OPERATING AND MAINTENANCE MANUAL

for the

Back Pressure Regulator, 45 Bar

(Part No: RP700)

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APPROVAL SHEET

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I. CONFIDENTIAL INFORMATION

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CHAPTER 1 INTRODUCTION

The built in Breathing System (BIBS) within a diving chamber consists of the gas supply system, a mask and an exhaust system.

When divers breathe gas from a mask within a chamber at depth their exhaled gas must be piped to the outside of the chamber. If the exhaled gas is allowed to dump into the chamber the depth within the chamber starts to increase due to the rise in pressure.

With a chamber at any depth greater than a few centimetres of water gauge, exposing the divers lung to the external atmospheric pressure cause injury to the diver. If the differential pressure between the diver's lung and atmospheric pressure is great enough, and the diver is exposed to it, the lungs can be sucked right out of the body.

To safely breathe gas on a mask and dump the exhaled gas overboard, i.e. to the outside of the chamber, the reduction in pressure from that in the diver's lung to atmospheric pressure must be reduced gradually by using Back Pressure Regulators (BPR's) in series. The exhaust valve in the mask itself is the first BPR and, depending on the make and model of mask, can typically withstand pressure differentials across it of 20 metres of seawater (msw) 2 barg.

If the chamber is to be dived deeper than the rated back pressure on the mask being used as a second heavier and more robust BPR must be positioned between the outlet of the mask's exhaust valve and the chamber wall. This second BPR should be able to tolerate the maximum pressure differential generated with the chamber at its maximum working depth.

The Divex BPR as shown as Fig 5.1 has been specifically designed for use as the second BPR within the diving chamber mask exhaust system.

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CHAPTER 2 DESCRIPTION

The Divex BPR consists of a spring housing, a mean seat assembly and a loading dome. The outlet from the mask is connected to the inlet of the BPR and the outlet of the BPR is connected to atmospheric pressure. The maximum operating pressure of the BPR is 450 msw (45 barg).

The BPR should be installed such that ambient chamber pressure is applied to the top of the diaphragm. Ideally, no isolation valves should be located between the outlet of the mask and the inlet of the BPR or on the outlet from the BPR. If it is possible to isolate the inlet to the BPR a bypass relief valve set at 6 barg (Divex Part No. RP700203) should be connected between the upper dome and the BPR inlet such that excess pressure can relieve into the inlet of the BPR. Also, if it is possible to isolate the outlet of the BPR an outward relieving check valve (Divex Part No. RP700202) should be fitted into that line. These safety devices protect the diaphragm from excessive pressure differentials.

Acceptable installations of the BPR both within and external to the chamber are shown in Fig 5.2.

The back pressure within the line between the outlet from the chamber mask and the inlet to the BPR can be adjusted (by the spring tension within the spring housing). The range of back pressures achievable are between chamber depth and chamber depth -40 msw. With the spring adjustment fully out the is a 0 pressure differential. With the spring adjustment fully in there is -40 msw pressure differential.

As a rough guide the following spring tensions give the following pressure differentials.

NOTE

The dimension refers to the length of internal thread showing inside the bottom of the spring housing.

THREAD LENGTH (MM)	PRESSURE DIFFERENTIAL (MSW)
0	0
8	0
12	-10
16	-20
20	-30
24	-40

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CHAPTER 3 MODE OF OPERATION

With the spring adjuster screwed in such that it exposes approximately 16mm of thread, the spring imposes an upward load on the diaphragm equivalent to approximately 20 msw (2 barg).

If we assume, for example, that the chamber's depth is 100 msw (10 barg) then the diver's exhaled gas entering the inlet of the BPR will also be at 100 msw (10 barg). The resultant upward load on the diaphragm is therefore (100 + 20) msw which is reacted by a downward load on the diaphragm of 100 msw. The diaphragm is therefore pushed upwards and the valve opens allowing exhaled gas to vent out of the BPR which is at atmospheric pressure i.e. 0 MSW.

This venting continues until the pressure on the inlet of the BPR falls to 80 msw at which point the forces across the diaphragm are equal, the valve closes and the venting stops.

The pressure within the line from the mask to the inlet of the BPR is 80 msw i.e. (80 – 100) or -20 msw below chamber pressure which is the setting on the spring.

The setting on the spring thus sets the negative pressure required to be controlled on the inlet to the BPR when referenced to chamber pressure.

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CHAPTER 4 PERIODIC MAINTENANCE

4.1 EVERY 2 YEARS

Strip down the BPR, clean to an approved oxygen cleaning procedure and replace all o-rings and the diaphragm.

Back Pressure Regulator Spares kit RP700201

ITEM	PART NO	DESCRIPTION	QTY
1	E10439	Spring	1
5	E10804	O-ring	2
6	E10805	O-ring	1
7	E10806	O-ring	1
8	E10807	O-ring	1
9	E10808	O-ring	1
10	E10811	Diaphragm	1
11	E11831	Grub Screw	1
15	FW085	Copper Washer	1
17	KI10298	Plastic Plug, 1” NPT	2

Disassemble Back Pressure Regulator as follows:

1. Remove grub screw (item 11) and unscrew adjuster (item 2). Discard spring (item 1) and O-rings (item 7 & 8).

2. Remove 10 off M6 bolts (item 12) from cap and remove cap (item 19) from body.

3. Remove screw (item 25) from plate (Item 23). Discard copper washer (item 15), diaphragm (item 10) and O-ring (item 9).

4. Unscrew sleeve (item 20) and discard O-rings (item 5 & 6).

Clean to an approved Oxygen Cleaning Procedure and reassemble Back Pressure Regulator in accordance with drawing P198153S1 and as follows progressively coating all soft seals with Christo-Lube grease:

1. Reassemble spring adjuster into body (item 18) and adjust to life spindle to approximately 5mm above the valve seat.

2. Apply Christo-Lube to copper washer (item 15) and apply Loctite 222 to screw (item 25) before fitting copper washer (item 15).

3. Assemble with diaphragm (item 10), plate (item 23) and sealing disc (item 24).

4. Torque up screw (item 25) to 6Nm (4.4 lb.ft) and wipe off excess Loctite.

5. Fit cap (item 19) and tighten M6 bolts in stages in an opposing sequence. Torque bolts to 9Nm (6.6 lb.ft).

6. Adjust spring retainer to set up as required and refit grub screw (item 11).

CHAPTER 5 DRAWINGS

ITEM NO.	PART NO.	DESCRIPTION	QTY
1	E10439	SPRING, 20.5 OD x 4.47 WIRE DIA, 71.2 LNG, 12.1/2 CO	1
2	E10797	SPRING RETAINER / ADJUSTER	1
3	E10800	SPRING TOP WASHER	1
4	E10801	SPRING BOTTOM WASHER	1
5	E10804	O-RING	2
6	E10805	O-RING	1
7	E10806	O-RING	1
8	E10807	O-RING	1
9	E10808	O-RING	1
10	E10811	DIAPHRAGM	1
11	E11831	GRUBSCREW, M2.5 x 6 LG	1
12	FB596	SETSCREW, HEX, M6 X 1.0 X 25 LG, A4-80	10
13	FP198	PLUG, SCKT HD, 1/8"MNPT, SS	2
14	FP280	PLUG, 1/4" NPT(M), HDPE PLASTIC, RED, WP0BAR	1
15	FW085	WASHER, SEALING, COPPER, M6 x 12 x 1.0TK.	1
16	FW123	WASHER, M6, FORM A, 316L ST. STEEL	10
17	MC36115	PLUG, PLASTIC, RED, UNTHREADED, TO FIT 1" NPT(FEM)	2
18	RP700301	BODY, BACK PRESSURE REGULATOR, 1" NPT F, BRASS	1
19	RP700302	CAP, BACK PRESSURE REGULATOR, BRASS	1
20	RP700303	SLEEVE, INNER, PISTON REGULATOR	1
21	RP700304	PISTON, REGULATOR	1
22	RP700305	SPINDLE, REGULATOR	1
23	RP700306	PLATE, REGULATOR	1
24	RP700307	DISC, SEALING, REGULATOR	1
25	RP700308	SCREW, REGULATOR	1

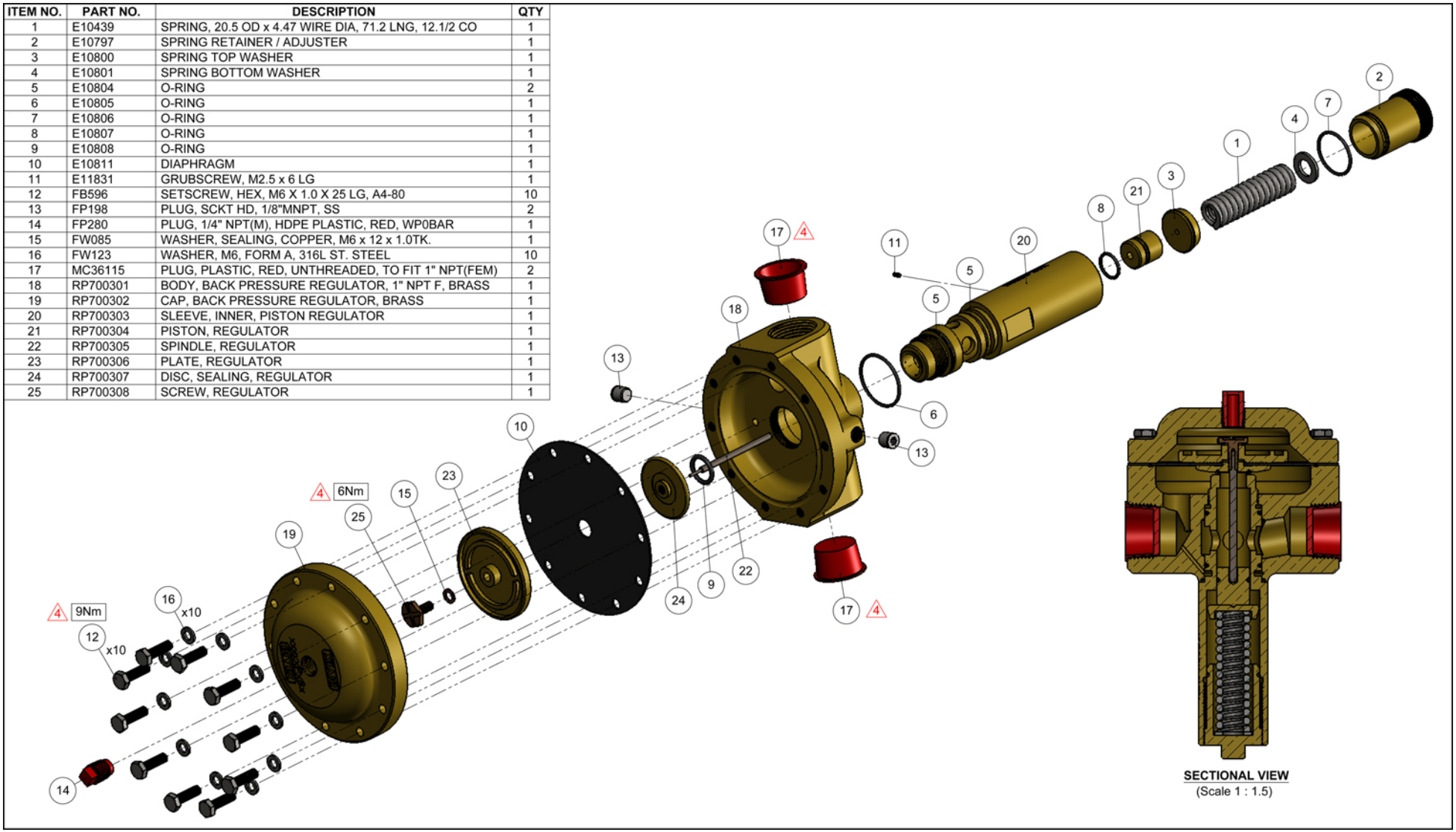

Fig 5.1 BPR Assembly
(Drawing Number: P198153S1)

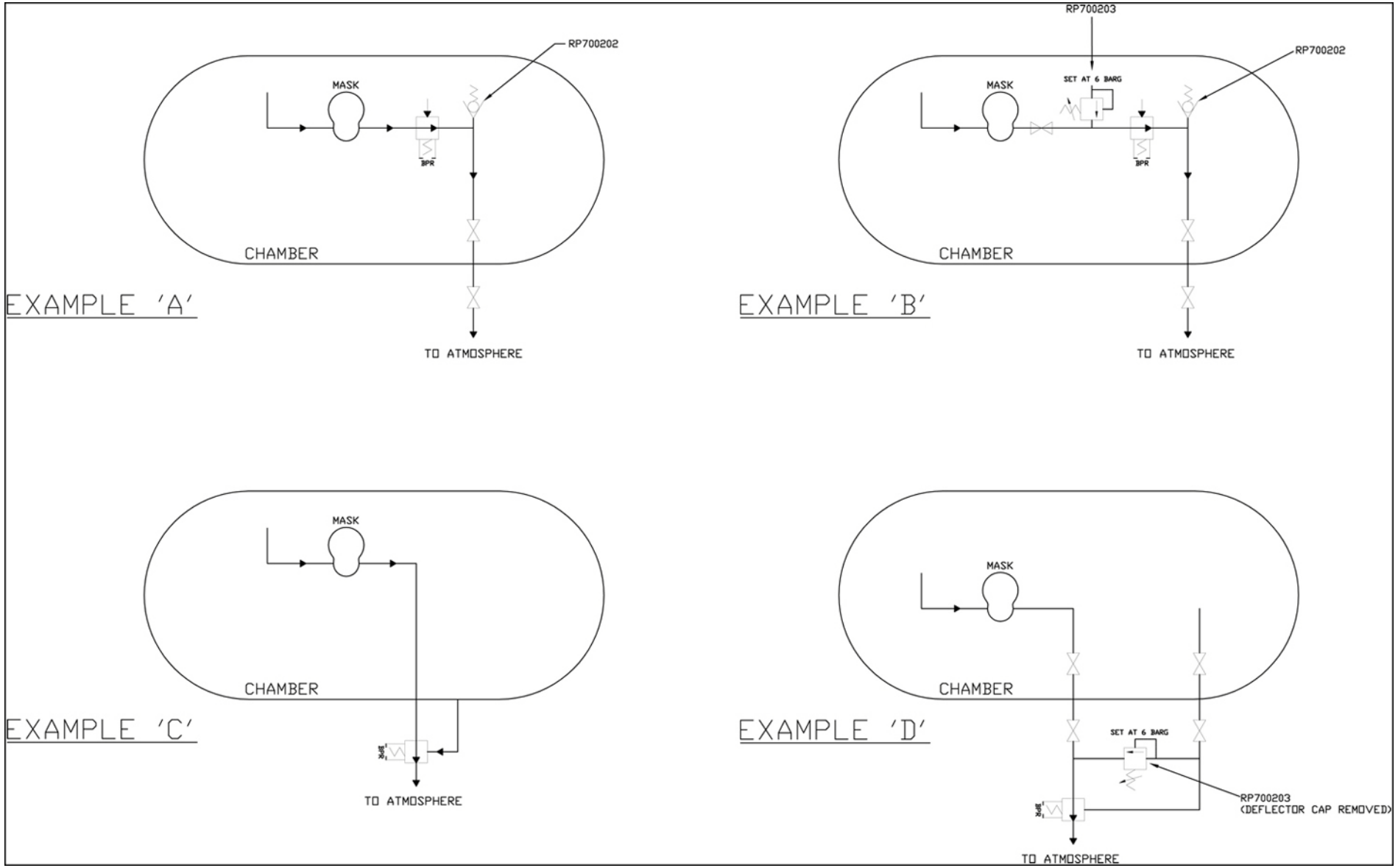

Fig 5.2 Acceptable Installation of the Divex BPR

CHAPTER 6 FITTING OF MOUNTING BRACKET - E15592

1. Loosen cap retaining bolts (Part No. FB435) starting with no 1 at inlet port and working in a diametral pattern 1-6-2-7-3-8-4-9-5-10.

2. Remove appropriate bolts to allow fitting of the mounting bracket.

3. Refit all bolts finger tight taking care not to disturb the diaphragm (Part No. E10811).

4. Using a calibrated torque wrench, torque all bolts to 5Nm (3.7 ft.lbs) in the same diametral sequence as dismantling.

5. Increase wrench setting to 7Nm (5.2 ft.lbs) and repeat sequence.

6. Increase wrench setting to 9Nm (6.6 ft.lbs) and repeat sequence THREE times to ensure uniformity.

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CHAPTER 7 LEAK TESTING

1. Apply maximum pressure of 2 bar to ¼" NPT port in regulator cap (Part No. RP700302).

2. Check for leakage at disturbed interfaces of diaphragm (Part No. E10811).

NOTE

Slight weeping through the diaphragm reinforcement layer is acceptable during this test.

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