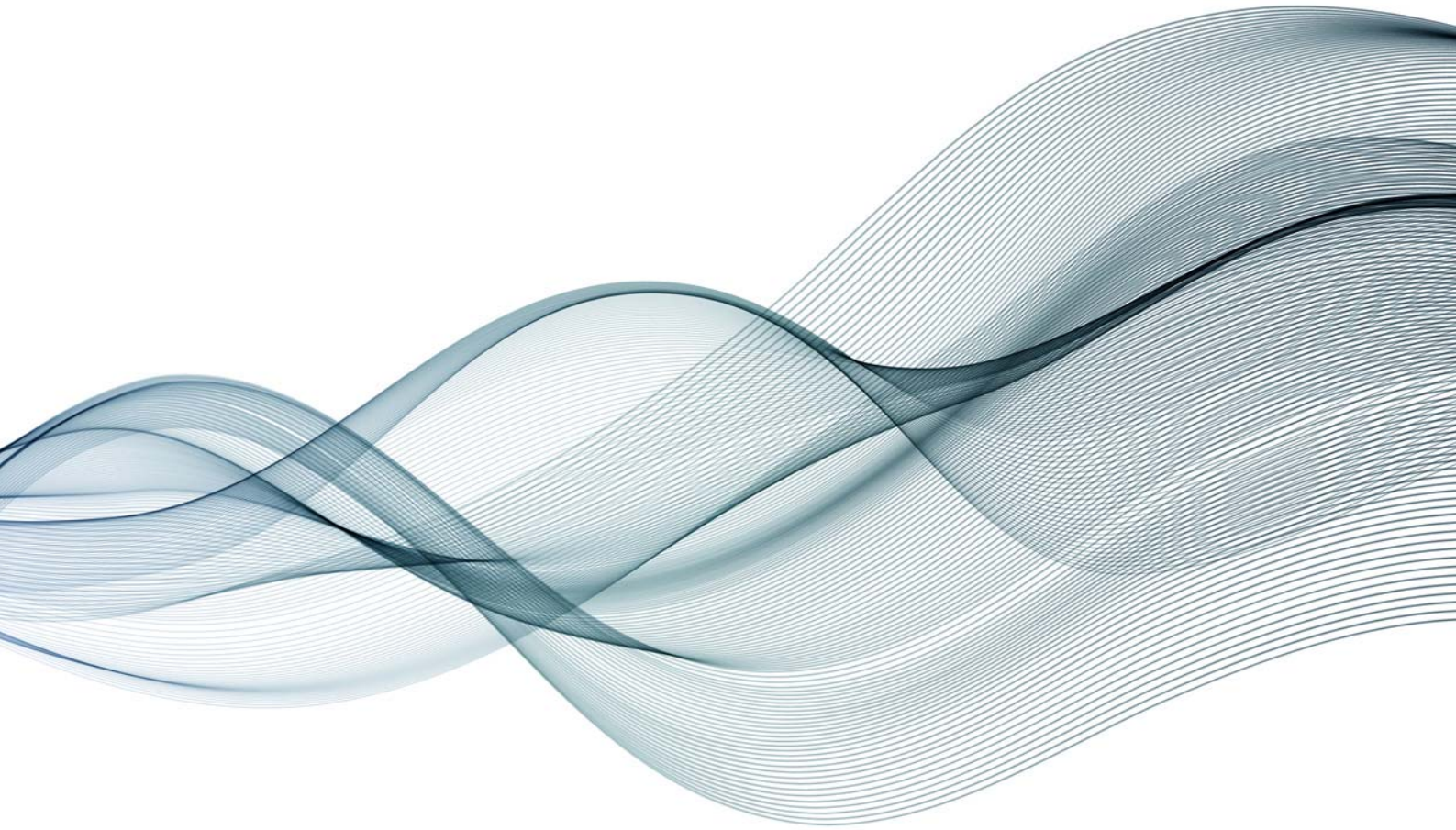

Operation and Maintenance Manual for the Bell Gas Management Panel

Part Number: A46983AA

Document Number: P1836-OM-296
Revision: 3

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APPROVAL SHEET

Document Information					
Manual No	**Advitium No**	**Title**	**Classification**	**Current Revision**	**Date**
OM533	P1836-OM-296	Bell Gas Management Panel - Mechanical Version	Commercial in confidence	3	08/12/2015

Revision History					
Rev	**Date**	**BY**	**CHK**	**APP**	**Comments**
0	13/02/2009	A. J. M.	G. McC	R. T. W.	Original for Issue
1	29/04/2010	G. McC	E. A.	S. W.	ECN: 13463
2	09/02/2011	G. McC	M. S.	S. W.	ECN: 13664
3	08/12/2015	Jurgina Lastakauskiene	Alastair Naylor	Philip Black	ECN: 18839

Original Approvals			
Responsibility	**Name**	**Position**	**Date**
Author	A. Middleton	Administrator	February 2009
Checked	George McClure	Engineer	February 2009
Approval	Ray Wylie	Senior Engineer	February 2009

Copyright Details

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TABLE OF CONTENTS

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CHAPTER 1 - INTRODUCTION

The following manual details the Divex mechanical version Bell Gas Management panel for use in diving bells. The panel incorporates the patented Divex shuttle block which meets and exceeds the criteria laid down in the Department of Energy Memorandum 10/83 and the qualifying AODC Memorandum of November 1984 and is fully interfaced with a commercially available gas recovery system.

The memoranda, which are included in the Appendix for reference, require that the gas supply to a diver should be designed in such a way as to safeguard the integrity of other circuits in the diver gas system. This means that in the event of a failure in one diver's umbilical or equipment, the supply to any other diver or the standby diver in the same supply system remains unaffected. The requirement also extends to the main bell umbilical where a failure in the bell gas supply hose should not permit the venting of the on board emergency supplies. A manually operated system is not considered adequate with both memoranda requiring that any changeover functions should be accomplished automatically and that the independent emergency supplies should also be made available to each diver.

The Divex Diver Gas Safety Shuttle Block meets and exceeds the criteria described above by providing visual warning that the block has been activated and emergency gas is being consumed. The block is designed to respond to emergency requirements and return to normal function if and when conditions permit. As with activation to emergency supply, return to normal is a totally automatic function and the unit will cycle in the order to take gas from the highest pressure source.

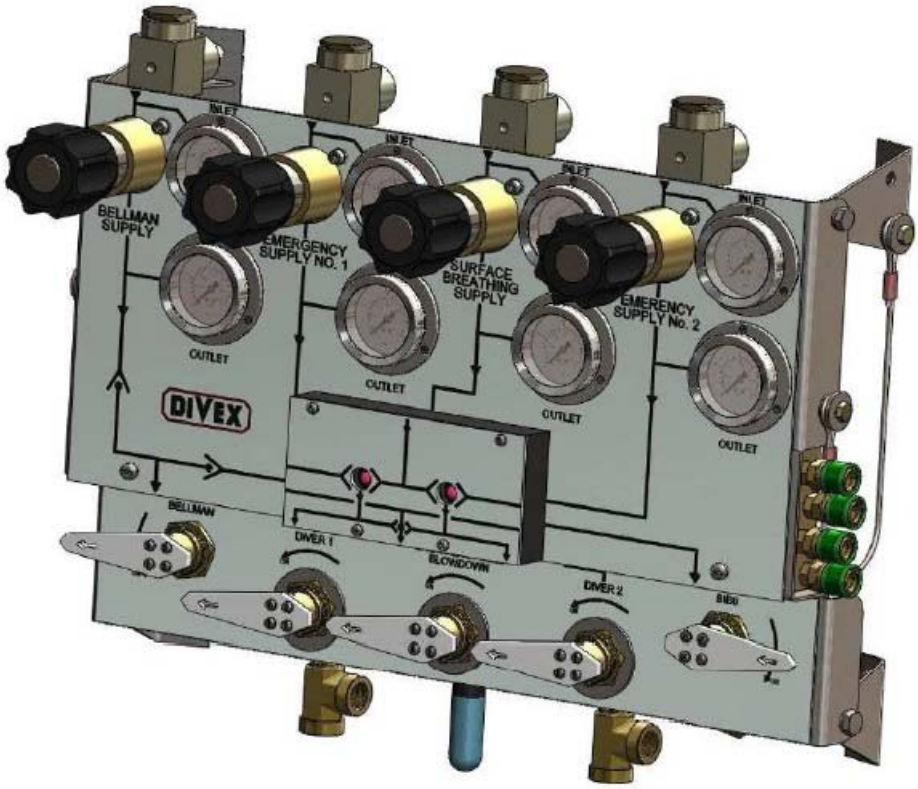

Fig 1.1 Bell Gas Management Panel

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CHAPTER 2 - DESCRIPTION

CONTENTS

2.1 BELL GAS MANAGEMENT PANEL

The bell gas management panel is used to regulate and supply to the diver's surface supplied gas under normal operating conditions. Under emergency conditions it regulates emergency gas from banks 1, 2 and 3 prior to onward distribution to the three divers excursion umbilicals, the bell emergency BIBS and the emergency pressurisation valve via the Divex Safety Shuttle Block. The panel is fitted to the bell inside wall in such a position as to make it easily visible to the bellman.

Prior to entering the panel, the surface, banks 1, 2 and 3 gas supplies are filtered and then supplied to panel mounted regulators with upstream and downstream pressure gauges. The outputs from the panel regulators that control the surface and emergency banks 1 and 2 supplies, feed a shuttle block which is designed to isolate and guarantee the emergency bank gas supplies to the two respective diver's in the water. The bell BIBS and the emergency pressurisation, take gas from the surface supply and either emergency bank 1 or 2 depending on the situation. The bellman is primarily supplied directly with bank 3 gas through the bellman panel regulator, i.e. not through the shuttle block however the bellman also has access to surface supply and also emergency banks 1 and 2 from port F of the shuttle block if necessary. The bellmans BIBS supply is supplied from the same source as the bellmans diving gas. Emergency bank 3 is for the exclusive use of the bellman at all times, divers 1, 2, divers BIBS and bell blow down do not get access to this supply. Surface supplied breathing gas is always available to each recipient provided its source has not failed. Each outlet from the panel is valved and two relief valves, set at 24 barg (350 psi), protect the shuttle block downstream circuits should a regulator fail.

Indicators on the panel, mechanically interconnected with the shuttle block, give a visual display as to whether surface gas or emergency bank gas is being used by the divers. A green display indicates normal surface gas while a red display indicates emergency gas.

For the correct functioning of the bell gas panel, the surface supply breathing gas regulator outlet must be set at 2 barg (30 psig) above the emergency banks 1 and 2 regulator outlets, and the bellman regulator is set at 1 barg (15 psig) above the setting of the surface supply gas. This initially biases the shuttle such that surface breathing gas supplies divers 1 and 2. If the normal surface gas pressure falls to less than that of the bank 1 and 2 regulators, the main shuttles activate to bring on emergency bank 1 and 2 gas and the visual indicators turn from green to red.

Reinstatement of the surface gas restores the block to normal operating conditions. If the bellman supply gas pressure falls below the surface supply breathing gas regulator setting, the bellman will be supplied with gas from the shuttle block with either surface breathing gas supply or emergency gas supplies 1 or 2. Should the diving depth, excessive diver demand or other restrictions in the main bell umbilical dictate, higher pressure differentials may be set.

2.2 SHUTTLE BLOCK - MODES OF OPERATION

2.2.1 Mode 1, Normal conditions
All outlets supplied from port A - Surface Supply.

Under normal conditions, the surface breathing gas is supplied to Port A. Due to the 2 barg minimum pressure differential set up on the gas panel between the emergency supply regulators and the surface supplied gas, the lower main shuttles seal off against Ports B and C. Under static conditions, the main shuttle springs seal the upper part of the shuttles against their respective housings and the spring loaded auxiliary shuttle seals against each half of the shuttle block. Surface gas is available to all outlet Ports D, E and F also both main shuttle indicators are green.

As a diver inhales, the reduction in pressure created in the outlet port causes the top half of the diver's main shuttle to break its seal to replenish the gas. On exhalation, both diver indicators are green.

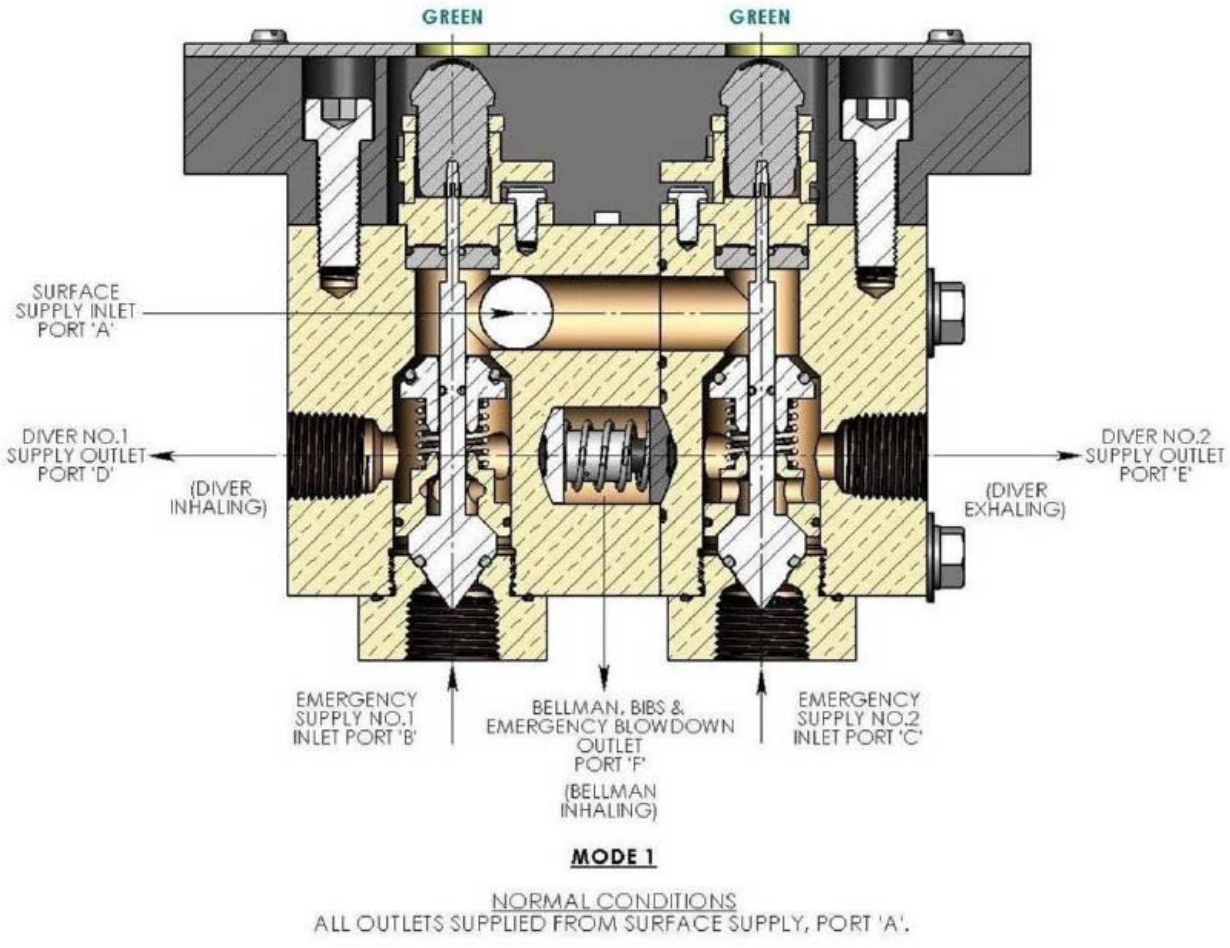

Fig 2.1 Mode 1

2.2.2 Mode 2, Severance of Surface Supply
All outlets supplied through ports B and C - Emergency Supplies.

In the event of the main bell umbilical being ruptured, with the consequential loss of all gas to the diving bell, the pressure in Port A will fall to below the pressure bias set on Ports B and C. The indicator rods will lift to give a red indication. The emergency supply No.1, Port B, is therefore available to supply outlet Ports D and F and the emergency supply No.2, Port C, is available to supply outlet Ports E and F. Under static conditions the spring loaded auxiliary shuttle seals against each half of the block.

As a diver inhales, the reduction in pressure created in the outlet port cause the piston seal around the lower half of the main shuttle to lift against its spring to replenish the gas. On exhalation, the pressure in the outlet port equalises with that in the emergency supply port and the spring resets the piston seal against the lower half of the shuttle. During inhalation and exhalation, both diver indicators are red.

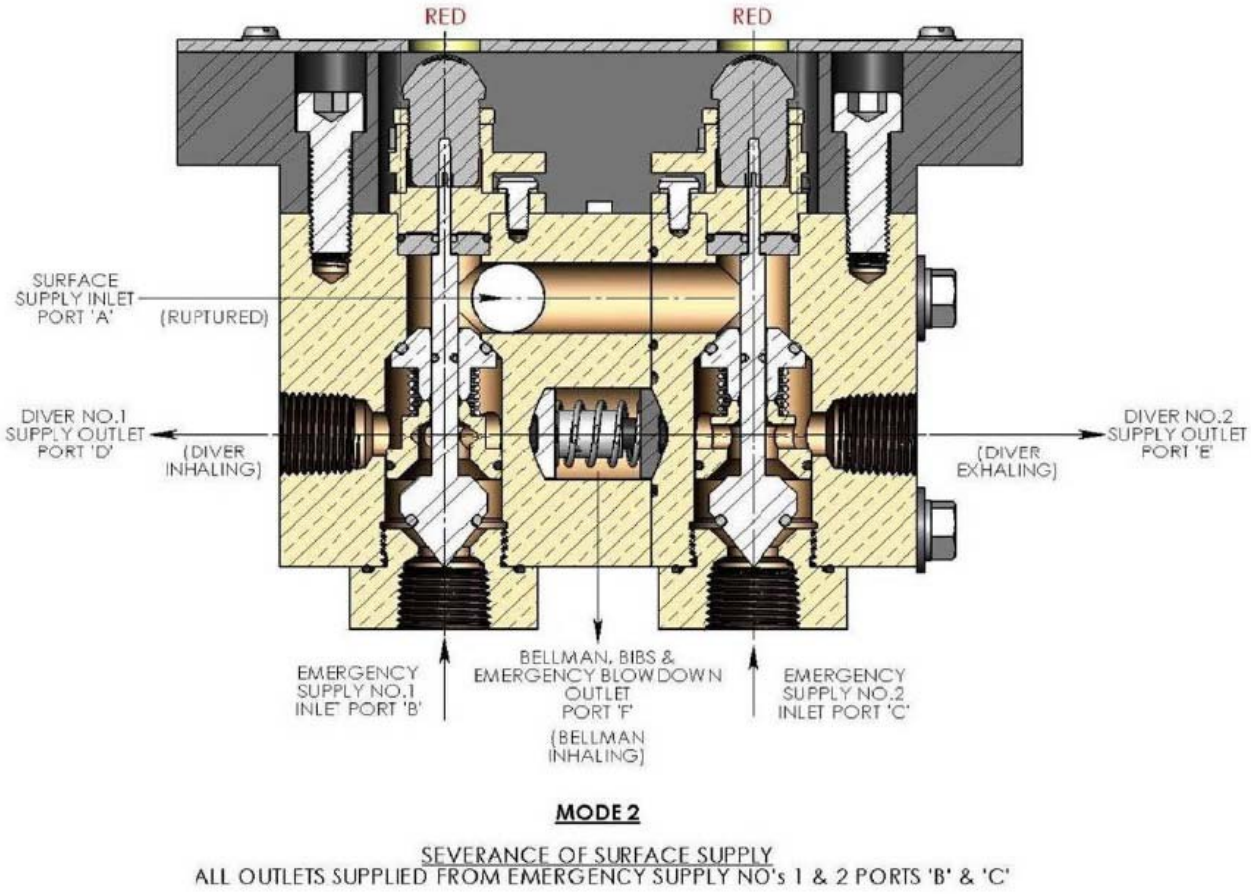

Fig 2.2 Mode 2

2.2.3 Mode 3, Severance of Diver 1 umbilical
Diver 2 supplied from Port C - Emergency Supply No2.

If diver 1 umbilical is ruptured in the water, and the surface breathing supply is unable to maintain the flow, the pressure in Port A will reduce. As the pressure reduction falls below the preset differential, the indicator rods will lift to give a red indication. The auxiliary shuttle protects the other half of the block by sealing the leak path through Port D. The emergency supply No.1, Port B, is therefore available to supply outlet Port D, and the emergency supply No.2, Port C is available to supply outlet Ports E and F.

Due to the ruptured umbilical, the excessive continuous demand from Port D causes both the upper and the lower halves of diver 1 shuttle to provide gas. Diver 1 indicator will remain red until the emergency supply 1 bank has been depleted and the shuttle spring resets the lower half of the shuttle. At this point, diver 1 indicator will revert to green.

Diver 2 indicator will, however remain red. As diver 2 inhales and exhales, the piston seal above the lower half of diver 2 shuttle raises and lowers to replenish the inhaled gas in Port E.

Diver 1 must return to the bell on his bail out bottle gas supply.

Severance of the diver 2 umbilical produces a similar condition but on the opposite half of the block.

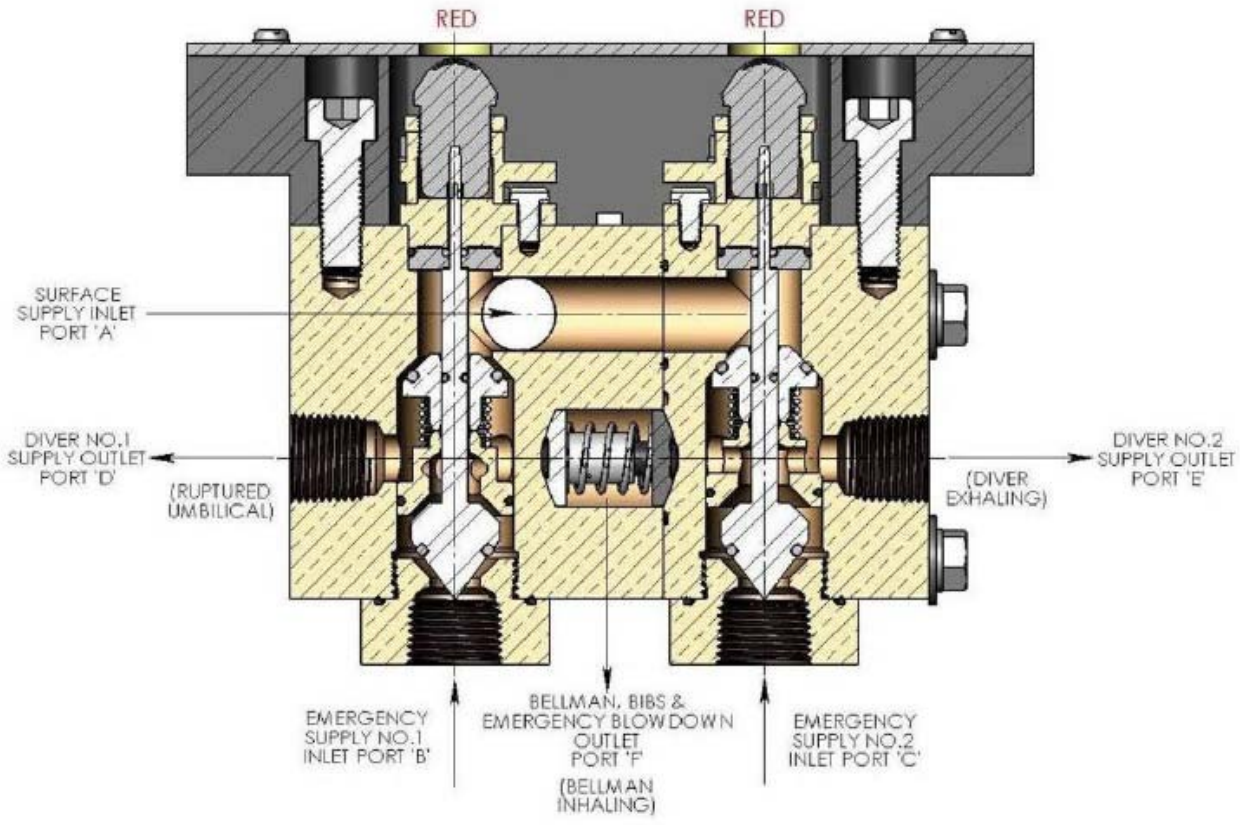

Fig 2.3 Mode 3

2.2.4 Mode 4, Shut Off of Surface Supply
All Outlets supplied form Ports B and C - Emergency Supplies.

With the surface supply shut off and the divers demanding gas, the 2 barg pressure differential, initially set up between the surface and the emergency supplies, diminishes and eventually equalises with the on board supply pressure. At this point the indicator rods lift to give a red indication.

The emergency supply No.1, Port B, is therefore available to supply outlet ports D and F and the emergency supply No.2, Port C, is available to supply outlet ports E and F.

Under static conditions the spring loaded auxiliary shuttle valve seals against each half of the block.

When the surface supply is restored and the 2 barg differential reinstated, the indicator rods reset and the indicator return to the green status.

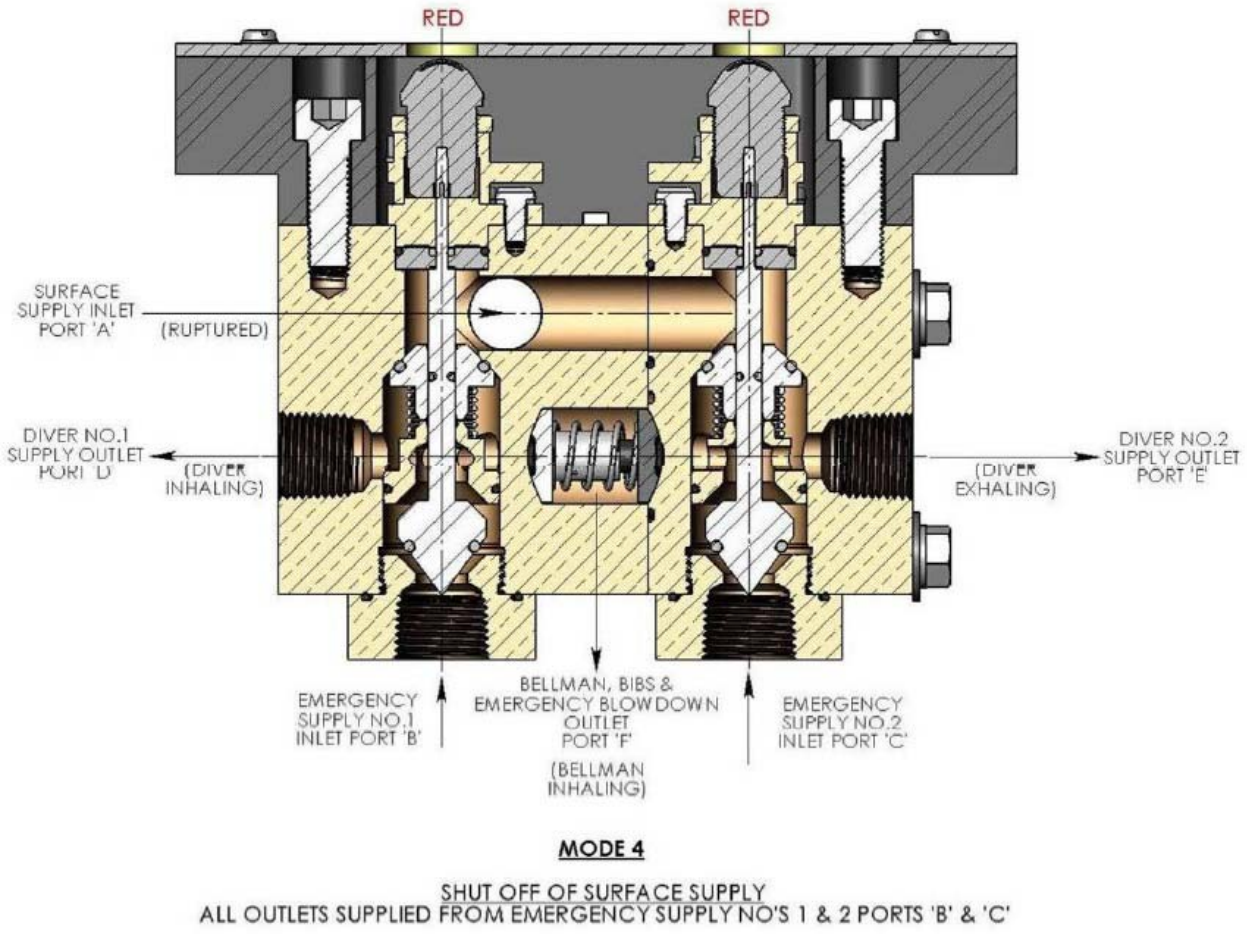

Fig 2.4 Mode 4

2.2.5 Severance of Divers 1 and 2 umbilicals Bellman supplied with emergency Bank 3.

If the divers 1 and 2 umbilicals are ruptured in the water and the surface breathing supply is unable to maintain the flow, the pressure in Port A will reduce. As it falls below the preset differential the indicator rods will lift to give a red indication, and the on board emergency banks 1 and 2 will be brought on line to both Ports B and C.

Due to the ruptured umbilicals causing excessive demands from Ports D and E both the upper and lower halves of Diver's 1 and 2 shuttle provide gas.

Both indicators will remain at red until the two on board banks are depleted, at which point they will revert to green and only surface breathing gas will be fed to Ports D and E.

Diver's 1 and 2 must return to the bell on their bail out bottle gas supplies.

The bellman is supplied from emergency bank No3 and remains unaffected by the loss of gas to divers 1 and 2.

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CHAPTER 3 - PRE- DIVE CHECKS

IMPORTANT
1. Have you read and understood the general description and method of Operation of the Shuttle Valve? Operating pressures can be changed but a minimum of 2 barg/30psig biases should be maintained between surface supply and emergency supplies. A minimum of 1 barg (15psig) bias should be maintained between surface supply and bellman supply. 2. Any malfunctions highlighted by the following check-list must be rectified and re-checked before diving commences.

1. Check the diver gas outlet valves, emergency blow-down valve and BIBS valve are closed.
2. Check that the four panel regulators are backed right-off.
3. Open the surface breathing gas supply hull stop valve.
4. Set surface supply regulator to 14 bar.
5. Check shuttle valve indicating eyes are both GREEN.
6. Check that the gas supply is available to Divers 1, 2 and 3, emergency blow-down and BIBS.
7. Open bank supply No.1 hull stop valve.
8. Set the emergency supply No.1 regulator to 12 bar (2 bar bias)
9. Close the surface breathing gas supply hull stop valve.
10. Open diver 1 supply valve to vent pressure from the surface supply regulator. Emergency supply No.1 will trip in when 2 bar bias pressure equalises.
11. Left hand indicator eye should now be RED.
12. Check that the gas supply is available to divers 1 and 3, emergency blow down and BIBS. Confirm that diver 2 is isolated.
13. Back surface supply regulator right off.
14. Open surface breathing gas supply hull stop valve.
15. Set surface supply regulator to 14 bar.
16. Check that both eyes are GREEN.
17. Back emergency supply No.1 regulator right off.
18. Open bank supply No.2 hull stop valve.
19. Set the emergency supply regulator No.2 to 12 bar (2 bar bias).
20. Close surface breathing gas supply hull stop valve.

21. Open diver 2 supply valve to vent pressure from the surface supplied regulator. Emergency supply No.2 will trip in when 2 bar bias pressure equalises.

22. Right hand indicator eye should now be RED.

23. Check that the gas supply is available to divers 2 and 3, emergency blow-down and BIBS. Confirm that diver 1 is isolated.

24. Back surface supply regulator right off.

25. Open surface breathing gas supply hull stop valve.

26. Set surface supply regulator to 14 bar.

27. Set emergency supply No.1 regulator to 12 bar.

28. Check the emergency supply No.2 regulator is set at 12 bar.

29. Check that both shuttle valve indicator eyes are GREEN.

30. Open emergency on board bank 3 gas supply hull stop valve.

31. Set the bellman panel regulator to 15 bar.

32. Close the surface breathing gas, bank No.1 and bank No.2 hull stop valves.

33. Open divers 1 and 2 supply valves to vent firstly the surface supply regulator then emergency bank supply regulators. The indicators will change from GREEN to RED.

34. Check that gas is available to the bellman and that the bellmans supply is isolated from divers 1, 2, BIBS and bell blow down.

35. Back the surface and emergency supplies regulators right off and open the respective hull stop valves.

36. Set the surface supply regulator to 14 bar, emergency supply regulators to 12 bar then check the bellman regulator is set to 15 bar.

37. Check that both shuttle valve indicator eyes are GREEN. The gas panel and safety shuttle valve are now fully operational.

CHAPTER 4 - MAINTENANCE

Pre-Dive checks are carried out on the panel prior to each dive (chapter 3, page 11).

Malfunctions highlighted by these checks requiring servicing of parts such as a regulator main valve seat or cleaning of a filter element must be rectified and rechecked before diving commences.

Monthly or between each saturation. Grease the main shuttle valve o-rings using silicon grease. Items 24, 28, 31 and 32 on Fig 5.5 (drawing P21753S1).

Access to this shuttle block for maintenance is via the rear of the gas panel. This is achieved by uncoupling the panel's interconnecting supply lines, releasing the top two bracket retaining bolts and swinging facia downwards through 90 degrees. The supply lines to be uncoupled are as follows:

a. Surface Supplied Breathing Gas

b. Emergency Bank 1

c. Emergency Bank 2

d. Emergency Bank 3

e. Diver No.1 SAECO Valve Supply

f. Diver No.2 SAECO Valve Supply

The shuttle o-rings are accessed by removing the two ½" OD Tungum emergency bank supply lines and removing the two retaining adaptors (Item 3 on Fig 5.5). Once the adaptor has been removed, the compressed internal spring (21) extends and pushes the piston (4) and indicator rod (13) out of the block.

The complete shuttle valve assembly (Items 4, 21, 5 and 13) can then be lifted out of the block for maintenance.

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CHAPTER 5 - DRAWINGS

Drawing	Rev	Title
P18364003S1	5	Gas Management Panel
P18364003S2	5	Gas Management Panel, Mounting Components
P18364003S3	5	Gas Management Panel, Piping Assembly
P18364003S4	5	Gas Management Panel, Fit Out Schematic
P21753S1	3	Shuttle block mechanical assembly
P21753S2	3	Shuttle block mechanical assembly
P21754005S1	0	Filter assembly
P2175201S1	2	Ball Valve
P2175204S1	2	Ball Valve
P2175205S1	0	Ball Valve

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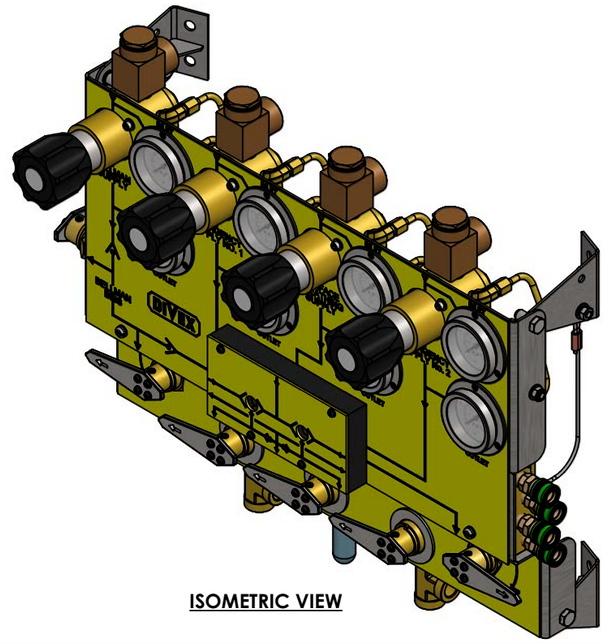
ITEM	PART No.	DESCRIPTION	QTY	MAWP	
1	A46983301	FACIA SET, GLOBRITE, 3 DIVER BELL PANEL	1	-	
2	A46983302	FABRICATION, FRAME, 3 DIVER BELL PANEL	1	-	
3	A46983304	SPACER, TOP HAT, 3 DIVER BELL PANEL	4	-	
4	D46310	COLLAR, MOUNTING	4	-	
5	D4632	WASHER, BALL VALVE RETAINING	3	-	
6	FB226	SET SCREW, HEX, M10 x 1.5 x 25, SS	4	-	
7	FB236	SCREW, CAP, SCKT, M8 x 1.25 x 25LG, 316 SS	4	-	
8	FB946	SCREW, CAP, SKT, M6 x 1 x 16, 316 SS	16	-	
9	FB263	SCREW, M/C, CSK, SLOTTED, M4 x 12mm LONG, SS 316	4	-	
10	FB280	SCREW, M/C, PAN HD, M6 x 15mm	2	-	
11	FB449	BOLT, HEX, M8 x 1.25 LG, ST.ST 316	4	-	
12	FB509	SCREW, M3 x 10mm LG, CSK HD, POZIDRIVE, SS316	24	-	
13	FN059	NUT, AEROTIGHT, M8	4	-	
14	FN136	NUT, CLINCH, CSK, SERRATED, 2.5-4mm, ST.STEEL, M6	2	-	
15	FN138	NUT, CLINCH, CSK, SERRATED, 2.5-4mm, ST.STEEL, M8	4	-	
16	FN140	NUT, CLINCH, CSK, 2.5-4mm, ST.STEEL, M10	4	-	
17	FW037	WASHER, PLAIN, 6mm, SS	10	-	
18	FW044	WASHER, PLAIN, M8, 316SS	4	-	
19	FW126	WASHER, SPRING, M10, TYPE A, SS 316	4	-	
20	MC359	MISC, WIRE ROPE SLING 580 LONG, 4mm x 7 x 19	2	-	
21	FB227	SCREW, CAP, SCKT, M5 x 20 LONG, A2-70	8	-	
22	A4698303	MANIFOLD BLOCK, BIBS, 4 PORT, BELL PANEL	1	-	
23	CA46230	FILTER ASSEMBLY, 3/4"NPT MALE/FEMALE	4	310 BAR	
24	C47130	SHUTTLE BLOCK ASSY (MECH)	1	-	
25	DM47100	BALL VALVE, MODIFIED ASSY, ACW ON, OUTWARD ARROW	4	172 BAR	
26	DM47110	BALL VALVE, MODIFIED ASSY, CW ON, INWARD ARROW	1	172 BAR	5
27	FJ217	ELBOW, MALE 90°, 4-JIC X 1/4" MNPT, BRASS, WP227B	8	227 BAR	
28	FJ228	CONNECTOR, FEMALE C/W NUT & FERRULE, 4JIC-1/4" FNP	8	227 BAR	
29	FJ407	ELBOW CONNECTOR, 8 JIC - 1/2"NPT(F) BRASS	1	137 BAR	
30	FJ420	CONNECTOR, 8-JIC-1/2"NPT(M), BRASS, MWP227 BAR	4	227 BAR	
31	FJ423	ELBOW, MALE, 8-JIC X 1/2"MNPT, BRASS, WP227 BAR	11	227 BAR	
32	E10073	SOCKET, QUICK CONNECT, 3/8"(M)NPT	5	103 BAR	
33	FP2029	PLUG, HEX, MALE, 1/2" NPT(M), BRASS, WP269 BAR	1	268 BAR	
34	FP405	TEE, STREET, 1/2"NPT(M) X 1/2"NPT(F), BRASS, MWP 131 BAR	3	131 BAR	
35	FP407	TEE, FEMALE, 1/2"(F)NPT	1	131 BAR	5
36	FP607	REDUCER, PIPE THRD, 3/4NPT(M)-1/2NPT(F), BRASS, MWP 227 BAR	4	227 BAR	
37	FP414	ADAPTOR, MALE-FEMALE, 1/2"MNPT-1/2"FNPT	2	220 BAR	

ITEM	PART No.	DESCRIPTION	QTY	MAWP	
38	FP417	ELBOW, FEMALE-FEMALE, 1/2" (F) NPT	2	131 BAR	
39	FP418	TEE, MALE, 1/2" (M)NPT	1	268 BAR	
40	FP423	1/2" NPT F - 3/8" NPT M REDUCER	2	220 BAR	
41	FP434	NIPPLE, CLOSE	4	261 BAR	
42	GP208	GAUGE, 0-1500PSI (DUAL SCALE), 1/4"NPT	4	103 BAR	
43	GP239	GAUGE, ∅63, 0-27 BAR DAUL, F/F, 1/4"NPT R/E,O2, DIVEX	4	27 BAR	
44	MC357	MISC, SILENCER	1	-	
45	RP616	REGULATOR, PRESSURE, TESCOM 44-1313-2122-053	4	258 BAR	
46	TM205	TUBE, TUNGUM, 1/4" X 20 SWG, TCL100/B	2m	320 BAR	
47	TM401	TUBE, TUNGUM, SEAMLESS, 1/2" OD X 16 SWG, TCL100/B	3m	280 BAR	
48	VC40P	VALVE, CAP, DEFELECTOR, 1/2" FNPT	3	-	5
49	VC403	VALVE, RELIEF	3	206 BAR	5
50	VC409	VALVE, CHECK, 1/2"NPT(M)	2	206 BAR	
51	FP309	ELBOW, STREET, 3/8"MNPT-3/8"FNPT, BRASS, WP 206 BAR	1	206 BAR	
52	FP406	REDUCER, PIPE THREAD, 1/2"MNPT-3/8"FNPT	1	220 BAR	
53	FP435	CROSS, FEMALE, 1/2" FNPT	1	131 BAR	5
54	DM47111	BALL VALVE ASSEMBLY, CW ON, OUTWARD ARROW	1	172 BAR	5



ISOMETRIC VIEW

NOTES

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

5 - DENOTES CHANGES MADE AT THIS REVISION.

MATERIAL: SEE PARTS LIST

FINISH: N/A

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No.	BY	DATE	AUTH. BY
R06					
R05	BoM UPDATED	18550	JR	03/12/15	AN
R04	MAWP COLUMN ADDED TO PARTS LIST & SHEETS 3 & 4 ADDED	17368	ZD	28/01/15	MS
R03	SHEET 2 UPDATED	14485	ZD	29/08/12	MS
R02	ADDITIONAL BIBS QC ON BELLMAN SUPPLY ADDED	13664	DR	07/10/10	GMcC
R01	PIPING UPDATED AS ON 1ST PROTOTYPE, TOP HAT SPACER ADDED	11547	GR	17/12/08	GMcC
R00	ISSUED FOR MANUFACTURE		GR	08/05/08	GMcC

DO NOT SCALE DRAWING

TITLE: **MECHANICAL / PIPING PARTS LIST, 3 DIVER BELL PANEL**

DRAWING No.: **P18364003S1** REV: **R05**

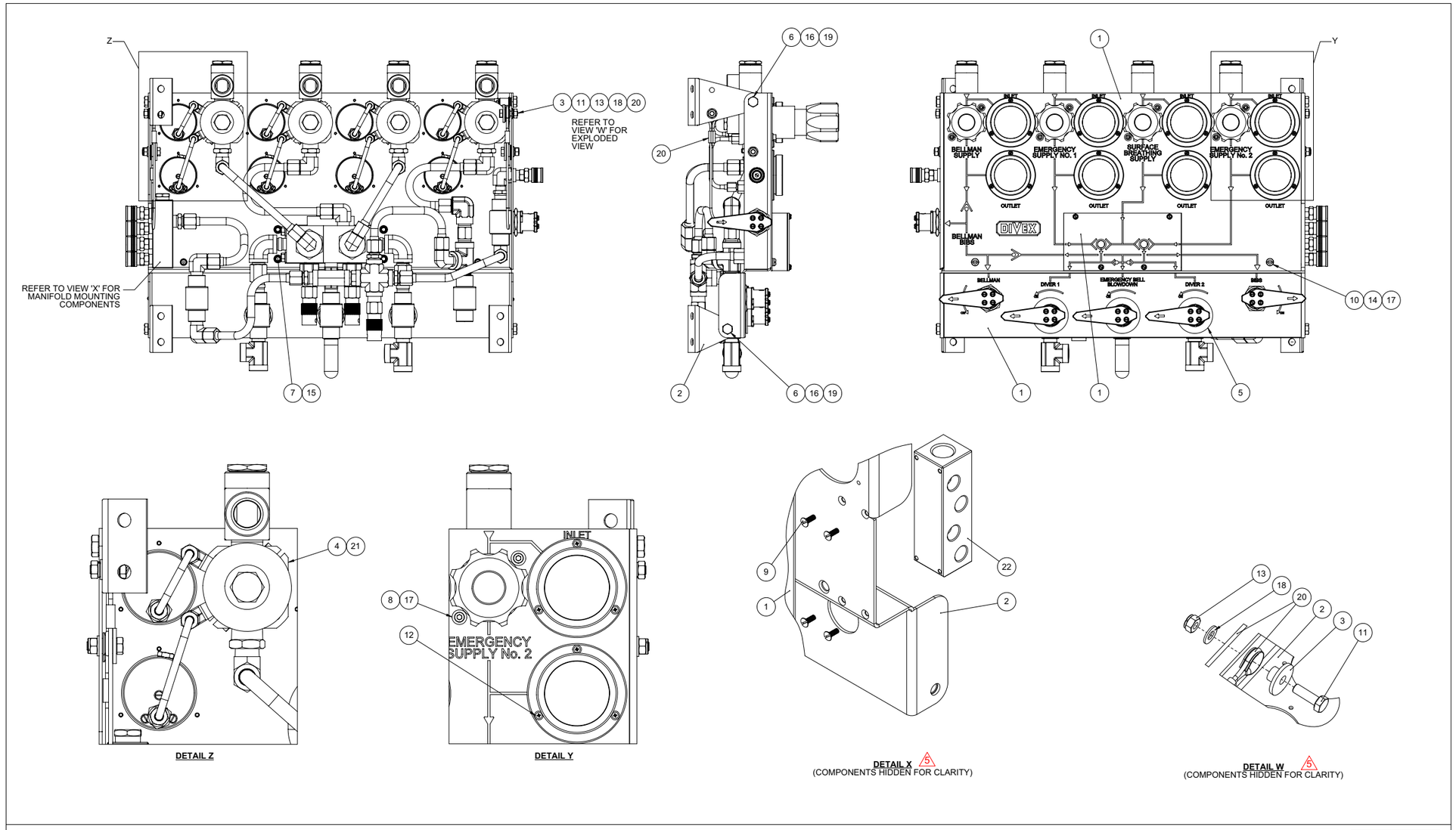
PART No.: A46983AA PRODUCT / PROJECT No.: MARA BGMP

SIZE: A3 SCALE: NTS SHEET 1 OF 4

DIVEX LIMITED
ENTERPRISE DRIVE
WESTHILL
ABERDEEN
AB32 6TQ
UNITED KINGDOM

Tel : +44(0)1224 740145
Fax : +44(0)1224 740172
email : info@divexglobal.com
www.divexglobal.com

Fig 5.1 Gas Management Panel
(Drawing P18364003S1)



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REMOVE ALL SHARP EDGES AND BURRS

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DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE SHEET 1

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05	SEE SHEET 1	18550	JR	03/12/15	AN
R04	SEE SHEET 1	17368	ZD	28/01/15	MS
R03	SHEET 2 UPDATED	14485	ZD	29/08/12	MS
R02	ADDITIONAL BIBS QC ON BELLMAN SUPPLY ADDED	13664	DR	07/10/10	GMcC
R01	PIPING UPDATED AS ON 1ST PROTOTYPE, TOP HAT SPACER ADDED	11547	GR	17/12/08	GMcC
R00	ISSUED FOR MANUFACTURE		GR	08/05/08	GMcC

DO NOT SCALE DRAWING

TITLE: MECHANICAL ASSEMBLY, 3 DIVER BELL PANEL

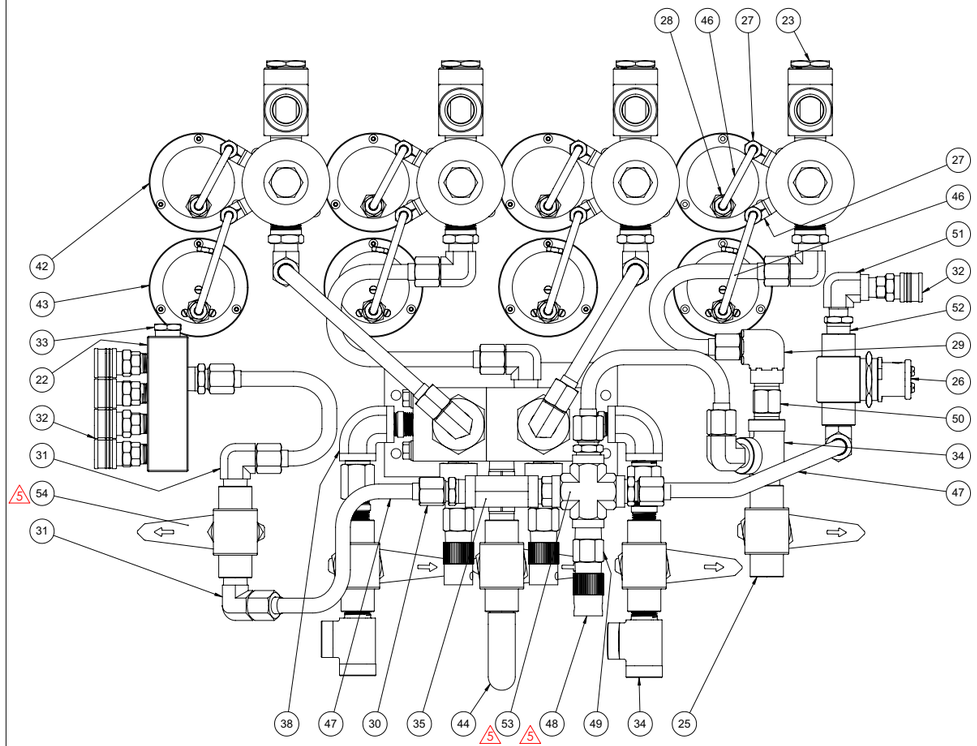
DRAWING No.: P18364003S2 REV: R05

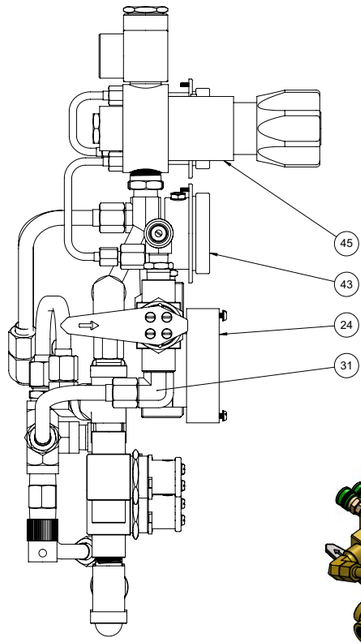
PART No.: A46983AA PRODUCT / PROJECT No.: MARA BGMP

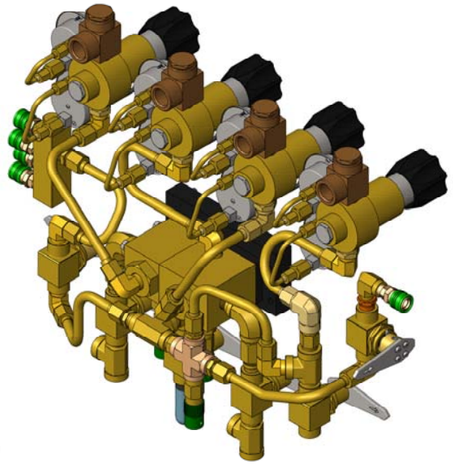
SIZE: A1 SCALE: NTS SHT: 2 OF: 4

DIVEX
DIVEX LIMITED
ENTERPRISE DRIVE
WESTHILL
ABERDEEN
AB32 6TQ
UNITED KINGDOM
Tel : +44(0)1224 740145
Fax : +44(0)1224 740172
email : info@divexglobal.com
www.divexglobal.com

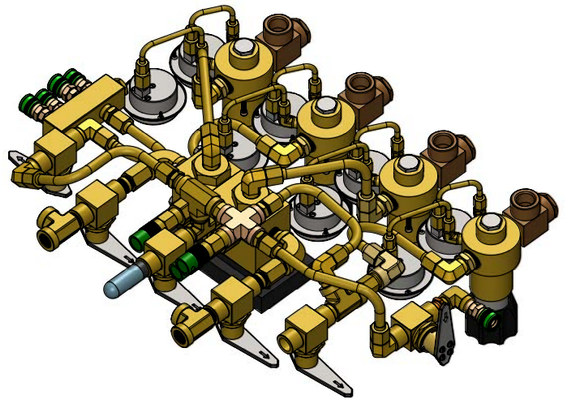
Fig 5.2 Gas Management Panel, Mounting Components
(Drawing P18364003S2)







ISOMETRIC VIEW



ISOMETRIC VIEW

NOTES
FASCIA NOT SHOWN FOR CLARITY

5 - DENOTES CHANGES MADE AT THIS REVISION.

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE SHEET 1

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05	SEE SHEET 1	18550	JR	03/12/15	AN
R04	SEE SHEET 1	17368	ZD	28/01/15	MS
R03	BoM UPDATED	14485	ZD	29/08/12	MS
R02	ADDITIONAL BIBS QC ON BELLMAN SUPPLY ADDED	13664	DR	07/10/10	GMcC
R01	CHECK VALVE ADDED. PIPING UPDATED BASED ON 1ST PROTOTYPE BUILD. 275BAR GAUGED REPLACED WITH 100BAR GAUGE	11547	GR	17/12/08	GMcC
R00	ISSUED FOR MANUFACTURE		GR	08/05/08	RTW

DO NOT SCALE DRAWING

TITLE: PIPING ASSEMBLY, 3 DIVER BELL PANEL

DRAWING No.: P18364003S3 | REV: R05

PART No.: A46983AA | PRODUCT / PROJECT No.: MARA BGMP

SIZE: A1 | SCALE: NTS | SHT: 3 | OF: 4

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AB32 6TQ
UNITED KINGDOM
Tel : +44(0)1224 740145
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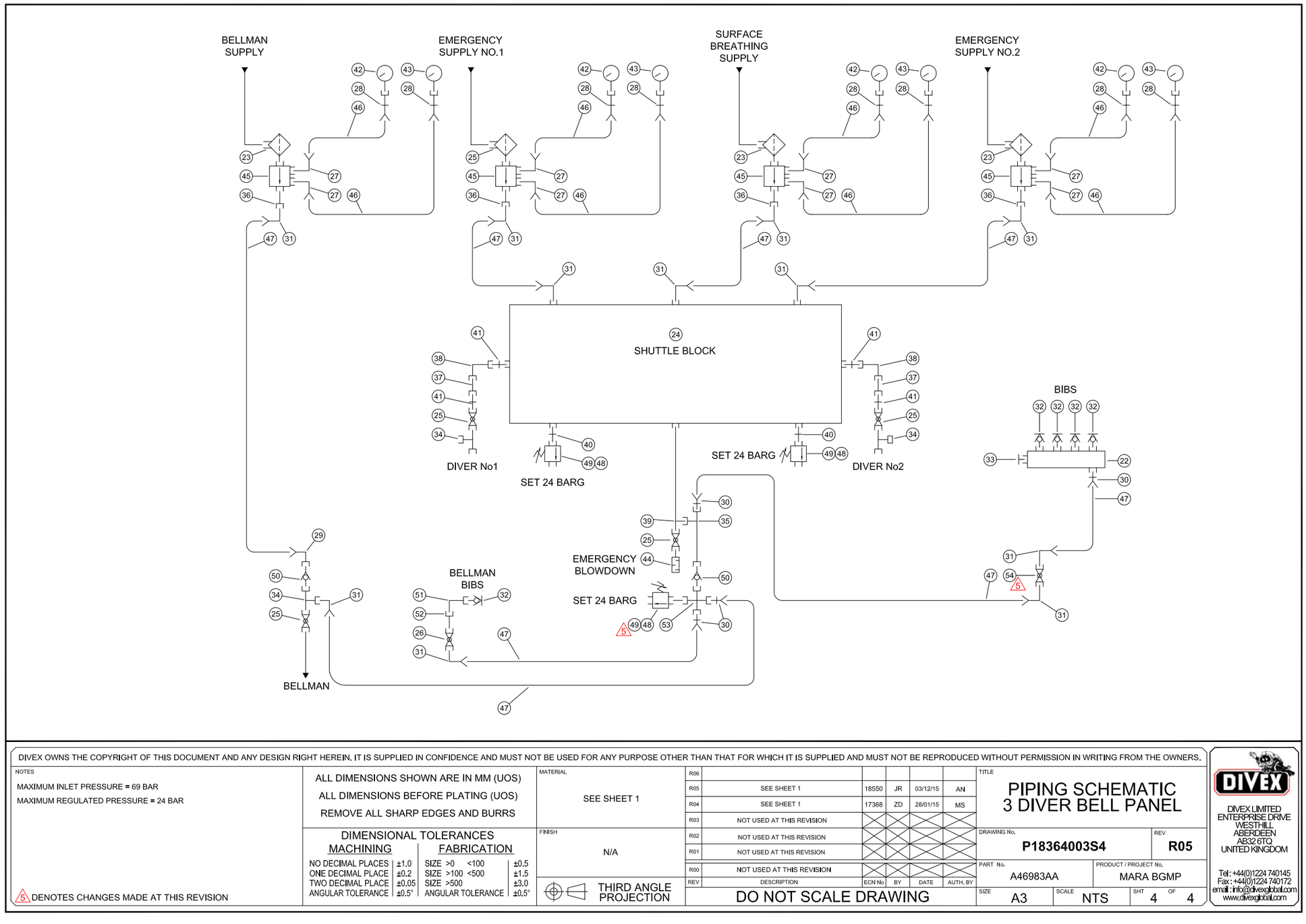
Fig 5.3 Gas Management Panel, Piping Assembly
(Drawing P18364003S3)



NOTES
MAXIMUM INLET PRESSURE = 69 BAR
MAXIMUM REGULATED PRESSURE = 24 BAR

5 DENOTES CHANGES MADE AT THIS REVISION

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE SHEET 1
FINISH: N/A
THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH. BY
R06					
R05	SEE SHEET 1	18550	JR	03/12/15	AN
R04	SEE SHEET 1	17368	ZD	28/01/15	MS
R03	NOT USED AT THIS REVISION				
R02	NOT USED AT THIS REVISION				
R01	NOT USED AT THIS REVISION				
R00	NOT USED AT THIS REVISION				

DO NOT SCALE DRAWING

TITLE: PIPING SCHEMATIC 3 DIVER BELL PANEL
DRAWING No. P18364003S4
REV R05
PART No. A46983AA
PRODUCT / PROJECT No. MARA BGMP
SIZE A3 SCALE NTS SHT 4 OF 4

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AB32 6TQ
UNITED KINGDOM
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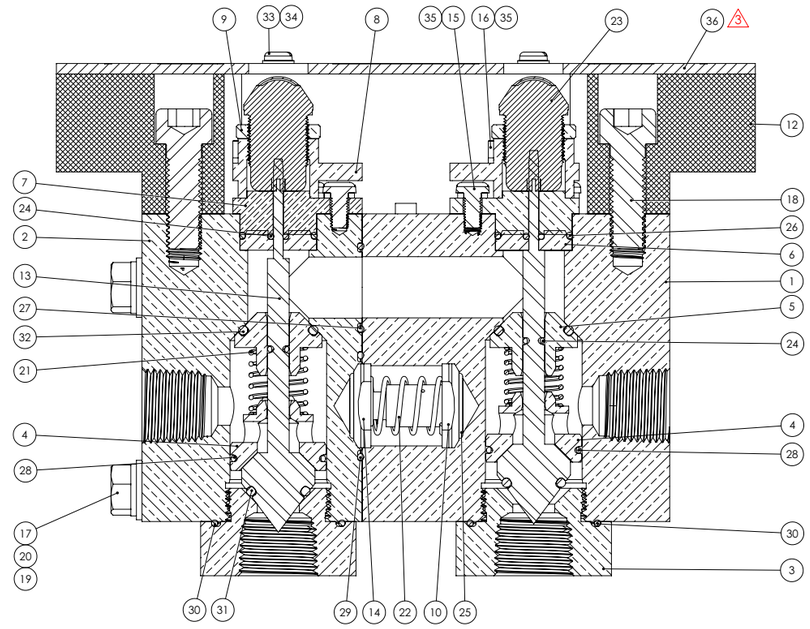
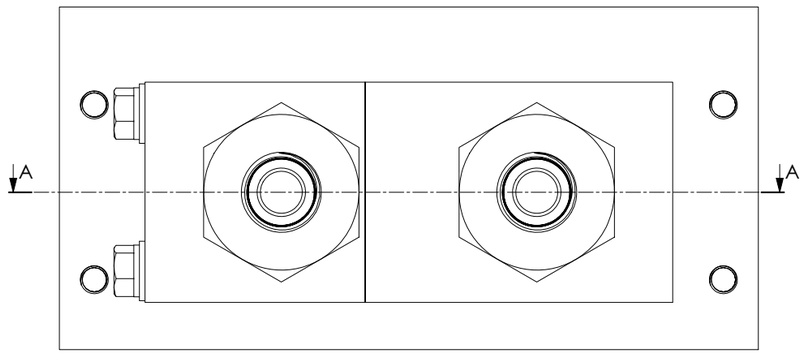
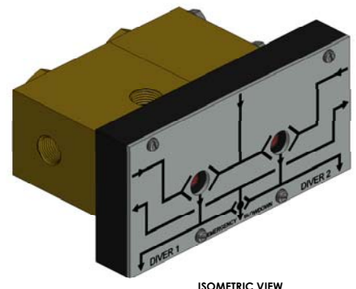
Fig 5.4 Gas Management Panel, Fit Out Schematic
(Drawing P18364003S4)



SECTION A-A

ITEM NO.	PART NO.	DESCRIPTION	Qty.
1	D45910	DVR EQP,VALVE BLOCK	1
2	D45920	DVR EQP,VALVE BLOCK	1
3	D45930	DVR EQP, MAIN SHUTTLE V/V RETAINING ADAPTOR	2
4	D45950	DVR EQP,PISTON SEAL	2
5	D45960	DVR EQP,TOP VALVE	2
6	D45970	INDICATOR ROD SEAL HOUSING	2
7	D4598	RETAINING CAP, SEAL HSG	2
8	D4599	DVR EQP,INDICATOR MNTG BOSS	2
9	D4600	LOCKRING,INDICATOR	2
10	D46030	DVR EQP,AUX.SHUTTLE V/V (F)	1
11	D46040	DVR EQP,DOWEL PIN (NOT SHOWN IN VIEW)	4
12	D46050	MOUNTING BLOCK (MECHANICAL)	1
13	D4707	ROD,INDICATOR,FOR MECHANICAL BLOCK, 84MM STEM	2
14	D47090	DVR EQP,AUX.SHUTTLE V/V (M)	1
15	FB527	SCREW, M5 X 10MM LG, PAN HD, SLOTTED, SSA2	6
16	FB227	SCREW,CAP,SCKT, M5 X 20 LONG,A2-70	4
17	FB229	BOLT,HEX, M8 X 80 LONG, SS	4
18	FB230	SCREW,CAP,SCKT, M10 X 30 LONG,316SS	2
19	FW044	WASHER, PLAIN, M8, 316SS	4
20	FW074	WASHER, SPRING, M8 SINGLE COIL, S316	4
21	MC355	MISC,SPRING,COMPRESSION	2
22	MC356	SPRING,COMPRESSION	1
23	MC358	ROTARY INDICATOR, GREEN TO RED	2
24	RN005-7	O-RING	4
25	RN015-7	O-RING	2
26	RN018-7	O-RING	2
27	RN020-7	O-RING	1
28	RN021-7	O-RING	2
29	RN026-7	O-RING	1
30	RN028-7	O-RING	2
31	RN111-7	O-RING	2
32	RN112-7	O-RING	2
33	FB232	SCREW,M/C,PAN HD, M4 X 6 LONG, SS 316	4
34	FW131	WASHER, PLAIN, SS316, M4	4
35	FW075	WASHER,SPRING, M5	10
3	36	P4620	PANEL, BELLMAN, GLOBRITE	1(REF)





ISOMETRIC VIEW
SCALE 1 : 1.5

NOTES
1. CLEAN FOR BREATHING GAS SERVICE
2. 36.2 BAR (GAS TEST)
3. APPLY SERIAL NO.
4. SOME O-RINGS MAY BE SHOWN IN AN UNTRUE TO REAL LIKE COLOUR TO IMPROVE DRAWING CLARITY

3 - DENOTES CHANGES MADE AT THIS REVISION.

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: N/A
FINISH: N/A
THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05					
R04					
R03	ITEM 36 BALLOON ADDED	18218	ZD	17/07/15	PB
R02	NOTES UPDATED	15218	MJ	08/11/12	MS
R01	FASCIA REMOVED. NOTES ADDED.	10209	GR	03/03/08	RTW
R00	ISSUED FOR MANUFACTURE		GR	11/05/07	RTW

DO NOT SCALE DRAWING

TITLE: **BLOCK, SHUTTLE, (MECHANICAL) ASSEMBLY**
DRAWING No.: **P21753S1**
REV: **R03**
PART No.: C47130
PRODUCT / PROJECT No.: P2175
SIZE: A1
SCALE: 1.5:1
SHT: 1 OF 2

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ABERDEEN
AB32 6TQ
UNITED KINGDOM
Tel : +44(0)1224 740145
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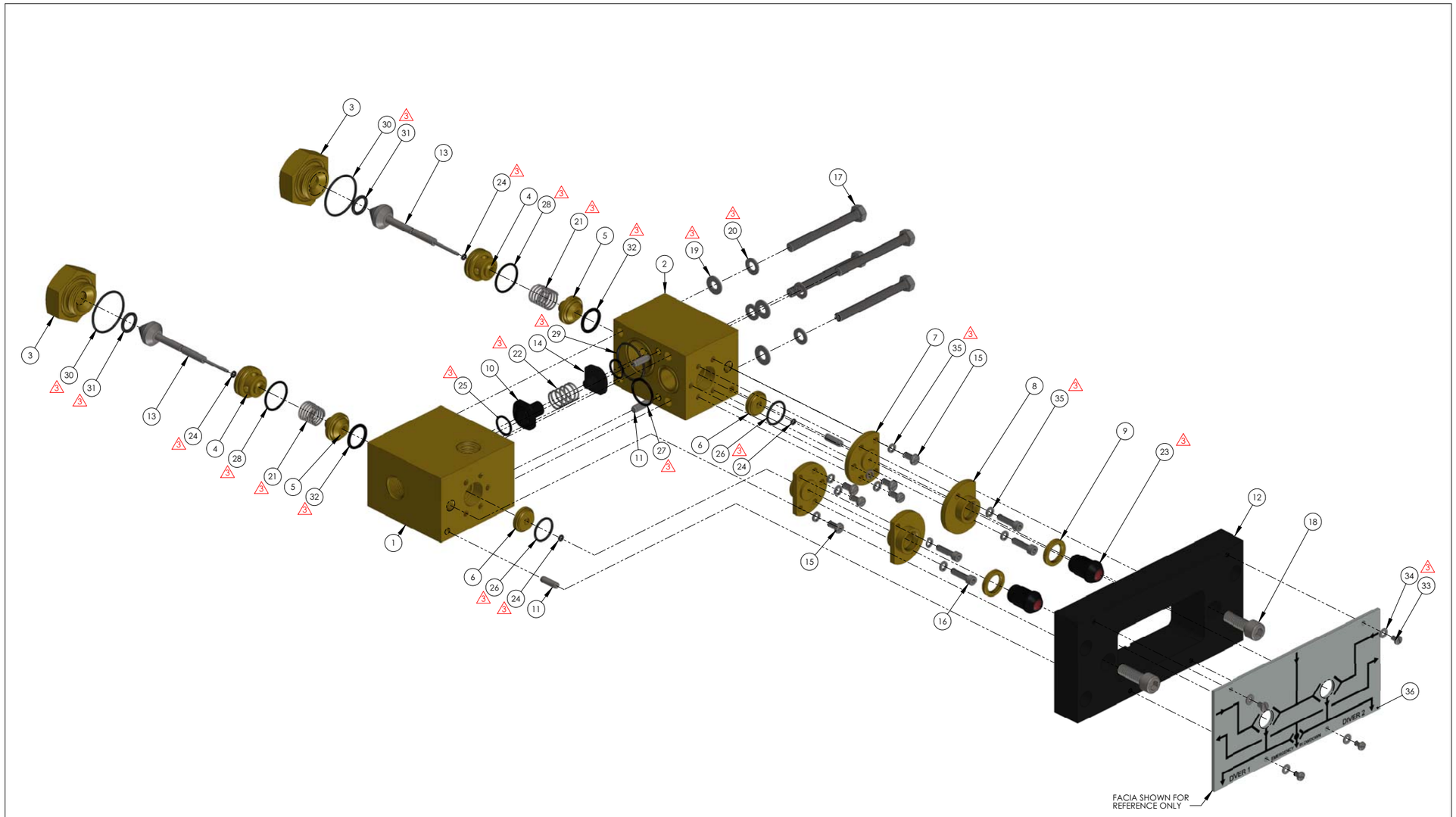
Fig 5.5 Shuttle block mechanical assembly
(Drawing P21753S1)



NOTES

3 - DENOTES CHANGES MADE AT THIS REVISION.

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: N/A

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05					
R04					
R03	BALLOON NUMBERS CORRECTED	18218	ZD	17/07/15	PB
R02	SEE SHEET 1	15218	MJ	08/11/12	MS
R01	FASCIA REMOVED. NOTES ADDED	10209	GR	03/03/08	RTW
R00	ISSUED FOR MANUFACTURE	X	GR	11/05/07	RTW

DO NOT SCALE DRAWING

TITLE: BLOCK, SHUTTLE, (MECHANICAL) ASSEMBLY

DRAWING No. P21753S2 | REV R03

PART No. C47130 | PRODUCT / PROJECT No. P2175

SIZE A1 | SCALE 1:1.5 | SHT 2 OF 2

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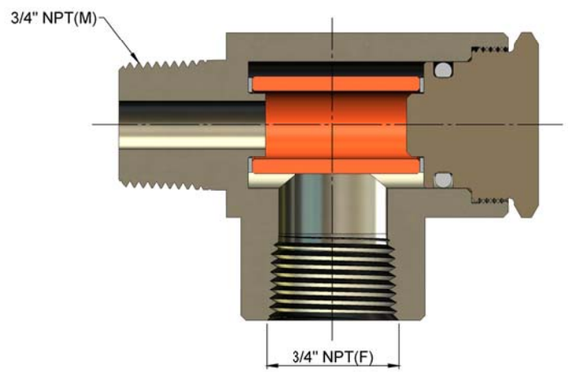
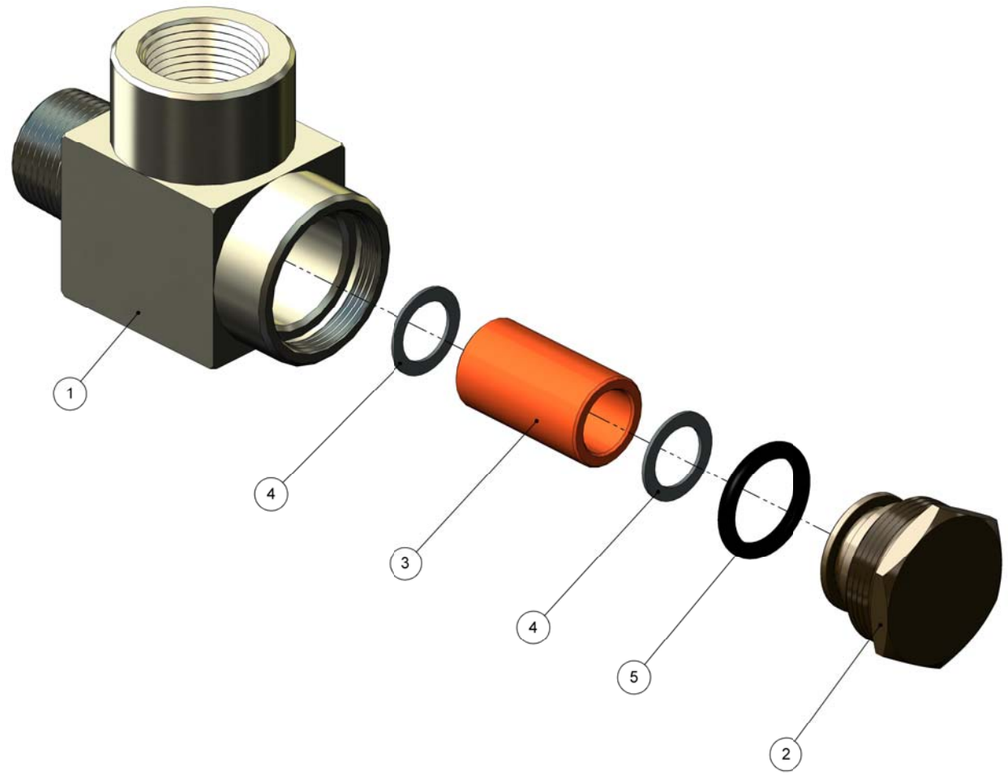
Fig 5.6 Shuttle block mechanical assembly
(Drawing P21753S2)

ITEM No.	PART No.	DESCRIPTION	Qty.
1	F4609	Housing, Filter	1
2	F4610	Cap, Element Retaining, Filter Housing	1
3	FE025	Element, Filter, 55 - 65 Microns	1
4	FW076	Washer, Flat, Copper, Annealed	2
5	RN210-7	O-Ring	1



SECTIONAL VIEW



NOTES

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE PARTS LIST
FINISH: N/A
THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH BY
R06					
R05					
R04					
R03					
R02					
R01					
R00	ISSUED FOR MANUFACTURE		GC	13/10/2008	JM

DO NOT SCALE DRAWING

TITLE: FILTER ASSEMBLY, 3/4" NPT MALE/FEMALE
PRODUCT / PROJECT No: MARA PANELS
PART No: CA46230
DRAWING No: P21754005S1
SIZE: A2 | SCALE: 1.5:1 | SHT 1 OF 1 | REV: R00

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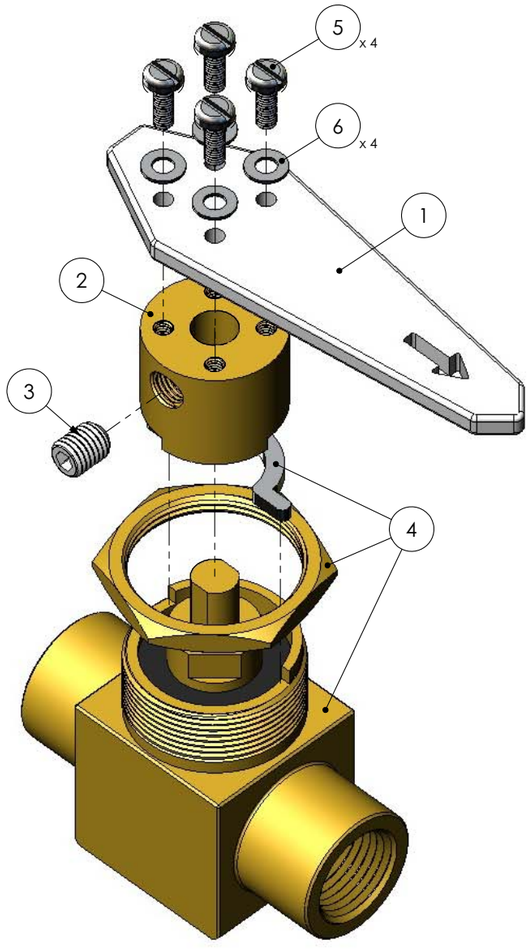
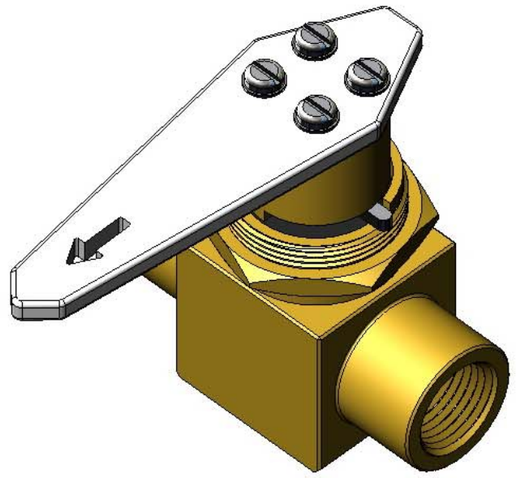
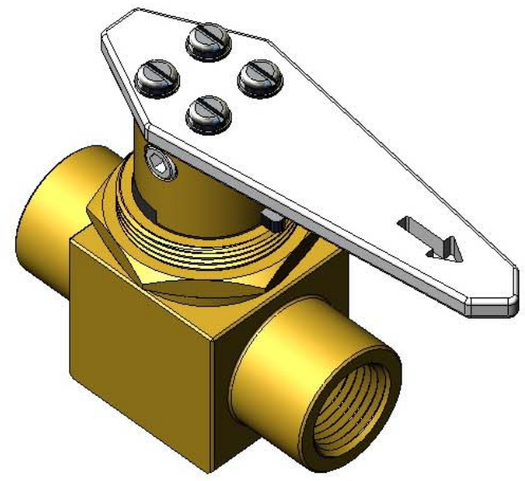
Fig 5.7 Filter assembly
(Drawing P21754005S1)

ITEM	PART No.	DESCRIPTION	Qty.
1	D4627	Handle, Valve, Outward Arrow Cut-Out	1
2	D46280	Boss, Valve Handle, ACW ON	1
3	FB237	Screw, Socket Set, Flat Bottom, M8 x 10 Lg.	1
4	VB402	Valve, Ball, Whitey, ½"NPT(F) Series 40, Brass	1
5	FB168	Screw, Pan Hd. M4 x 12 Lg. 316L St. Steel	4
6	FW131	WASHER, PLAIN, SS316, M4	4





VALVE SHOWN IN 'CLOSED' POSITION



VALVE SHOWN IN 'OPEN' POSITION

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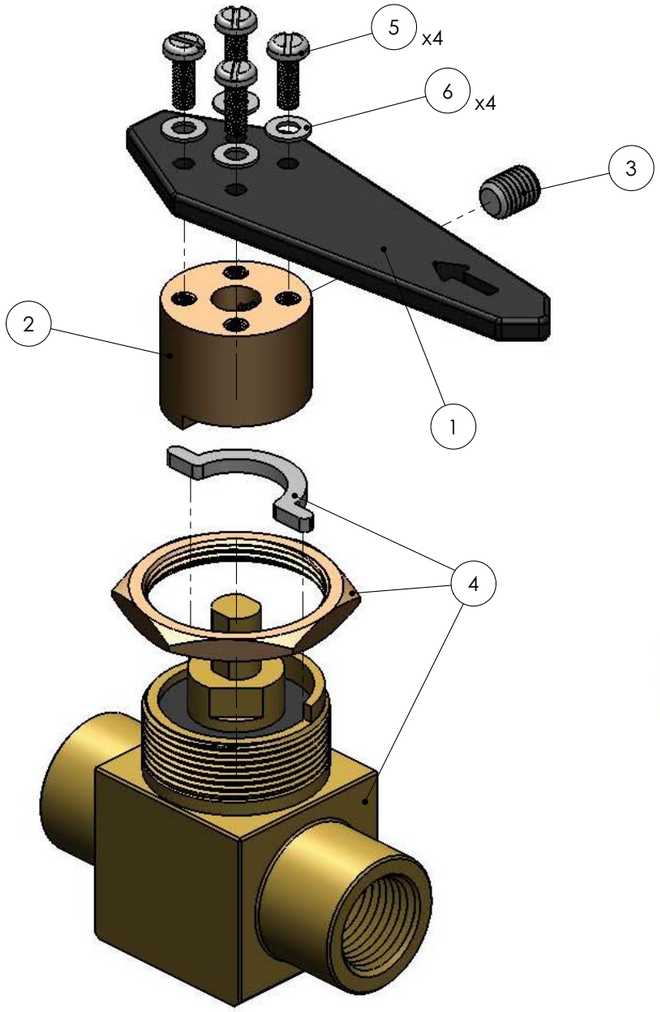
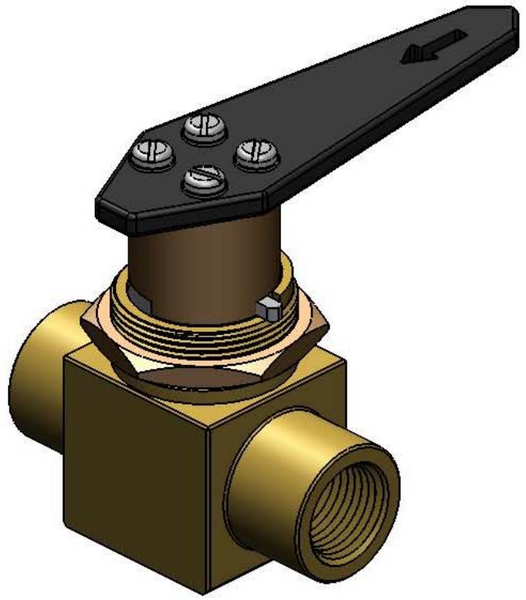
					ALL DIMENSIONS IN MM (UOS)	SCALE 1 : 1	PRODUCT MARA	TITLE: MODIFIED BALL VALVE ASSEMBLY, ACW ON, OUTWARD ARROW
					ALL DIMENSIONS BEFORE PLATING (UOS)			
	R02	ORIENTATION OF VALVE HANDLE CORRECTED	9823	FINISH: -	REMOVE SHARP EDGES & BURRS	PART No. DM47100		
	REV	DESCRIPTION OF REVISION	ECN		DIMENSIONAL TOLERANCES: NO DECIMAL PLACES ±1.0 ONE DECIMAL PLACE ±0.2 TWO DECIMAL PLACES ±0.05 ANGULAR TOLERANCE ±0.5°	DRAWN BY K.Baxter	DATE 21/05/2008	DRG No. P2175201S1 / SHEET 1 of 1 / REV R02
3RD ANGLE PROJECTION	DO NOT SCALE DRAWING							

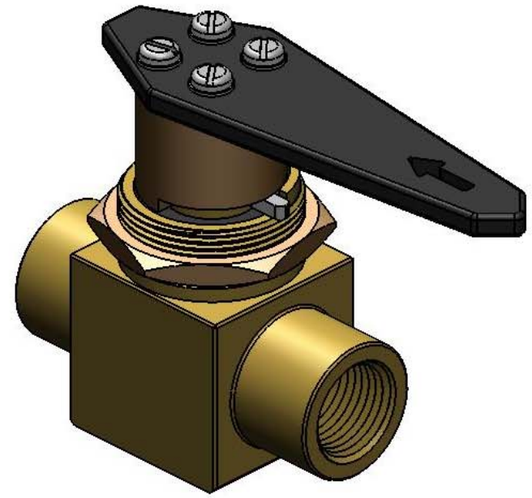
Fig 5.8 Ball Valve
(Drawing P2175201S1)

ITEM No.	PART No.	DESCRIPTION	Qty.
1	D4633	HANDLE, VALVE, INWARD ARROW CUTOUT, BELL PANEL	1
2	D4634	BOSS, VALVE HANDLE, CW ON, BELL PANEL	1
3	FB237	SCREW, SOCKET SET, FLAT BOTTOM, M8 x 10 LONG	1
4	VB402	VALVE, BALL, WHITEY, 1/2"NPTF, BRASS, SERIES 40	1
5	FB168	SCREW,M/C,PAN HD, M4 X 12, 316L ST. STEEL	4
6	FW131	WASHER, PLAIN, SS316, M4	4





VALVE SHOWN IN 'CLOSED' POSITION



VALVE SHOWN IN 'OPEN' POSITION

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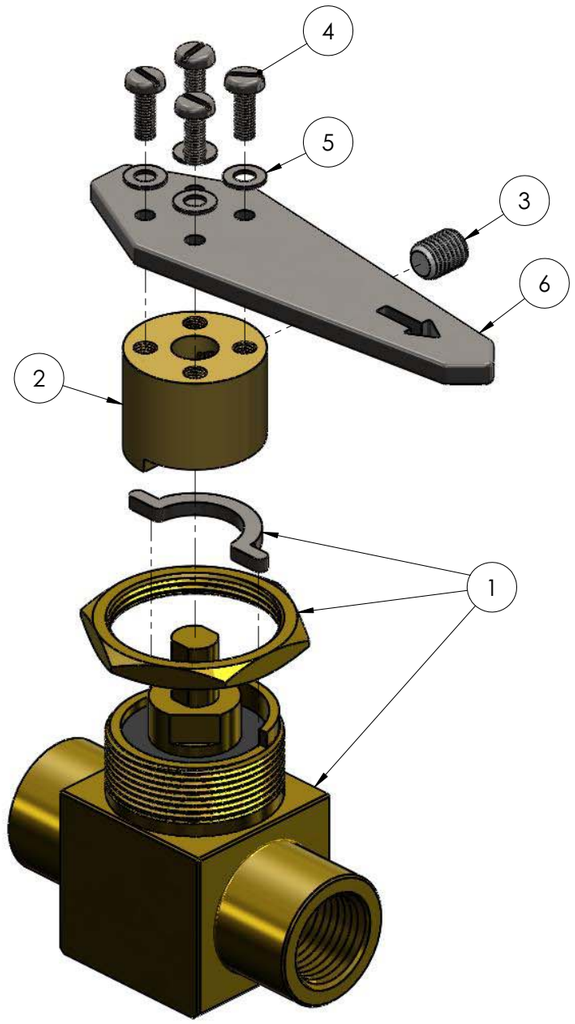
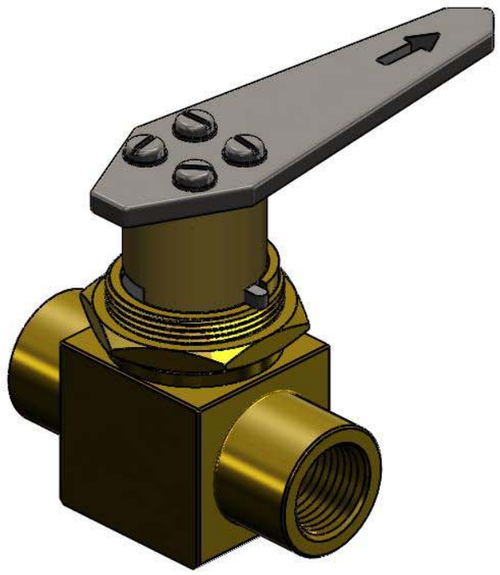
					ALL DIMENSIONS IN MM (UOS)	SCALE 1:1	PRODUCT MARA	TITLE: BALL VALVE, MODIFIED ASSEMBLY, CW ON, INWARD ARROW
					ALL DIMENSIONS BEFORE PLATING (UOS)			
	R02	BOSS ROTATED TO CORRECT POSITION	9823	FINISH: N/A	REMOVE SHARP EDGES & BURRS	PART No. DM47110		
	REV	DESCRIPTION OF REVISION	ECN		DIMENSIONAL TOLERANCES: NO DECIMAL PLACES ±1.0 ONE DECIMAL PLACE ±0.2 TWO DECIMAL PLACES ±0.05 ANGULAR TOLERANCE ±0.5°	DRAWN BY M.McCaskill	DATE 22/05/2008	DRG No. P2175204S1 / SHEET 1 of 1 / REV R02
3RD ANGLE PROJECTION	DO NOT SCALE DRAWING							

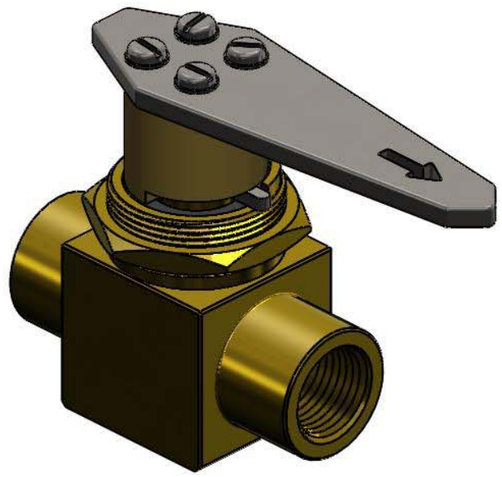
Fig 5.9 Ball Valve
(Drawing P2175204S1)

ITEM NO.	PART NUMBER	Description	QTY.
1	VB402	VALVE, BALL, WHITEY, 1/2"NPTF, BRASS, SERIES 40	1
2	D4634	BOSS, VALVE HANDLE, CW ON, BELL PANEL	1
3	FB237	SCREW, SOCKET SET, FLAT BOTTOM, M8 x 10 LONG	1
4	FB168	SCREW,M/C,PAN HD, M4 X 12, 316L ST. STEEL	4
5	FW131	WASHER, PLAIN, SS316, M4	4
6	D4627	HANDLE, VALVE, OUTWARD ARROW CUTOUT, BELL PANEL	1





VALVE SHOWN IN 'CLOSED' POSITION



VALVE SHOWN IN 'OPEN" POSITION

NOTES

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE PARTS LIST

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No.	BY	DATE	AUTH. BY
R06					
R05					
R04					
R03					
R02					
R01					
R00	ISSUED FOR MANUFACTURE	X	MJ	30/09/13	MS

DO NOT SCALE DRAWING

TITLE: **BALL VALVE, ASSEMBLY, CW ON, OUTWARD ARROW**

DRAWING No.: **P2175205S1** REV: **R00**

PART No.: DM47111 PRODUCT / PROJECT No.: MARA

SIZE: A3 SCALE: 1:1 SHEET: 1 OF 1

DIVEX LIMITED
ENTERPRISE DRIVE
WESTHILL
ABERDEEN
AB32 6TQ
UNITED KINGDOM

Tel : +44(0)1224 740145
Fax : +44(0)1224 740172
email : info@divexglobal.com
www.divexglobal.com

Fig 5.10 Ball Valve
(Drawing P2175205S1)

CHAPTER 6 - RECOMMENDED SPARES

Description	Divex Part No	Qty.
Regulator Soft Seals Kit	RK027	12
Regulator Standard Repair Kit	RK27374	3
Spares for Filter		
Washer	FW076	3
Filter Element	FE025	3
O-Ring Seal (Nitrile)	RN210-7	3
Spares for Shuttle Block		
Soft Seals Kit	C10450	4
Spring	MC355	2
Indicator Rod	D4707	2
Spring	MC356	1
Auxiliary Shuttle Valve – Female	D46030	1
Auxiliary Shuttle Valve – Male	D47090	1

APPENDIX A DOE MEMO 10/1983 AND AODC LETTER 028

Department of Energy
PETROLEUM ENGINEERING DIVISION
Thames House South
Millbank London SW1P 4QJ
Telegrams Energy London SW1
Telephone Direct Line 01-211 4945
Switchboard 01-211 3000

Your reference

Our reference
PED 709/17

Date
21 October 1983

Dear Sir

DIVING SAFETY MEMORANDUM NO 10/1983 - DIVERS' AIR GAS SUPPLY SYSTEMS

Diving Safety Memorandum No 14/1976 called attention to potential design faults regarding the gas supply to divers and the consequences of a primary failure.

It appeared that some principles behind these recommendations are misunderstood or misinterpreted and therefore to clarify the situation the following recommendations should be followed:-

Surface Orientated Diving

1. The air supply system to a diver should be designed in such a way that in the event of the diver's umbilical being cut or severed it should not deprive any other diver or standby diver of their air supply. It should be noted that it is impractical for the affected air supply to be isolated by manually shutting a valve.

Bell Diving

2. The gas supply system in a diving bell should be designed in such a way that in the case of the loss of the main surface to bell umbilical pressure, the emergency bell onboard gas is brought on line to the diver or divers either manually or automatically with a safeguard against exhausting back into the main umbilical.

3. The gas supply system to the bell standby diver should give him the option of using either unlimited surface or the independent limited onboard gas supply.

Divers Bail Out

4. Breathing gas supply to divers' masks must be designed in such a way that in the event of failure of the diver's umbilical supply, the gas from the reserve or bailout cylinder does not exhaust into the sea.

5. When designing new diving bells or modifying existing bells to accommodate two divers plus the standby diver consideration shouldbe given to the provision of independent gas supply to each diver.

Yours faithfully

S.A. WARNER

The International Marine Contractors Association

Divers' Gas Supply

www.imca-int.com

AODC 028
November 1984

The International Marine Contractors Association (IMCA) is the international trade association representing offshore, marine and underwater engineering companies.

IMCA promotes improvements in quality, health, safety, environmental and technical standards through the publication of information notes, codes of practice and by other appropriate means.

Members are self-regulating through the adoption of IMCA guidelines as appropriate. They commit to act as responsible members by following relevant guidelines and being willing to be audited against compliance with them by their clients.

There are two core activities that relate to all members:

- Safety, Environment & Legislation
- Training, Certification & Personnel Competence

The Association is organised through four distinct divisions, each covering a specific area of members' interests: Diving, Marine, Offshore Survey, Remote Systems & ROV.

There are also four regional sections which facilitate work on issues affecting members in their local geographic area – Americas Deepwater, Asia-Pacific, Europe & Africa and Middle East & India.

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Diving Safety Memo No. 10/1983 from the Department of Energy gave advice on divers air and gas supply systems.

One paragraph in memo No. 10/10/1983 states :

> *"The air supply system to a diver should be designed in such a way that in the event of the diver's umbilical being cut or severed, it should not deprive any other diver or standby diver of their air supply. It should be noted that it is impractical for the affected air supply to be isolated by manually shutting a valve."*

There is some misunderstanding over ways of meeting this requirement, particularly when two divers are working in the water at the same time.

The memo concerned the need to ensure that the loss of gas supply to one diver would not compromise another diver by depriving him of his supply. This would happen if two divers are fed from a common supply and one diver's umbilical is cut or ruptured resulting in the second diver losing his supply through the gas taking the path of least resistance into the water.

Although the memo refers to "air supply", the problem is the same for air or mixed gas diving and is equally applicable to surface orientated or bell diving.

It must be stressed that the standby diver (or bellman) should also be considered. If there are two working divers in the water, plus a standby diver (or bellman), then the breathing mixture supply must be such that rupture of one diver's umbilical and the consequent escape of gas does not deprive either the other diver, or the standby diver, of his supply.

There are numerous ways of meeting this requirement including totally separate supply systems (from separate sources) and complex valving arrangements with automatic shut down of the line in which pressure is lost. Most of these arrangements meet the requirement and provided the basic intent of the requirement is understood then it is possible to check whether any specific system is suitable.

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