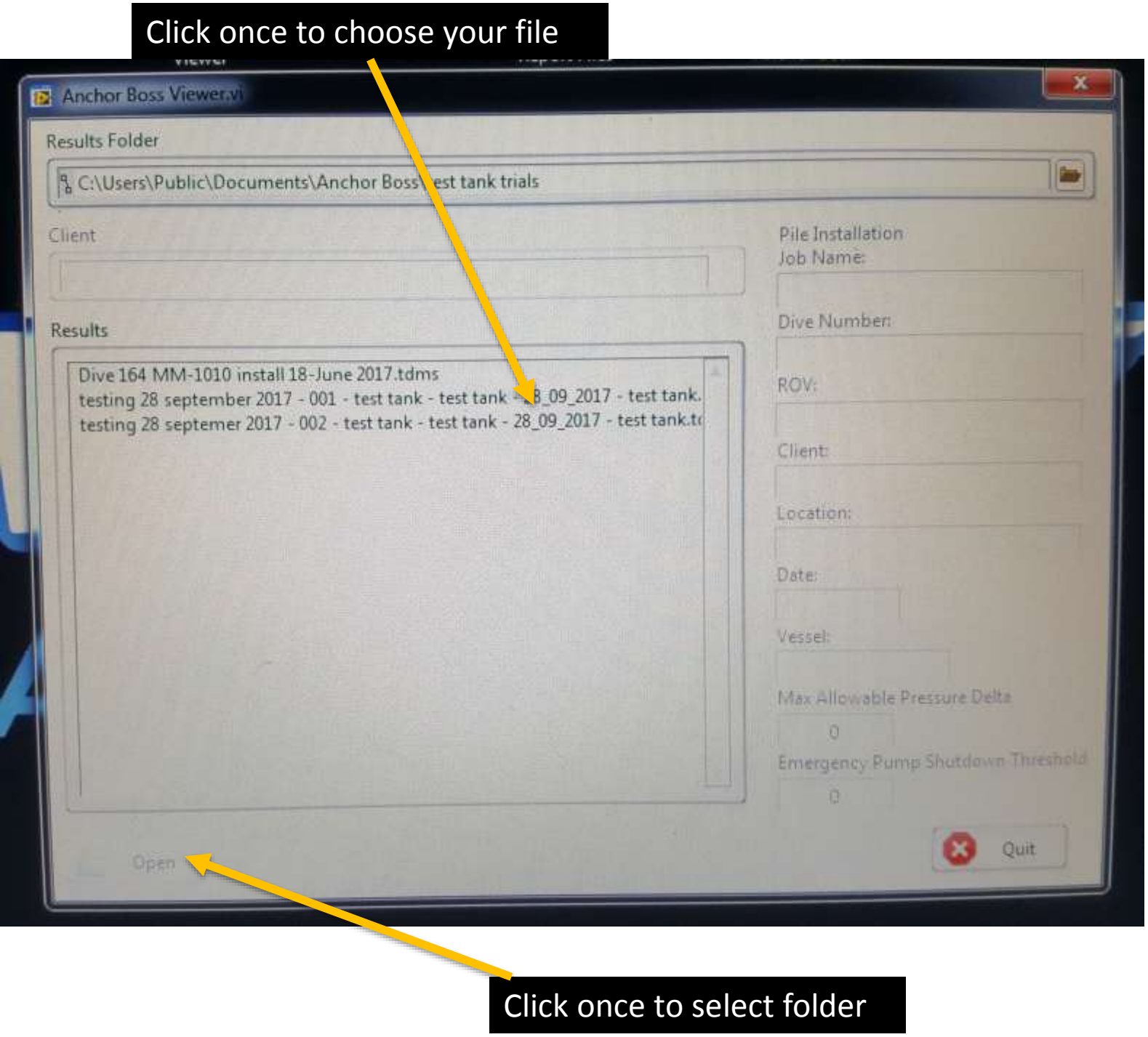
Click once to open the file you crated earlier to find logged run



Click once to select folder

Software:

To look back at the last run or other runs follow these steps.



Software:

To look back at the last run or other runs follow these steps.

Safety:

Personal protection equipment recommended for use when working on ship/platform deck

- Hard Hat
- Safety glasses
- Gloves
- Safety Boots
- Overall

Risks - Normal Operations

All personnel involved in deck operations shall be aware of the potential risk described hereafter.

- High pressure oil.
- Crane Handling (possible danger of e.g. heavy falling object)
- Launch and recovery of equipment over the side of the vessel
- Personnel working over open sea (typical personnel working with launch and recovery of equipment from vessel deck or moon pool)
- Object falling down from height (rocks following the equipment when recovering)
- Working with equipment under pressure (hydraulics or water)
- Hydraulic oil spillage

If you don't know, ask someone.
Your safety is your responsibility.

Safety:

User Checklist Before Dive
To prevent any damage to the equipment this checklist must be followed

Project: .....
Anchor Boss serial No: .....

Item	Description	Checked	Comments	Date
1.	Pull vacuum on control can to ensure O-ring seal.			
2.	Ensure ROV can and does supply sufficient hydraulic pressure and flow			
3.	All fittings are checked for leakage			
4.	All hose clamps are checked			
5.	Suction hose is fastened			
6.	Anchor Boss is fastened, no loose ends			
7.	All hoses are fastened and in proper condition			
8.	No hoses are squeezed or bent			
9.	Case drain and coupling are filled with clean oil			

Comments: .....

.....

.....

.....

Anchor Boss is checked by: .....

Date: .....

Safety:

To prevent any damage to the equipment this checklist must be followed

Project: .....
Anchor Boss serial No: .....

Item	Description	Checked	Comments	Date
1.	Equipment used in the sea must be properly cleaned with fresh water			
2.	All fittings are checked for leakage			
3.	All hose clamps are checked			
4.	Pumps are fastened, no loose screws			
5.	Hot stab hose is fastened			
6.	Anchor Boss is fastened and in proper condition			
7.	All hoses are fastened and in proper condition			
8.	No hoses are squeezed or bent			
9.	Hydraulic motor and coupling is filled with clean oil			
10.	Broken parts are reported to vortex			
11.	Pull vacuum on control can to ensure O-ring seal.			

Comments.....
.....
.....

Anchor Boss is checked by: .....**Date:** .....
What were the positives? .....
What were the negatives? .....
Suggestions to make this kit better for you to use in the field:
.....
.....
.....

Inventory: Topside computer

Topside computer with data cable to connect to ROV output and power supply.

Inventory: Cables and electrics

Control can to ROV cable , 3 mtr long

MacArtney PN# SGP1701495-B.

Flotation lifting lug.

Inventory:

Relief valve spring and shim kit.

There are a total of six springs in the kit with two springs placed in the suction and pressure valve at any one time.

Shim spacers are stamped with numbers referring to their thickness in mm. There are two of each shim.

20, 10, 8, 6, 5, 4.1, 4, 3, 2.6, 2.5, 2.4, 2.3, 2.2, 2.1, 2, 1mm

Inventory: Control line and analogue gauge.

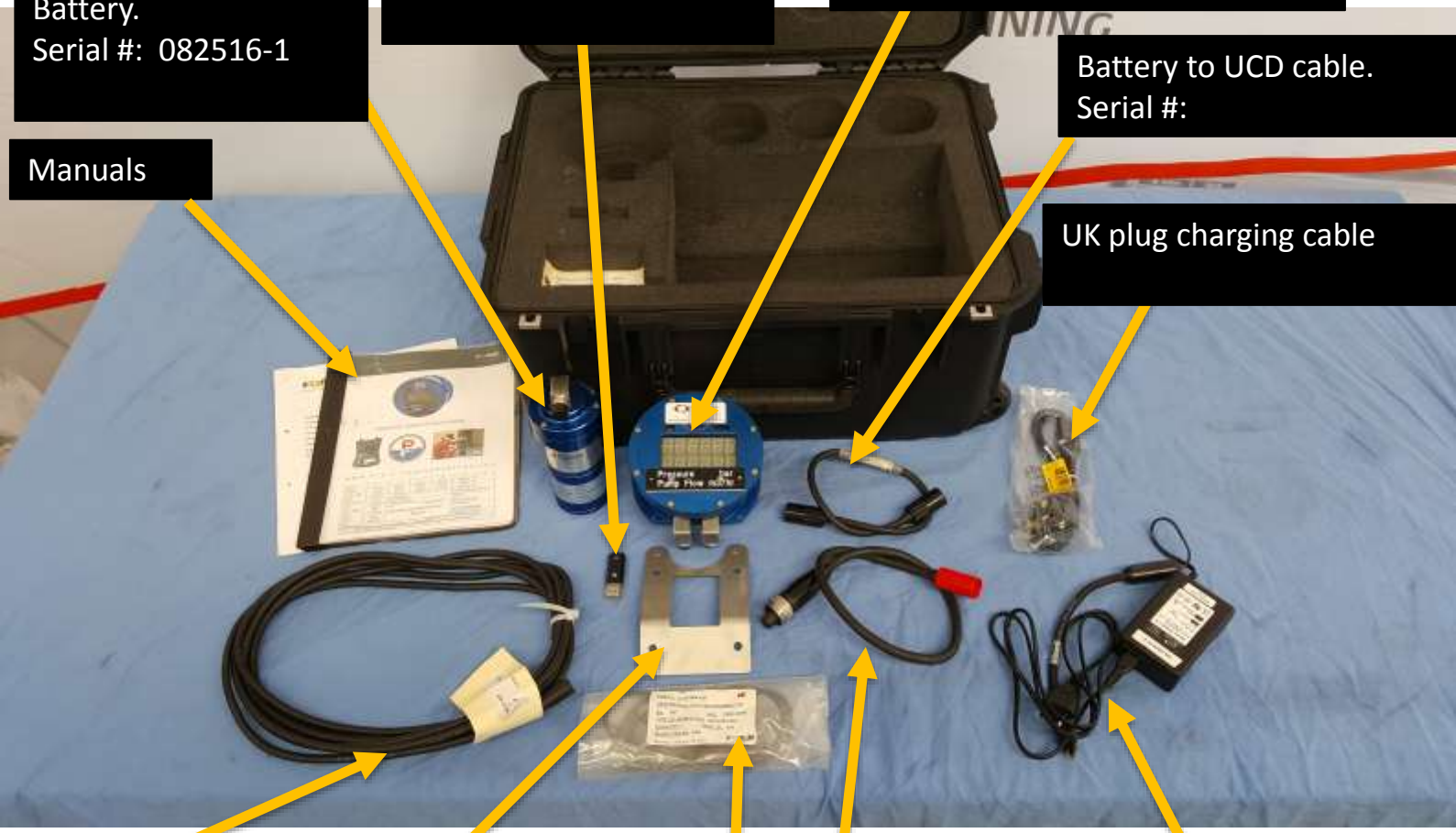
- 3 bar to + 3 bar gauge.

Control line to gauge, Hot stab and control can.

Pre drilled bracket for mounting gauge.

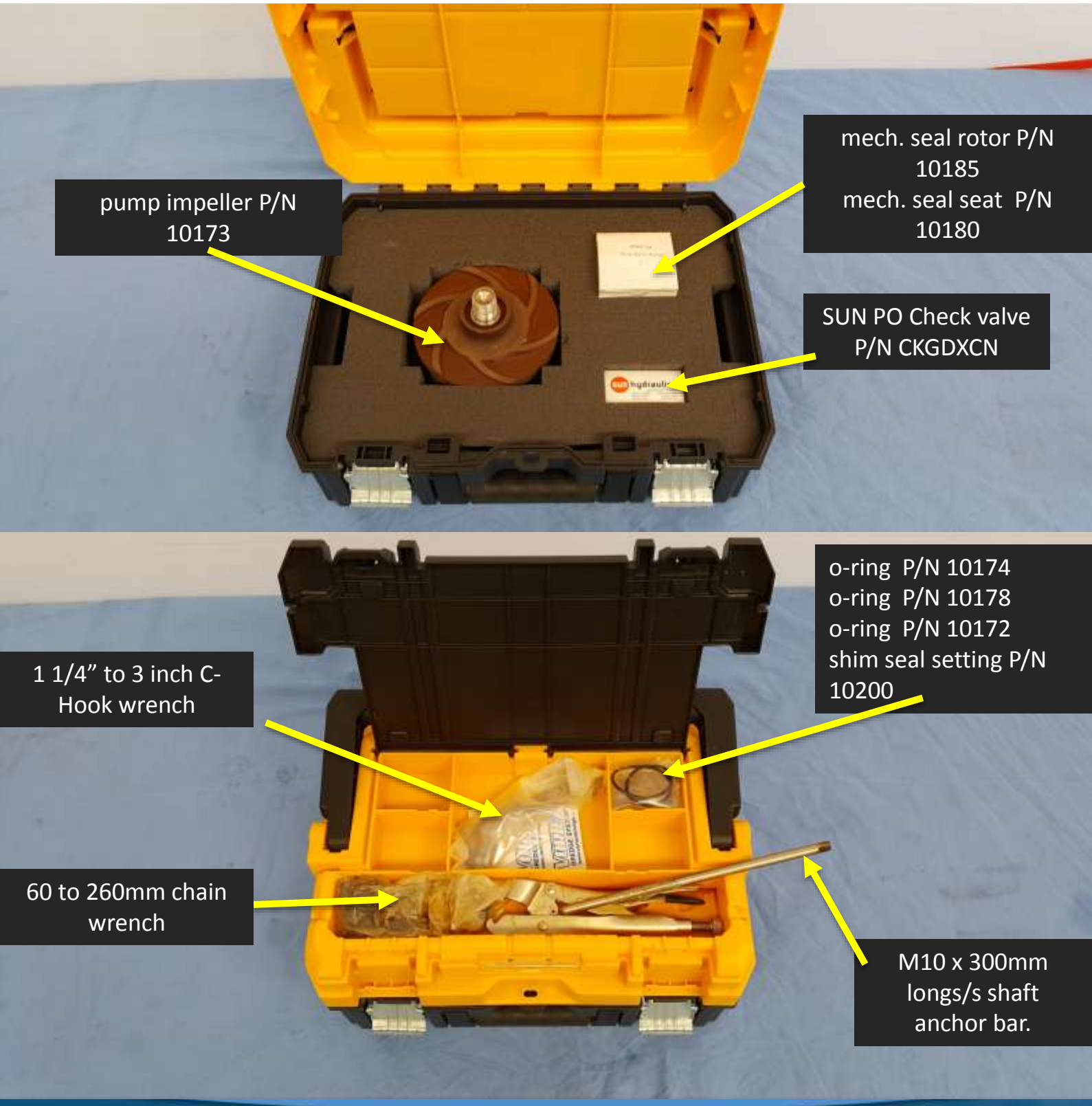
Inventory:

Perry Dual line USD kit. PN: A019-904-400/01

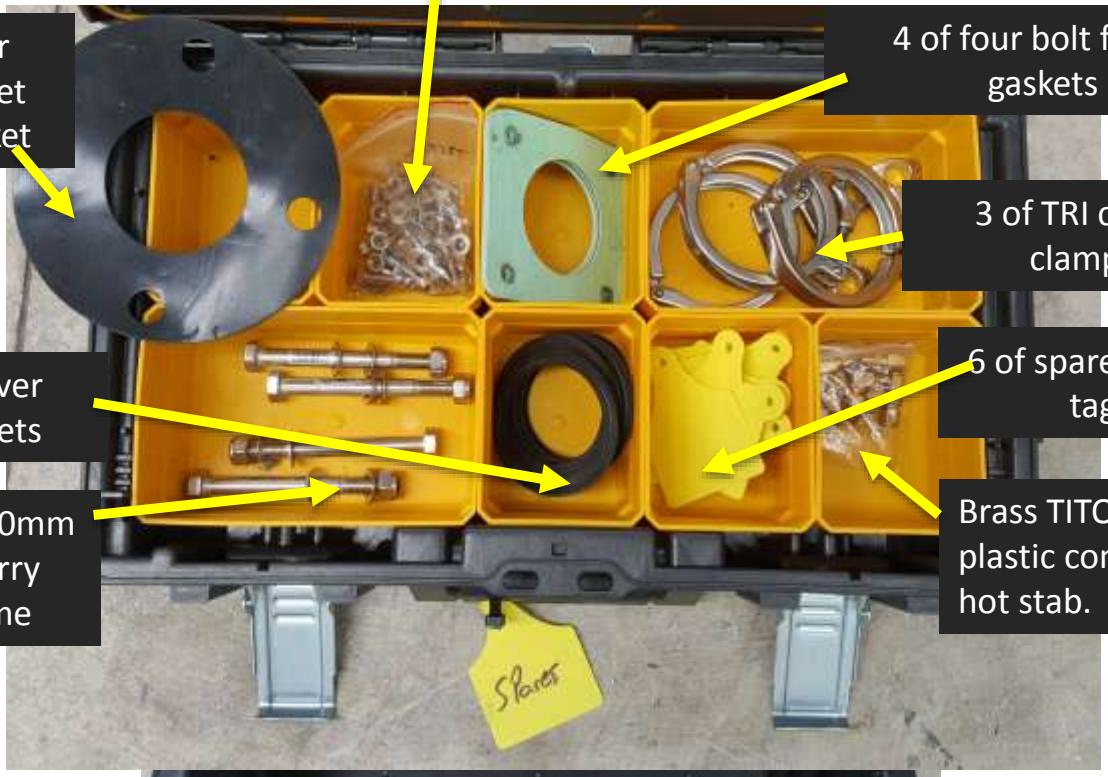


Inventory:

Water pump spares kit



Inventory: Spares



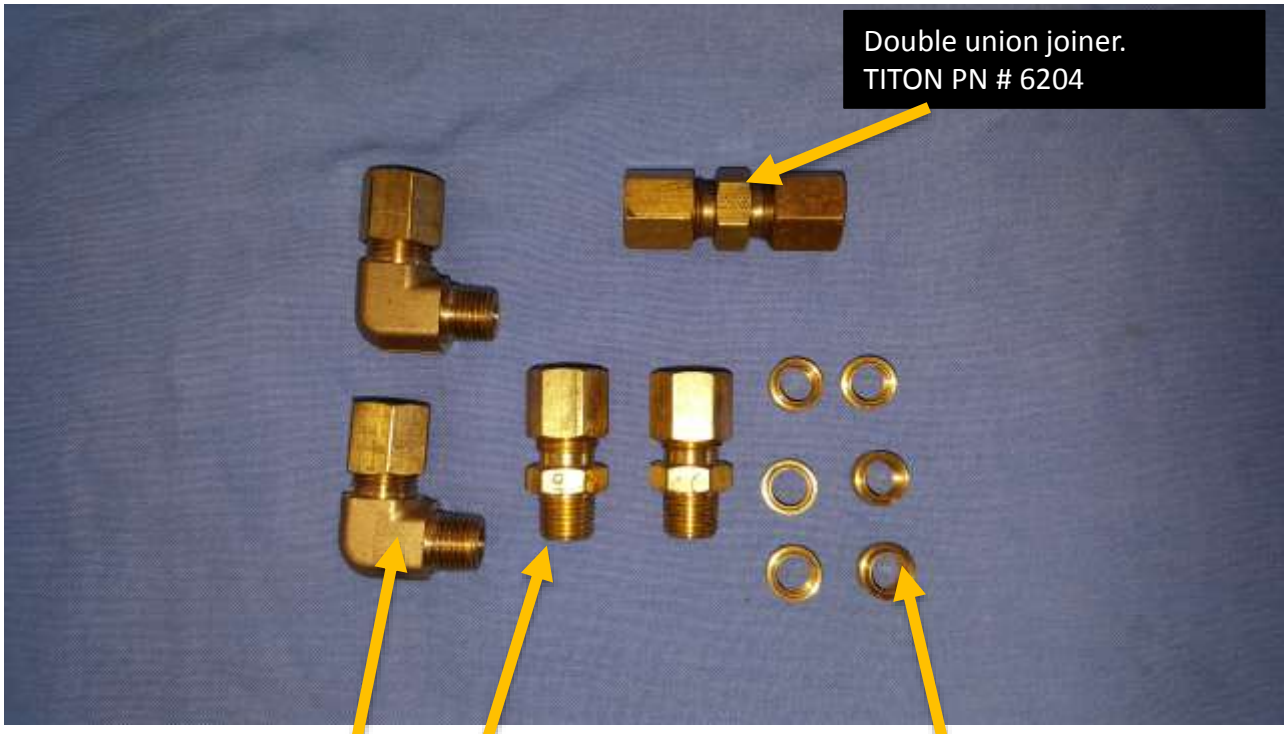
Inventory:

Modular components

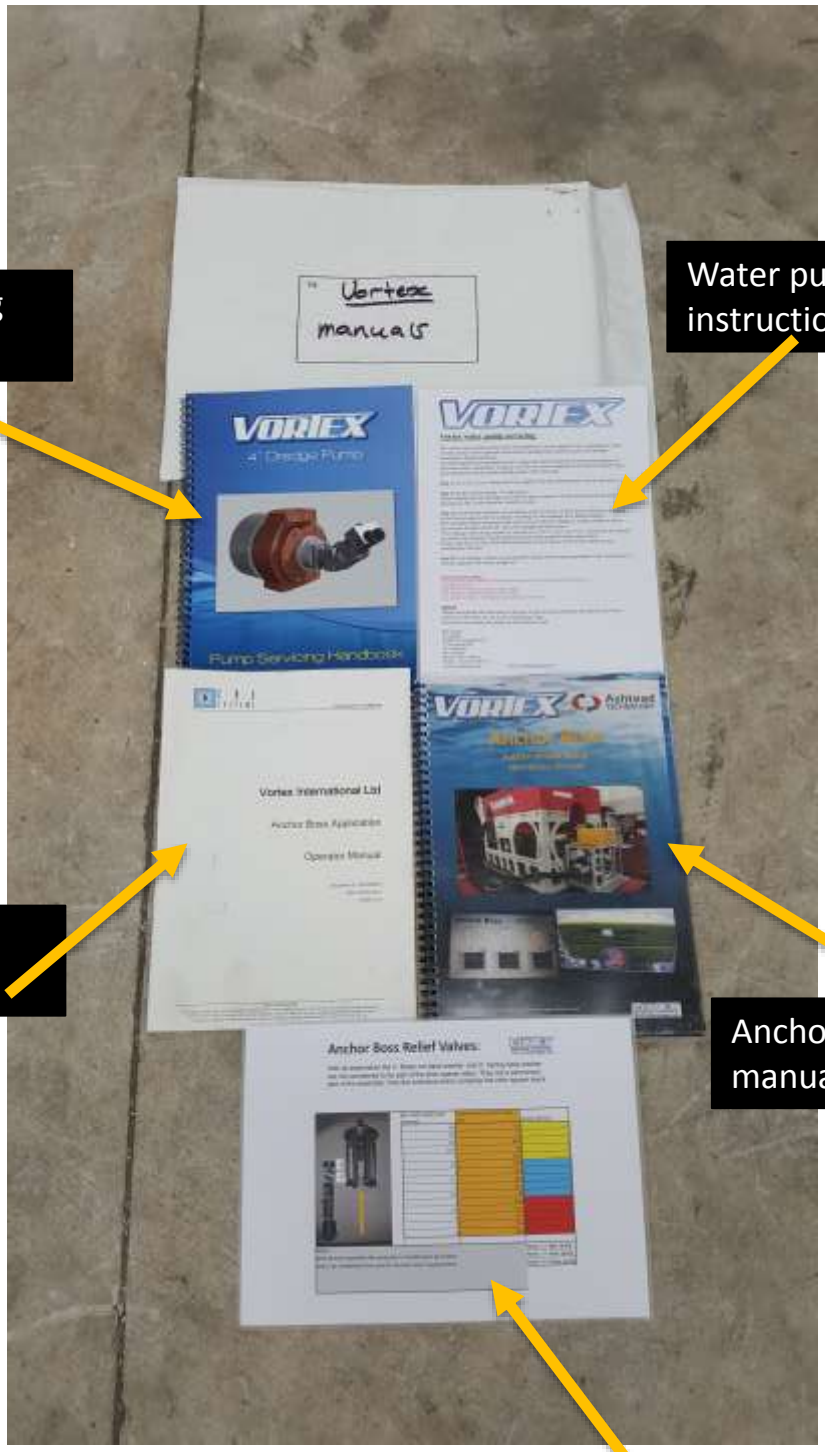
Spare Components kit for electronics can to hot stab control line consists as shown.

These brass fittings are available worldwide on the following links:

www.rwc.com or www.titon.co.nz



Inventory: Manuals



Water pump servicing handbook

Water pump servicing instructions

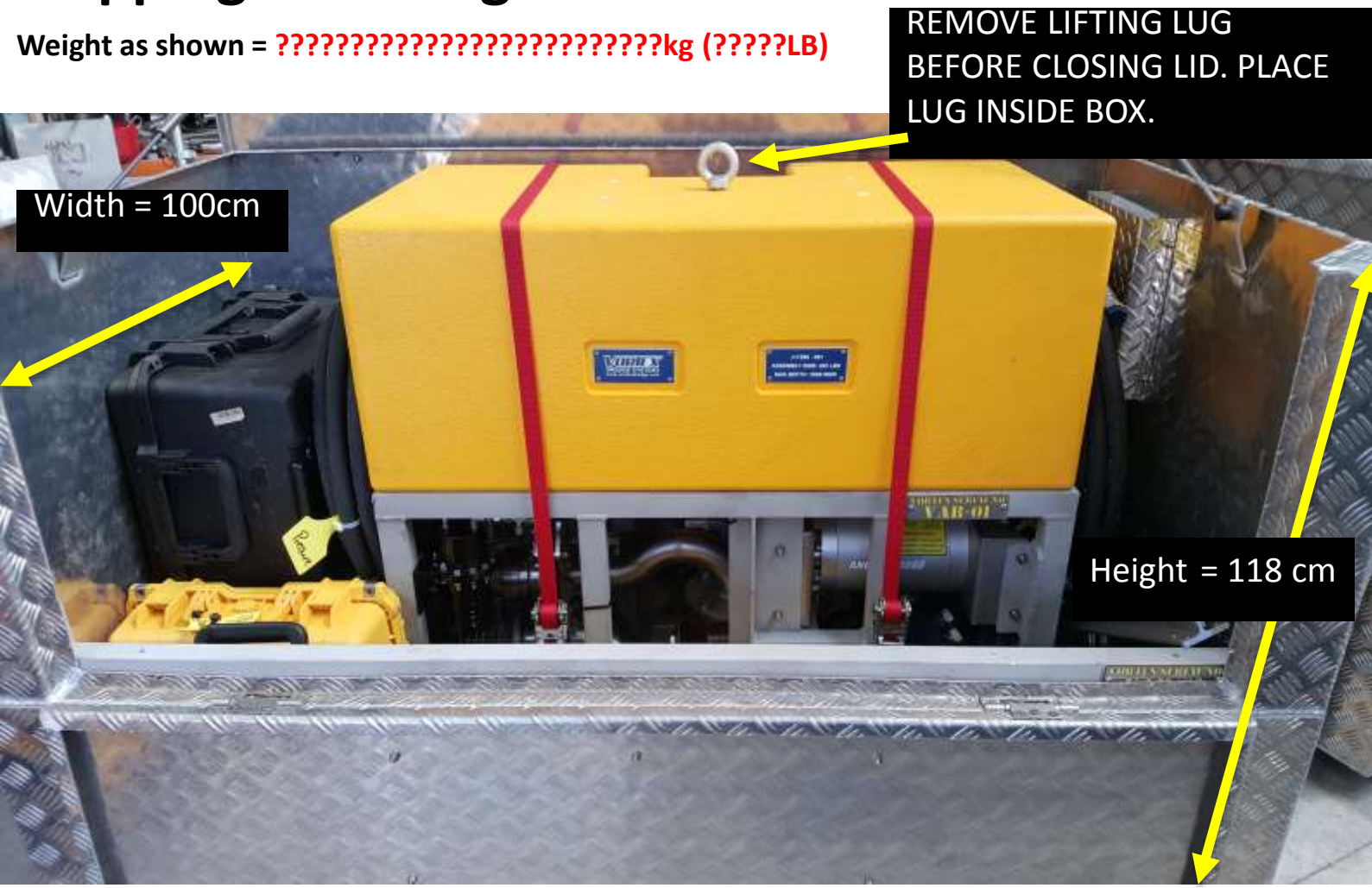
Top side operation instructions

Anchor Boss operation manual

Relief valve instructions

Shipping Box Weight & dimensions:

Weight as shown = ??????????????????????????kg (?????LB)



Length = 162 cm

Shipping Box fitted with fork slots to allow crane riggers to sling under box. This removes the need for rated lifting points.

Fold down front for easy access.

Trouble Shooting

Symptom: Water pump not operating

Remedy:

1. Ensure that the hydraulic hoses are connected as per manual drawings and match connection labels.
2. Check that required flow and pressure can be seen directly at the Vortex. Check hydraulic flow on topside feedback is enough to operate pump at desired setting.
3. Check any quick connect fittings you may have in the circuit as they can sometimes be faulty.
4. Are your thrusters using most of the available system flow and starving your circuit feeding the Vortex water pump?
5. Ensure the Vortex case drain is connected directly to tank. It is preferable to connect as close as possible to the reservoir and not run any hoses through quick connects.
6. Has the water pump impeller been damaged by excessive silt or other dirt ingress? If so, please repair as necessary with accordance to supplied Vortex pump servicing handbook.
7. Check that the EMERGENCY PUMP SHUT DOWN has been reset on the software.

Symptom: No data feedback.

Remedy:

1. Check comms green light is lit. If not, swap com ports in settings.
2. Check all cables and bulkhead connectors for water ingress and damage.
3. Check control line 6mm hose is connected from Anchor Boss to the hot stab.

Contacts:

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VORTEX DREDGE SYSTEMS

Ashtead TECHNOLOGY