CONSTRUCTOR™ Operators Manual	KYSTDESIGN AS www.kystdesign.no
Volume 2 – Hydraulic System	*File ref.:* Volume 02 Constructor 05 Hydraulic System
	Date of issue: 07.01.2016

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1 Introduction

The CONSTRUCTOR ™ is equipped with two hydraulic systems, where two separate pumps are driven by the same electric motor. This is done to isolate the Hydraulic circuit powering the thruster motors from the Auxiliary system.

The main hydraulic system is dedicated for controlling the thrusters, and should not be modified or altered by the operator.

The auxiliary hydraulic system is intended for supply of power to auxiliary equipment. All user interfaces for this system is located in the SUPPORTER front for easy access.

1.1 Using this manual

The various components used in the main and auxiliary hydraulic system is identified with a pos number on the hydraulic schematic drawings located in section 4 of this volume. A data sheet for the same component can be found under a tag with the same number in section 5.

Example: Locate the return filter on the Main Hydraulic Schematic AF25-1000H01. Next to the return filter symbol you will find pos balloons 4a and 4b. Pos 4a is the filter unit, and 4b is the element. A data sheet covering both items can be found in section 5 under tag 4.

2 Main components

2.1 Hydraulic Power pack

The 160kW hydraulic power pack consists of an electric motor with two hydraulic pumps attached. For information on the electric motor, reference is made to Volume 3.

CAUTION
The combined weight of this unit is approx 490 kg. Appropriate handling gear and procedures must be used to move and fit the HPU.

2.2 Main pump

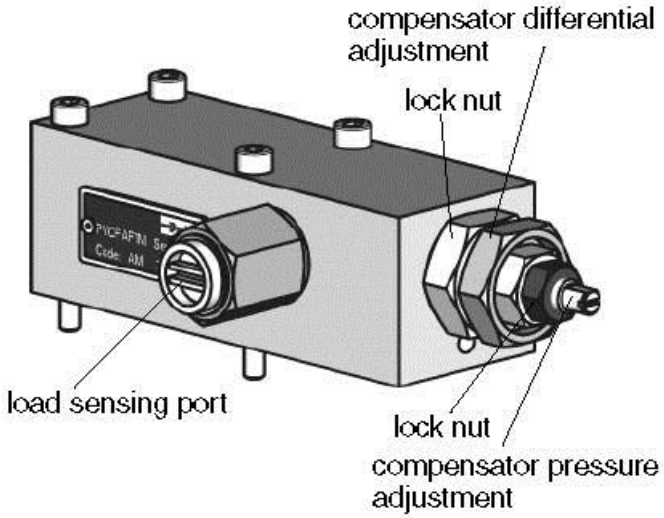
2.2.1 Technical Data

Manufacturer	Parker Hannifin
Model code	PV180R1K1T1NMFC
Manufacturers Documentation See section 5.1 This Volume	HY30-3245-uk-PV016-PV360
Hydraulic Fluid	Tellus S3M22
Design	Variable swash plate
Max pressures	Nominal 350Bar peak 420Bar
Type of operation	Pump in open circuit
Max displacement	180 cc/rev
Control device	Load sensing control (MFC)
Series	PV
Direction of rotation	Clock wise (viewed on shaft end)
Seals	NBR
Shaft end	Ø50 L92 Parallel with key to DIN 6885
Mounting Flange	4 x ø18mm, PCD 200mm
Pressure port	SAE 1 ¼" 6000 psi (M12 – 20 deep fixing threads)
Suction port	SAE 2 ½" 3000 psi (M12 – 20 deep fixing threads)
Case drain port	1" BSPP
Control port	¼" BSPP
Weight in Air	95 Kg

2.2.2 Settings

Idle pressure	:	25 Bar	(factory setting)
Operation pressure	:	220-230 Bar	(see section 2.2.3)
Displacement	:	180cc /rev	(factory setting)
Flow	:	315 l/min @ 60 Hz	

2.2.3 Adjusting cut off pressure



When replacing the pump, always adjust the cut off pressure to minimum before starting the pump first time. Pressure adjustment to be performed according to the following steps:

1. Fit new pump and fill system with oil until compensator volume reads 90%
2. Turn adjustment screw fully counter clockwise
3. Start HPU
4. Turn adjustment screw clockwise until operational pressure is reached
5. Lock off adjustment screw with the locking nut

2.2.4 Pump replacement

Pump replacements to be performed according to the following steps:

1. Drain the electric motor for oil
2. Drain the main hydraulic system for oil
3. Disconnect the hydraulic hoses
4. Remove the four fixing bolts.
5. Check O-ring in the flange of the electric motor and replace if necessary.
6. Bolt replacement pump onto the electric motor
7. Install hydraulic fittings and hoses.
8. Fill up the hydraulic system and the electric motor with oil.
9. Bleed air from pump and electric motor.
10. Adjust pump cut off pressure as described in the previous chapter.

2.3 Auxiliary Pump

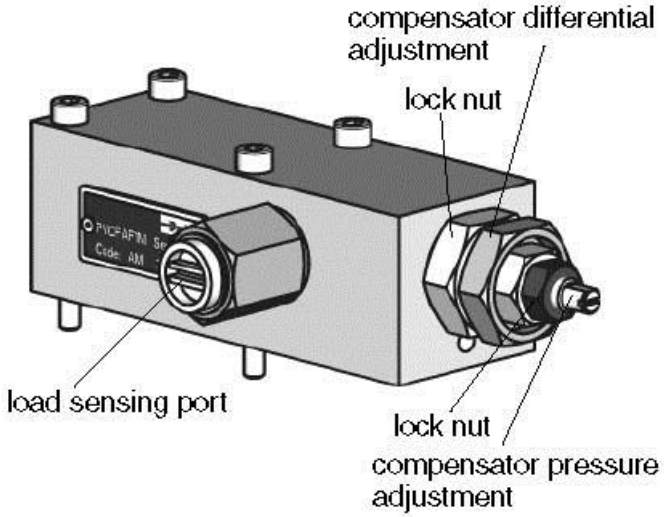
2.3.1 Technical Data

Manufacturer	Parker Hannifin
Model code	PV092L1K1T1NMRC
Manufacturers Documentation See section 5.2 This Volume	HY30-3245-uk-PV016-PV360
Hydraulic Fluid	Tellus S3M22
Design	Variable swash plate
Max pressures	Nominal 350Bar peak 420Bar
Type of operation	Pump in open circuit
Max displacement	92 cc/rev
Control device	Remote pressure control (MRC)
Series	PV
Direction of rotation	Counter clock wise (viewed on shaft end)
Seals	NBR
Shaft end	Ø40 L92 Parallel with key to DIN 6885
Mounting Flange	4 x ø18mm, PCD 200mm
Pressure port	SAE 1 ¼" 6000 psi (M12 – 20 deep fixing threads)
Suction port	SAE 2" 3000 psi (M12 – 20 deep fixing threads)
Case drain port	3/4" BSPP
Control port	¼" BSPP
Weight in Air	62 Kg

2.3.2 Settings

Idle pressure	:	25 Bar	(factory setting)
Operation pressure	:	200 Bar	(see section 2.3.2)
Displacement	:	92cc /rev	(factory setting)
Flow	:	160 l/min @ 60 Hz	

2.3.3 Adjusting cut off pressure



When replacing the pump, always adjust the cut off pressure to minimum before starting the pump first time. Pressure adjustment to be performed according to the following steps:

1. Fit new pump and fill system with oil until compensator volume reads 90%
2. Turn adjustment screw fully counter clockwise
3. Start HPU
4. Turn adjustment screw clockwise until operational pressure is reached
5. Lock off adjustment screw with the locking nut

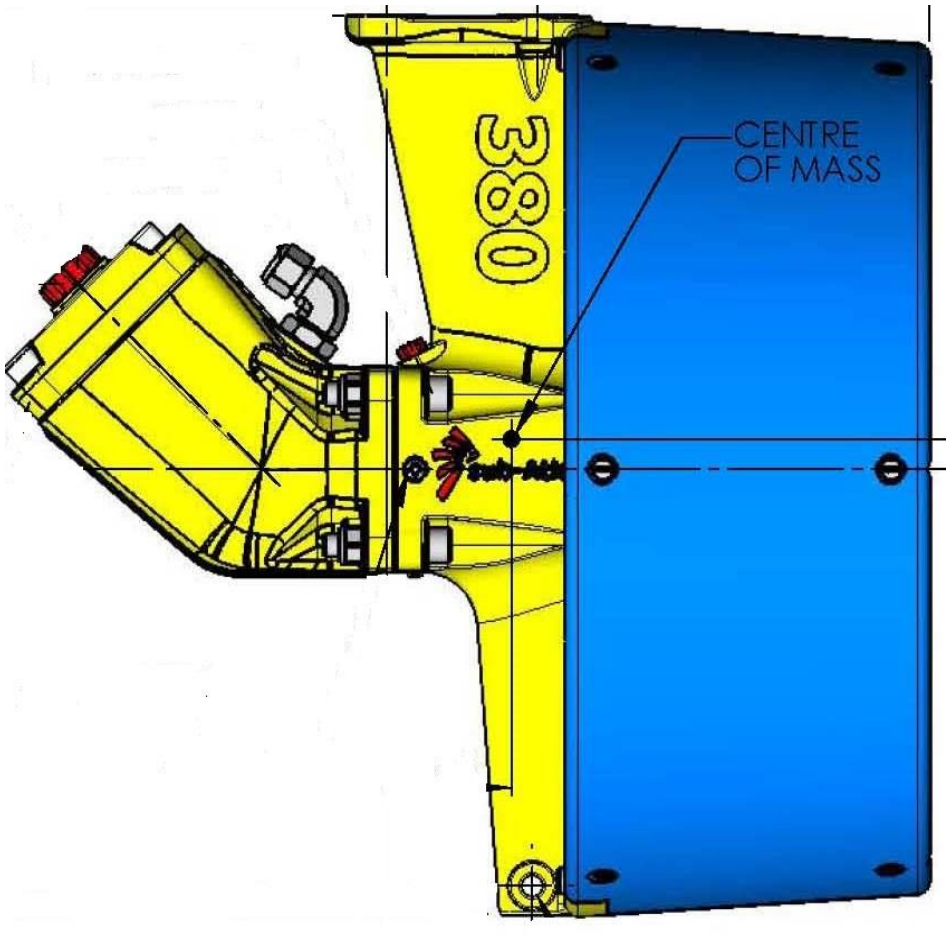
2.3.4 Pump replacement

Pump replacements to be performed according to the following steps:

1. Drain the electric motor for oil
2. Drain the auxiliary hydraulic system for oil
3. Disconnect the hydraulic hoses
4. Remove the four fixing bolts.
5. Check O-ring in the flange of the electric motor and replace if necessary.
6. Bolt replacement pump onto the electric motor
7. Install hydraulic fittings and hoses.
8. Fill up the hydraulic system and the electric motor with oil.
9. Bleed air from pump and electric motor.
10. Adjust pump cut off pressure as described in the previous chapter.

2.4 Thrusters

Manufacturer	Sub Atlantic
Model code	SA-PH38041
Manufacturers Documentation See section 5.19 This Volume	OMM-00047 rev04 3836-GA Rev 1B
Hydraulic motor	2 port 40.9CC
Pressure port **A**	¾" BSPP
Suction port **B**	¾" BSPP
Motor case drain **C**	½" BSPP
Bearing housing oil supply	1/8" BSPP
Weight in Air	27 Kg
Weight in seawater	14 Kg



2.5 Valve packs

2.5.1 Thruster Control Unit – TCU

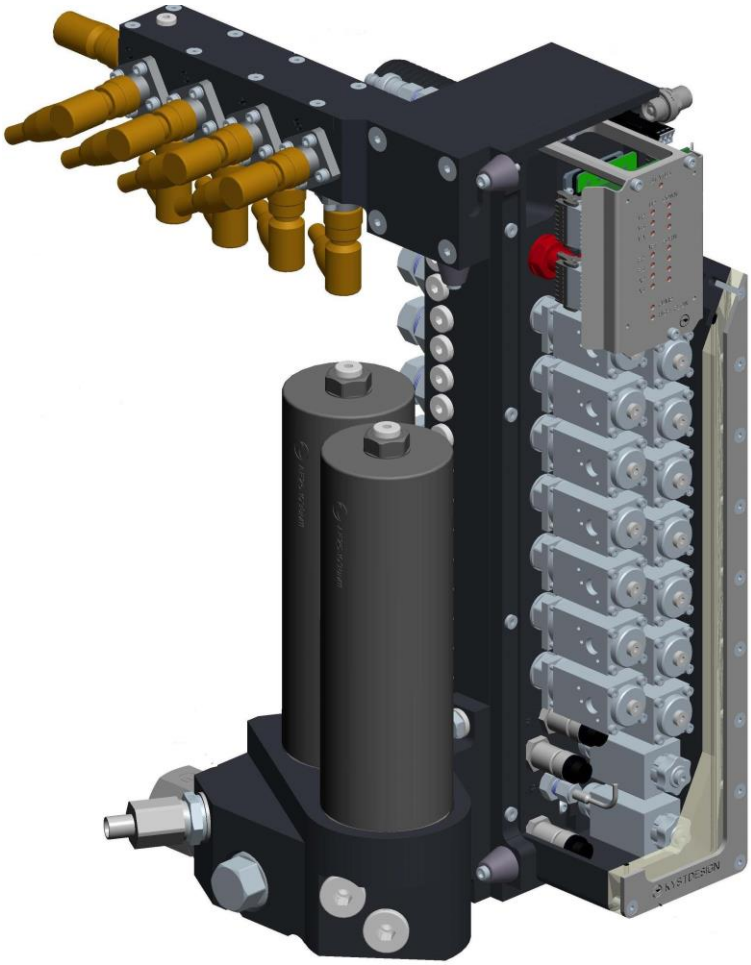
The TCU is a remote controlled hydraulic manifold, fitted with hydraulic valves for controlling the oil flow to the thrusters.

It is also equipped with the necessary valves and sensors for controlling the main pump and monitoring the performance of the main hydraulic system.

Directly attached to the TCU is the dual supply filter unit. This unit also contains the high flow valve and associated connection point.

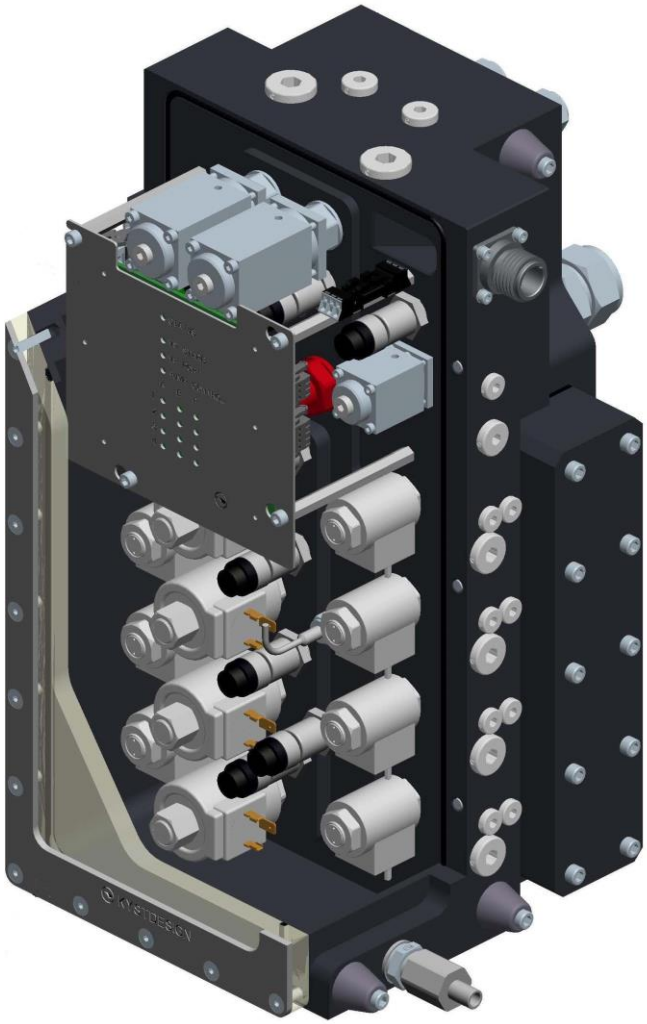
For understanding of the functionality of this unit please use the hydraulic diagram AF25-1000H01.

The position number in the parts list on this drawing will also guide you to the relevant data sheet for each sub component in section 5 of this volume.



Manufacturer	Kystdesign AS
Model code	AF25-1033
Manufacturers Documentation	AF25-1000H01 (Main hydraulic schematic) AF25-1033M01 (General Assembly drawing) AF25-1033E01 (Wiring Diagram)
Hydraulic Fluid	Tellus S3M22
Relief valve setting	260 - 280 BAR
Thruster ports **A&B 1-7**	¾" BSPP
Main supply port **P**	1 ¼ SAE 6000PSI – 12mm bolt threads
Main return port **T**	2" hose barbs
Return manifold	3 x ¾" BSPP
Pump Control Port	¼" BSPP
Deck pack supply	¾" BSPP

2.5.2 Auxiliary Control Unit - ACU



The ACU is a hydraulic manifold, fitted with hydraulic valves and sensors for controlling and monitoring the pressure to GFVP 1 & 2.

It is also equipped with the necessary valves and sensors for controlling the auxiliary pump and monitoring the performance of the auxiliary hydraulic system.

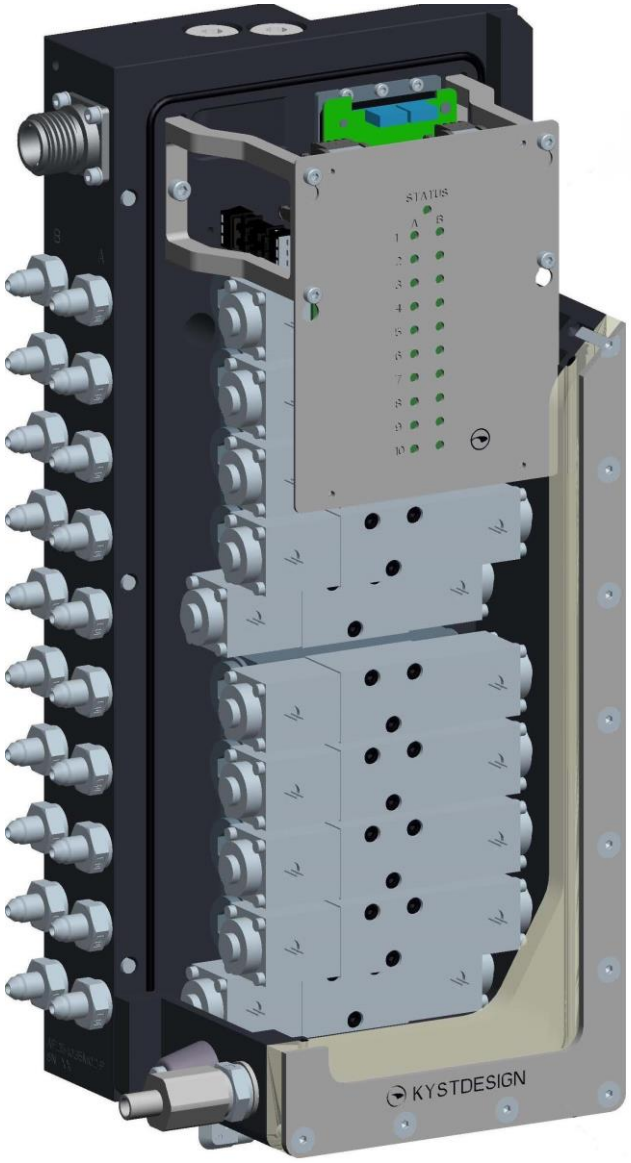
In addition it controls pressure and flow to four separate outlets on the front manifold.

For understanding the functionality of this unit, read the hydraulic schematic 1000H02 attached in section 4.

The position number in the parts list on this schematic will also guide you to the relevant data sheet for each sub component, attached in section 5.

Manufacturer	Kystdesign AS
Model code	AF25-1034
Manufacturers Documentation	AXXX-1000H02 (Auxiliary hydraulic schematic) AF25-1034M01 (General Assembly drawing) AF25-1034E01 (Wiring Diagram)
Hydraulic Fluid	Tellus S3M22
Relief valve setting	260-280 BAR
Supply port P	1” BSPP
Return port **T**	1” BSPP
High flow portS **A1-A4,B1-B4**	¾” BSPP
Service ports **STB & PORT GFVP**	½” BSPP
Pump control port **Pump**	¼” BSPP
Sensor port **Filter**	¼” BSPP
Comp Port **Comp**	¼” BSPP

2.5.3 General Function Valvepacks - GFVP



The GFVP is a hydraulic manifold, fitted with 10 of NG3 proportional hydraulic valves. There are two of these units in the Auxiliary hydraulic system, one port and one starboard version.

For understanding the functionality of this unit, read the hydraulic schematic 1000H02 attached in section 4.

The position number in the parts list on this schematic will also guide you to the relevant data sheet for each sub component, attached in section 5.

Manufacturer	Kystdesign AS
Model code	AF25-1035
Manufacturers Documentation	AXXX-1000H02 (Auxiliary hydraulic schematic) AF25-1035M01 (General Assembly drawing) AF25-1035E01 (Wiring Diagram)
Hydraulic Fluid	Tellus S3M22
Supply ports P	½" BSPP
Return ports **T**	½" BSPP
Service ports **A1-10, B1-10**	¼" BSPP

2.5.4 Opening & Closing the valve packs.

Opening

1. Isolate the compensator circuit by closing the isolation valve located on the compensator panel.
2. Drain oil through the 1/4" quick release coupling at the bottom of the VP housing.
3. Removing the relief valve located at the top of the housing will increase the oil flow.
4. Remove all M6 bolts holding the housing.
5. Remove Housing

Closing

1. Clean the O-ring groove
2. Clean and inspect the O-ring for damages.
3. Lubricate the O-ring with a thin film of Molycote 111.
4. Reinstall the O-ring
5. Reinstall the housing and all bolts
6. Tighten up the bolts
7. Fill up with Oil and open the compensator isolation valve.

2.5.5 Replacing hydraulic valves

Cavity mounted valves

1. Drain the relevant hydraulic reservoir.
2. Disconnect the coil from the relevant connector on the diode board.
3. Remove the coil.
4. Remove the valve.
5. Check that cavity or mounting surface is clean and free from foreign matter.
6. Inspect the replacement valve for damages.
7. Check that all o-rings are in place and not damaged.
8. Insert valve into cavity and tighten up by hand.
9. Apply torque as specified in the table below.
10. Attach the coil and tighten up the nut/bolts with specified torque.
11. Connect the flying leads to the diode board.

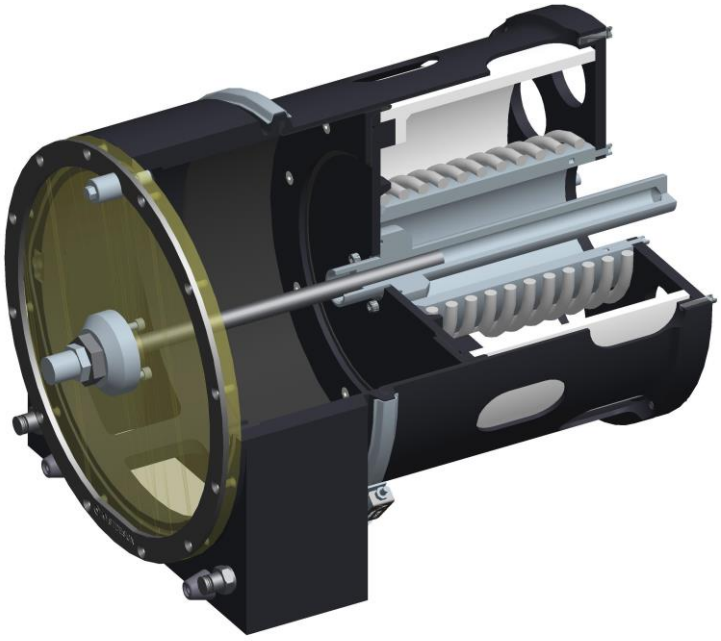
		Torque		
Pos	**Type**	**Cartridge**	**Coil nut**	**Coil Bolts**
6	MVPPM22-220-G24-M35	50		2,6
7	BVSPM22-350	50		
8	BDPPM18-200-G24-M35	30		1,8
9	EHPR08-33-0-N24-DL	27,1	6,8	
10	TS12-36AS-0-N-24-DL	45-50	9,5 - 13,6	
11	PE16-S67C	62-72		
12	PE16-S67H	62-72		

NG 3 Valves

1. Drain the aux hydraulic reservoir.
2. Disconnect the coil from the relevant connector on the diode board.
3. Remove the fastening bolts for that valve.
4. Clean the manifold surface before replacing the faulty valve, if this is a stacked assembly clean all sealing surfaces.
5. Also clean the fastening bolts before applying Aqualube to the threaded section.
6. Insert the fastening bolts and tighten until finger tight.
7. Use a torque wrench and tighten the bolts to **2,8 Nm**
8. Connect the flying leads to the diode board.

2.6 Reservoirs

The ROV is equipped with two identical reservoirs, one for each hydraulic system. The reservoir compensates for variations in oil volume by a spring loaded piston which compresses a rolling diaphragm. Variations in oil volume are monitored by an analogue linear sensor. Connection to the hydraulic systems is made through separate manifold.



WARNING !
The compensator contains a compressed spring with the following spring force: Empty compensator (assembly / disassembly mode): ~1200 N Full compensator: ~2000 N **Do NOT remove V-Clamp or Spring Retainer Plate before reading the below procedure. To unfasten these items without controlling the spring force can result in serious injuries to personnel and equipment.**

Manufacturer	Kystdesign AS
Model code	AB25-4000
Manufacturers Documentation	AB25-4000M01 (General Assembly drawing)
Hydraulic Fluid	Tellus S3M22
Volume	16L
Active Volume	15,8 L

Pressure	0,15 – 0,25 Bar
Relief Valve	0,8 Bar
Weight	30 kg
Depth rate - Compensator	Full ocean depth
Depth rate – Linear Sensor	3000 msw

2.6.1 Replacement of linear sensor

The linear sensor can be replaced without opening the reservoir. Just drain the compensator and unscrew the sensor.

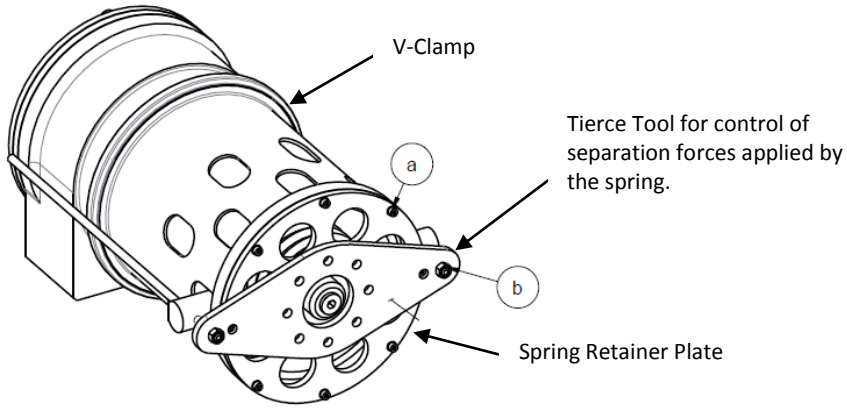
2.6.2 Disassembly of Compensator for replacement of rolling diaphragm and O-rings

NB! When loosening the bolts in the Spring Retainer Plate, the spring will push this plate by a force of ~1200N. The spring is fully extended after 350mm from "empty comp mode".

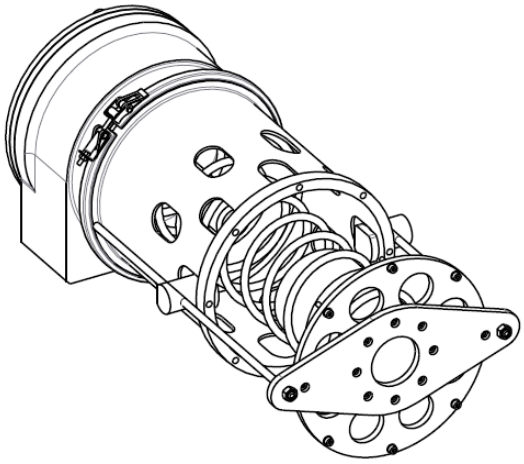
The below procedure is based on the use of a purpose made tool to control the separation force applied by the spring. This tool as shown on the below figures can be supplied by KYSTDESIGN.

1. Drain the compensator
2. Disconnect compensator from the hydraulic circuit and move it to a clean maintenance area.
3. Install tool as shown on the below figure.

Tool is normally in the puller tool draw.



4. Tighten up Tierce Rods (b).
5. Remove eight bolts (a) holding the Spring Retainer Plate.
6. Carefully untighten the Tierce Rods (b) while keep the spring retainer plate as parallel as possible with the bottom of the compensator to avoid buckling of the spring. Continue until the spring is fully extended.



7. Remove the tool and the spring.
8. Note the position of the V-Clamp lock. It is important to reinstall the V-Clamp with the lock in the same direction and position.
9. The V clamp can now be removed.

Note! When the compensator is disassembled, it is recommended to replace diaphragm and all o-rings by new ones.

10. Make sure that the new diaphragm and o-rings are clean and not damaged.
11. Grease o-rings and diaphragm flange with Molycote 111 or similar.

2.6.3 Assembly of compensator

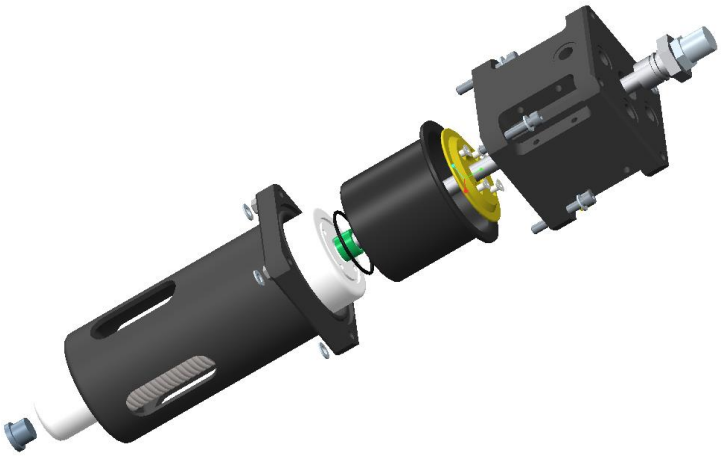
Assembly of the compensator to be done in reverse order of the steps in section 2.2.

Installation of the V-Clamp shall be according to the following instruction:

Make sure that both the inner surface of the V-Clamp and the mating flange is clean. Then lubricate the flange surface with a thin film of Molycote 111. Install the V-Clamp and torque up the locking nut to 10Nm. Use a lightweight hammer to tap gently on the surface of the V-Clamp while tightening the nut. This to overcome the static friction.

2.7 Compensators

The Supporter is equipped with four identical compensators, one for the electric motor, one for termination and light JB, one for Valve packs, and one for thrusters shaft seals.



The compensators compensates for variations in oil volume by a spring loaded piston compressing a rolling diaphragm. Variations in oil volume are monitored by an analogue linear sensor.

Manufacturer	Kystdesign AS
Model code	AB89-1037
Manufacturers Documentation	AB89-1037M01 (General Assembly drawing)
Hydraulic Fluid	Tellus S3M22
Volume	1,2L
Weight	5,2 Kg
Pressure	0,15 – 0,55 Bar
Relief Valve	0,8 Bar
Service ports	3/8" BSPP
Depth rate - Compensator	Full ocean depth
Depth rate – Linear Sensor	3000 msw

2.7.1 Replacing the linear sensor

The linear sensor can be replaced without opening the compensator. Just drain the compensator and unscrew the sensor.

2.7.2 Replacing the rolling diaphragm

1. Drain the compensator
2. Disconnect compensator from the hydraulic circuit and seal the connection ports to protect the hydraulic system from ingress of foreign matters.
3. Move compensator to a clean maintenance area.
4. Split the unit by removing the four bolts holding it together

NB! It's important to be aware that when loosening the bolts, the spring will push the two main parts apart by a force of ~100N. The spring is fully extended after ~70mm from "empty comp mode".

5. The piston and diaphragm can now be pulled out.

Note! When the compensator is disassembled, it is recommended to replace both diaphragm and o-rings by new once.

6. Make sure the new diaphragm and o-rings are clean and not damaged.
7. Apply a thin film of Molycote 111 on o-rings and the diaphragm flange.
8. Assemble compensator in reverse of the above steps.

3 Maintenance Schedule

Component	Part	Action	Interval
Electric Motor	Oil	Change	1000 Hrs.
Electric Motor	Rotor shaft bearings	Change	4000 Hrs. / Annual
Thruster	Bearings	Change	4000 Hrs.
Thruster	Seals	Change	1000 Hrs.
Main Hyd System	Filters	Change	1000 Hrs
Aux Hyd System	Filters	Change	1000 Hrs
Shaft seal oil	Oil	Change	Weekly
Pumps		Replace / Overhaul	4000 Hrs. / Annual

4 Drawings

Doc.	Description	
AF25-1000H01	Main Hydraulic Schematic	
AF57-1-1000H02	Aux Hydraulic Schematic	
AF25-1000H03	Hydraulic hoses	
AF25-1031M01	Hydraulic System	General Arrangement
AF25-1033M01	Thruster Control Unit	General Arrangement
AF25-1034M01	Auxilliary Control Unit	General Arrangement
AF25-1035M01	General Function Valvepack	General Arrangement
AB25-4000M01	16 Litre Compensator	General Arrangement
AB89-1037M01	Compensator 1,2 litre	Assembly

5 Data Sheets

The various components used in the main and auxiliary hydraulic system is identified with a pos number on the hydraulic schematic drawings located in section 4 of this volume. A data sheet for the same component can be found under a tag with the same number in section 5.

Example: Locate the return filter on the Main Hydraulic Schematic 1000H01. Next to the return filter symbol you will find pos balloons 4a and 4b. Pos 4a is the filter unit, and 4b is the element. A data sheet covering both items can be found in section 5 under tag 4.

Tag No.	Description
1	Pump Parker PV180R1K1T1NMFC
2	Pump Parker PV092L1K1T1NMRC
3	Filter 15P/30P Series
4	Filter 15/40/80CN Series
5	Filter SDU H350
6	Proportional Reducing Valve
7	Pressure Relief Valve
8	Proportional Pressure Relief Valve
9	Proportional Pressure Control Valve
10	Proportional Pressure Control Valve
11	Directional Valve
12	Directional Valve
13	Check Valve
14	Proportional Spool Valve
15	Poppet Valve Cartridge
16	Pressure Transducer
17	Check Valve
18	Pressure Relief Valve
19 -1	SA thrusters operation and mainenance manual
19 - 2	SA 380 thruster GA drawing
20	
21	
22	Poppet logic element