Supply Pressure Requirements & Tables

Contents

The corresponding low pressure supply table should be used whenever low pressure compressors are used or when using surface control panels that are limited to outlet pressures within the range of 220 psig or less.

It is important to insure the required outlet pressure from the table can be maintained in a stable manner at the surface to insure adequate supply at depth. When used with high pressure consoles that can regulate pressures greater than 220 psig use the corresponding high pressure regulated source supply table.

1.1 Diver Work Rates

The divers work rate, also known as respiratory minute volume (RMV), is basically how hard the diver breathes. As the diver's physical exercise increases, so does the ventilation rate. Proper training teaches the diver to never push the work rate beyond normal labored breathing. (This is in the 30-50 RMV range). To put things in perspective, heavy work for a physically fit person:

Swimming at one knot is about	38 RMV
Running at 8 miles per hour is about	50 RMV

Once the diver hits 55 RMV, he is entering the extreme range. Many fit divers can do 75 RMV for one to two minutes providing the inhalation resistive effort of the breathing system is not much above 1-1.3

J/L. The divers work rate should never be so heavy that the diver cannot maintain a simple conversation with topside.

When the work rate gets into the moderately heavy to heavy range 40-50 RMV the diver needs to slow down!

Working to the point of being excessively winded should be avoided at all costs!

Working at rates greater than 58 RMV underwater is extreme, and can pose hazards that are not present when doing extreme rates on the surface. When underwater, inhalation and exhalation resistive effort increases due to the density of the breathing gas and resistive effort of the equipment. The increase in resistive effort can cause an increase in blood level CO_2 because the diver cannot ventilate as freely as when breathing at the surface. When breathing air at the deeper depths, nitrogen narcosis can mask CO_2 symptoms which can then snowball into even heavier breathing, often resulting in confusion, panic, and in rare cases muscle spasm, unconsciousness, sometimes resulting in death. In some rare cases, high ventilation rates have been suspected as the cause of respiratory barotraumas, including arterial gas embolism. The possibility of suffering a respiratory over inflation event during high work rates while underwater could be even greater for divers that smoke, or have previously known or unknown lung disease or respiratory damage. The safest course for the diver is to keep the equipment properly maintained for peak performance and to know and understand the capabilities and limitations of the equipment including all breathing supply systems they use.

The output capability of the supply system, including umbilicals, should be known to all that use it and periodic tests should be done to ensure flow capability.

1.2 Use Of Low Pressure Supply Table

The low pressure supply tables were developed to simplify calculation of supply pressure. In order to get the required volume to the diver, you need to have the proper supply pressure. The table starts at 90 psig and increases in 10 psig increments. The user simply selects the lowest pressure that best represents the low cycling pressure of the compressor being used. The table basically shows the maximum depth that can be attained while breathing at RMV's (breathing rates in liters per minute) listed. It is strongly recommended that divers plan for a minimum supply pressure that will allow the diver to work at no less that 50–62.5 RMV.

1.3 Work Rate Expressed as Respiratory Minute Volume (RMV)*

Work Load	RMV	Cubic Feet/Minute (CFM)	Equivalent Land Based Exercise
Rest	7-10 RMV	0.2 - 0.35 CFM	
Light Work	10-20 RMV	0.35 - 0.7 CFM	Walking 2 miles per hour
Moderate Work	20-37 RMV	0.7 - 1.3 CFM	Walking 4 miles per hour
Heavy Work	37-54 RMV	1.3 - 1.9 CFM	Running 8 miles per hour
Severe Work	55-100 RMV	1.94 - 3.5 CFM	
* *source: U.S. Navy Diving Manual*			

1.4 Surface Supplied MOD-1 Supply Pressures

The proper supply pressure is important to ensure maximum overall breathing performance. The minimum recommended and maximum supply pressures listed below will allow for at least a respiratory work rate of 75 RMV at all depths listed.

Depth		Min. Supply Pressure		Max. Supply Pressure		Normal/Recommended Supply Pressure	
FSW	**MSW**	**BAR**	**PSIG**	**BAR**	**PSIG**	**BAR**	**PSIG**
0–50	0–15.2	7	100	19.6	275	8.6	125
50–100	15.2–30.5	10.3	150	19.6	275	12	175
100–125	30.5–38	12	175	19.6	275	13.8	200
125–145	38–44	13.8	200	19.6	275	15.5	225
145–165	44–50.3	15.5	225	19.6	275	17.2	250
165–190	50.3–58	17.2	250	19.6	275	17.2	250

When the diver is working at light to heavy work rates, (15–50 RMV) the minimum recommended Supply Pressure for a particular depth, should offer the smoothest overall performance. Use of the maximum pressure should only be needed at a depth of 165 FSW (50 MSW) or deeper in the event the diver is breathing at the extreme work rate of 75 RMV or greater. The maximum supply pressure is listed primarily due to European CE requirements which requires the maximum and minimum supply pressures be listed. The minimum supply pressures for the depths listed below will allow for a work rate of 75 RMV IAW the CE requirements of EN15333-1.

Performance is based on a minimum of 75 RMV to depths of 165 FSW (50 MSW) using a ⅜" (9.5 mm) umbilical 600 foot (183 meters) long, made up of two 300 foot (91 meter) sections.

1.5 SuperFlow®/SuperFlow® 350 LP Compressor Supply Table

Supply Pressure Requirements for Helmets & Masks equipped with SuperFlow®/SuperFlow® 350 Non-balanced regulators when used with low pressure compressors

Supply Pressure	RMV	Depth		ATA	Required SLPM	w/20% safety margin	Required SCFM
		FSW	**MSW**				
90 PSIG / 6.21 BAR	**40**	76	23	3.30	132.12	158.55	5.60
	50	63	19	2.91	145.45	174.55	6.17
	62.5	44	13	2.33	145.83	175.00	6.18
	75	33	10	2.00	150.00	180.00	6.36
100 PSIG / 6.9 BAR	**40**	86	26	3.61	144.24	173.09	6.11
	50	72	22	3.18	159.09	190.91	6.74
	62.5	55	17	2.67	166.67	200.00	7.06
	75	42	13	2.27	170.45	204.55	7.23
110 PSIG / 7.59 BAR	**40**	100	31	4.03	161.21	193.45	6.83
	50	83	25	3.52	175.76	210.91	7.45
	62.5	67	20	3.03	189.39	227.27	8.03
	75	50	15	2.52	188.64	226.36	8.00

Supply Pressure	RMV	Depth		ATA	Required SLPM	w/20% safety margin	Required SCFM
		FSW	MSW				
120 PSIG / 8.28 BAR	**40**	112	34	4.39	175.76	210.91	7.45
	50	91	28	3.76	187.88	225.45	7.96
	62.5	71	22	3.15	196.97	236.36	8.35
	75	57	17	2.73	204.55	245.45	8.67
130 PSIG / 8.97 BAR	**40**	122	37	4.70	187.88	225.45	7.96
	50	100	31	4.03	201.52	241.82	8.54
	62.5	82	25	3.48	217.80	261.36	9.23
	75	60	19	2.82	211.36	253.64	8.96
140 PSIG / 9.66 BAR	**40**	137	42	5.15	206.06	247.27	8.73
	50	108	33	4.27	213.64	256.36	9.06
	62.5	84	26	3.55	221.59	265.91	9.39
	75	65	20	2.97	222.73	267.27	9.44
150 PSIG / 10.35 BAR	**40**	145	44	5.39	215.76	258.91	9.15
	50	120	37	4.64	231.82	278.18	9.83
	62.5	95	29	3.88	242.42	290.91	10.28
	75	69	21	3.09	231.82	278.18	9.83
160 PSIG / 11.04 BAR	**40**	157	48	5.76	230.30	276.36	9.76
	50	124	38	4.76	237.88	285.45	10.08
	62.5	100	31	4.03	251.89	302.27	10.68
	75	76	23	3.30	247.73	297.27	10.50
170 PSIG / 11.73 BAR	**40**	167	51	6.06	242.42	290.91	10.28
	50	135	41	5.09	254.55	305.45	10.79
	62.5	107	33	4.24	265.15	318.18	11.24
	75	86	26	3.61	270.45	324.55	11.46
180 PSIG / 12.42 BAR	**40**	181	55	6.48	259.39	311.27	11.00
	50	148	45	5.48	274.24	329.09	11.62
	62.5	115	35	4.48	280.30	336.36	11.88
	75	93	28	3.82	286.36	343.64	12.14
190 PSIG / 13.11 BAR	**40**	190	58	6.76	270.30	324.36	11.46
	50	154	47	5.67	283.33	340.00	12.01
	62.5	122	37	4.70	293.56	352.27	12.44
	75	100	31	4.03	302.27	362.73	12.81
200 PSIG / 13.8 BAR	**40**	192	59	6.82	272.73	327.27	11.56
	50	166	51	6.03	301.52	361.82	12.78
	62.5	132	40	5.00	312.50	375.00	13.25
	75	102	31	4.09	306.82	368.18	13.01
210 PSIG / 14.49 BAR	**40**	212	65	7.42	296.97	356.36	12.59
	50	175	53	6.30	315.15	378.18	13.36
	62.5	137	42	5.15	321.97	386.36	13.65
	75	108	33	4.27	320.45	384.55	13.58
220 PSIG / 15.18 BAR	**40**	220	67	7.67	306.67	368.00	13.00
	50	182	56	6.52	325.76	390.91	13.81
	62.5	147	45	5.45	340.91	409.09	14.45
	75	111	34	4.36	327.27	392.73	13.87

1.6 SuperFlow®/SuperFlow® 350 HP Regulated Supply Table

Depth		Regulator Setting Surface Gauge in P.S.I.G.		Regulator Setting Surface Gauge in BAR	
FSW	MSW	Minimum P.S.I.G.	Maximum P.S.I.G.	Minimum Bar	Maximum Bar
0-60	0-18	150	225	10.3	15.5
61-100	19-30	200	250	13.8	17.2
101-132	31-40	250	275	17.2	18.9
133-165	41-50	250	300	17.2	19.6
*166-220	51-67	300	325	20.6	22.4

*May not be capable of performing at 75 RMV deeper than 165 FSW.

Performance is based on a minimum of 75 RMV to 165 FSW (50 MSW) and 62.5 RMV to 220 FSW (67 MSW) using a ⅜" (9.5 mm) umbilical 600 foot (183 meters) long, made up of two 300 foot (91 meter) sections.

1.7 REX® LP Compressor Supply Table

Supply Pressure	RMV (Respiratory Minute Volume)	Maximum Recommended Depth		Required SCFM**	Required SLPM**
		FSW	MSW		
90 P.S.I.G . (6.21 BAR)	40 (heavy work)	104	32	7.0	198
	50 (heavy work)	76	23	7.0	198
	62.5 (severe work)	61	18.8	7.5	212
	75 (severe work)	50	15.4	8.0	227
100 P.S.I.G. (6.9 BAR)	40 (heavy work)	108	33	7.25	205
	50 (heavy work)	90	27	7.9	223
	62.5 (severe work)	75	22.9	8.7	246
	75 (severe work)	59	18	8.9	252
110 P.S.I.G. (7.59 BAR)	40 (heavy work)	117	35	7.7	218
	50 (heavy work)	100	30	8.6	244
	62.5 (severe work)	83	25	9.3	263
	75 (severe work)	68	21	9.7	275
120 P.S.I.G. (8.28 BAR)	40 (heavy work)	127	38.7	8.2	232
	50 (heavy work)	113	34	9.4	266
	62.5 (severe work)	93	28	10	283
	75 (severe work)	75	23	9.7	275
130 P.S.I.G. (8.97 BAR)	40 (heavy work)	145	44	9.1	258
	50 (heavy work)	125	38	10	283
	62.5 (severe work)	106	32	11	311
	75 (severe work)	85	26	11.36	322

Supply Pressure	RMV (Respiratory Minute Volume)	Maximum Recommended Depth		Required SCFM**	Required SLPM**
		FSW	MSW		
140 P.S.I.G. (9.66 BAR)	40 (heavy work)	160	48	10	283
	50 (heavy work)	135	41	11	311
	62.5 (severe work)	114	35	12	340
	75 (severe work)	92.5	29	12	340
150 P.S.I.G. (10.35 BAR)	40 (heavy work)	170	52	10.5	297
	50 (heavy work)	149	45	11.7	331
	62.5 (severe work)	126	38	13	368
	75 (severe work)	105	32	13.3	377
160 P.S.I.G . (11.04 BAR)	40 (heavy work)	186	57	11.3	320
	50 (heavy work)	157	48	12.2	345
	62.5 (severe work)	134	41	13.4	379
	75 (severe work)	112	34	14	396
170 P.S.I.G. (11.73 BAR)	40 (heavy work)	203	62	12.2	345
	50 (heavy work)	170	52	13	368
	62.5 (severe work)	143	43	14	396
	75 (severe work)	121	37	14.9	422
180 P.S.I.G. (12.42 BAR)	40 (heavy work)	219	67	13	368
	50 (heavy work)	180	55	13.7	388
	62.5 (severe work)	158	48	15.4	436
	75 (severe work)	130	39	15.7	445
190 P.S.I.G. (13.11 BAR)	40 (heavy work)	220	67	13	368
	50 (heavy work)	192	58	14.5	411
	62.5 (severe work)	165	50	16	453
	75 (severe work)	141	43	16.8	476
200 P.S.I.G. (13.80 BAR)	40 (heavy work)	220	67	13	368
	50 (heavy work)	205	62	15.3	433
	62.5 (severe work)	174	53	16.7	473
	75 (severe work)	147	45	17.4	493
210 P.S.I.G. (14.49 BAR)	40 (heavy work)	220	67	13	368
	50 (heavy work)	214	65.8	16	453
	62.5 (severe work)	186	56	17.6	498
	75 (severe work)	159	48	18.5	524
220 P.S.I.G. (15.18 BAR)	40 (heavy work)	220	67	13	368
	50 (heavy work)	220	67	16.3	462
	62.5 (severe work)	194	59	18.2	515
	75 (severe work)	165	50	19	538

These values were derived from actual breathing simulator tests using an ANSI wet simulator with 600' long umbilical 3/8" I.D (9.5mm) at Dive Lab, Inc. The respiratory work rates and test procedures used are based on internationally recognized test practices and procedures.

*** includes a 20% safety factor*

NOTE

Most sustained work rates by professional divers average between 20 to 40 RMV. When calculating supply requirements, KMDSI® recommends using no less than 40 RMV.

For more information, check the Dive Lab website, www.divelab.com.

1.8 REX® HP Regulated Supply Table

Depth		Regulator Setting P.S.I.G.		Regulator Setting BAR	
FSW	MSW	Optimum P.S.I.G.	Maximum P.S.I.G.	Optimum BAR	Maximum BAR
0-60	0-18	140	200	9.7	13.8
61-100	19-30	165	220	11.4	15
101-132	31-40	180	250	12.4	17
133-165	41-50	220	300	15	20.7
166-220	51-67	270	300	18.6	20.7

Performance is based on a minimum of 75 RMV to depths of 220 FSW (67 MSW) using a 3/8 (9.5mm) umbilical 600 foot (183 meters) long, made up of two 300 foot (91 meter) sections.

1.9 455 & KM Diamond LP Compressor Supply Table

Supply Pressure	RMV (Respiratory Minute Volume)	Maximum Recommended Depth		ATA	Required SLPM	w/20% safety margin	Required SCFM
		FSW	MSW				
90 P.S.I.G . (6.21 BAR)	40 (heavy work)	101	30	4.06	162.42	194.91	6.88
	50 (heavy work)	84	25	3.55	177.27	212.73	7.51
	62.5 (severe work)	66	20	3.00	187.50	225.00	7.95
	75 (severe work)	51	16	2.55	190.91	229.09	8.09
100 P.S.I.G. (6.9 BAR)	40 (heavy work)	115	35	4.48	179.39	215.27	7.60
	50 (heavy work)	97	29	3.94	196.97	236.36	8.35
	62.5 (severe work)	77	23	3.33	208.33	250.00	8.83
	75 (severe work)	62	19	2.88	215.91	259.09	9.15
110 P.S.I.G. (7.59 BAR)	40 (heavy work)	130	39	4.94	197.58	237.09	8.37
	50 (heavy work)	100	30	4.03	201.52	241.82	8.54
	62.5 (severe work)	90	27	3.73	232.95	279.55	9.87
	75 (severe work)	73	22	3.21	240.91	289.09	10.21
120 P.S.I.G. (8.28 BAR)	40 (heavy work)	145	44	5.39	215.76	258.91	9.15
	50 (heavy work)	125	38	4.79	239.39	287.27	10.15
	62.5 (severe work)	101	30	4.06	253.79	304.55	10.76
	75 (severe work)	83	25	3.52	263.64	316.36	11.17
130 P.S.I.G. (8.97 BAR)	40 (heavy work)	157	47	5.76	230.30	276.36	9.76
	50 (heavy work)	130	39	4.94	246.97	296.36	10.47
	62.5 (severe work)	110	33	4.33	270.83	325.00	11.48
	75 (severe work)	91	28	3.76	281.82	338.18	11.95

Supply Pressure	RMV (Respiratory Minute Volume)	Maximum Recommended Depth		ATA	Required SLPM	w/20% safety margin	Required SCFM
		FSW	MSW				
140 P.S.I.G. (9.66 BAR)	40 (heavy work)	171	52	6.18	247.27	296.73	10.48
	50 (heavy work)	145	44	5.39	269.70	323.64	11.43
	62.5 (severe work)	120	36	4.64	289.77	347.73	12.28
	75 (severe work)	103	31	4.12	309.09	370.91	13.10
150 P.S.I.G. (10.35 BAR)	40 (heavy work)	187	57	6.67	266.67	320.00	11.30
	50 (heavy work)	158	48	5.79	289.39	347.27	12.27
	62.5 (severe work)	134	41	5.06	316.29	379.55	13.41
	75 (severe work)	103	31	4.12	309.09	370.91	13.10
160 P.S.I.G . (11.04 BAR)	40 (heavy work)	198	60	7.00	280.00	336.00	11.87
	50 (heavy work)	176	54	6.33	316.67	380.00	13.42
	62.5 (severe work)	147	45	5.45	340.91	409.09	14.45
	75 (severe work)	125	38	4.79	359.09	430.91	15.22
170 P.S.I.G. (11.73 BAR)	40 (heavy work)	203	61	7.15	286.06	343.27	12.13
	50 (heavy work)	183	56	6.55	327.27	392.73	13.87
	62.5 (severe work)	154	47	5.67	354.17	425.00	15.01
	75 (severe work)	125	38	4.79	359.09	430.91	15.22
180 P.S.I.G. (12.42 BAR)	40 (heavy work)	230	70	7.97	318.79	382.55	13.51
	50 (heavy work)	196	60	6.94	346.97	416.36	14.71
	62.5 (severe work)	163	50	5.94	371.21	445.45	15.73
	75 (severe work)	144	44	5.36	402.27	482.73	17.05
190 P.S.I.G. (13.11 BAR)	40 (heavy work)	239	73	8.24	329.70	395.64	13.98
	50 (heavy work)	196	60	6.94	346.97	416.36	14.71
	62.5 (severe work)	173	53	6.24	390.15	468.18	16.54
	75 (severe work)	152	46	5.61	420.45	504.55	17.82
200 P.S.I.G. (13.80 BAR)	40 (heavy work)	201	61	7.09	283.64	340.36	12.02
	50 (heavy work)	220	67	7.67	383.33	460.00	16.25
	62.5 (severe work)	187	57	6.67	416.67	500.00	17.66
	75 (severe work)	156	48	5.73	429.55	515.45	18.21
210 P.S.I.G. (14.49 BAR)	40 (heavy work)	273	83	9.27	370.91	445.09	15.72
	50 (heavy work)	237	72	8.18	409.09	490.91	17.34
	62.5 (severe work)	201	61	7.09	443.18	531.82	18.79
	75 (severe work)	172	52	6.21	465.91	559.09	19.75
220 P.S.I.G. (15.18 BAR)	40 (heavy work)	245	75	8.42	336.97	404.36	14.28
	50 (heavy work)	203	62	7.15	357.58	429.09	15.16
	62.5 (severe work)	194	59	6.88	429.92	515.91	18.22
	75 (severe work)	181	55	6.48	486.36	583.64	20.62

1.10 455 HP Regulated Supply Table

Depth		Regulator Setting P.S.I.G.		Regulator Setting BAR	
FSW	MSW	Optimum P.S.I.G.	Maximum P.S.I.G.	Optimum BAR	Maximum BAR
0-60	0-18	100	150	7	10
61-100	19-30	125	150	8.6	10.3
101-132	31-40	175	225	12	15.5
133-165	41-50	200	250	14	17
166-190	51-61	225	275	15.5	19
191-220	58-67	225	300	15.5	20.6

Performance is based on a minimum of 75 RMV to depths of 220 FSW (67 MSW) using a ⅜" (9.5 mm) umbilical 600 foot (183 meters) long, made up of two 300 foot (91 meter) sections.

1.11 KM Diamond HP Regulated Supply Table

Depth		Regulator Setting P.S.I.G.			Regulator Setting BAR		
FSW	MSW	Minimum P.S.I.G.	Maximum P.S.I.G.	Recommended P.S.I.G.	Minimum BAR	Maximum BAR	Recommended BAR
0-60	0-18	101	275	145	7	19	10
61-100	19-30	145	275	174	10	19	12
101-132	31-40	174	275	203	12	19	14
133-165	41-50	218	275	245	15	19	17

The proper supply pressure is important to ensure maximum overall breathing performance. The minimum recommended and maximum supply pressures listed below will allow for at least a respiratory work rate of 75 RMV at all depths listed.

When the diver is working at light to heavy work rates, (15–50 RMV) the minimum recommended Supply Pressure for a particular depth, should offer the smoothest overall performance. **Use of the maximum pressure should only be needed at a depth of 165 fsw (50 MSW) or deeper in the event the diver is breathing at the extreme work rate of 75 RMV or greater.** The maximum supply pressure is listed primarily due to European CE requirements which requires the maximum and minimum supply pressures be listed. The minimum supply pressures for the depths listed below will allow for a work rate of 75 RMV IAW the CE requirements of EN15333-1.

1.12 Standard Kirby Morgan Surface Supply Pressure Formula - Old Method

1.12.1 Old Pressure Table Calculation

The old method of determining supply pressure was to multiply the dive depth by .445 PSI and then add the over-bottom pressure called out in the depth ranges for the depth from the KMDSI operations manual. The old method was based on a minimum RMV of 62.5. This method can still be used. The old method used the formula and called out over bottom pressures for depth as follows [(FSW x .445) + PSIG for depth] from the table below.

Depth in Feet and Meters		Over Bottom Pressure	
0-60 FSW	(0-18 MSW)	90 PSIG	(6.2 Bar)
61-100	(18-30)	115	(7.9)
101-132	(30-40)	135	(9.3)
133-165	(40-50)	165	(11.4)
166-220	(50-67)	225	(15.5)

For more information on determining supply pressure related information check the Dive Lab web site at www.divelab.com.

1.13 KM Diamond Exhaust Back Pressure Flow Table

1.13.1 Back Pressure System

When the KM Diamond surface return line helmet reaches 90 to 100 fsw (27–30.48 msw) in depth, the combination of differential pressure and air density starts having a significant effect on the exhalation effort at heavy respiratory work rates above 60 RMV. The increase in exhalation effort at depths in excess of 100 fsw (30.48 msw) is primarily due to the high differential pressure on the 2nd stage exhaust diaphragm on one side and the existing lower pressure found at the surface (topside). Another effect is the flow resistance that is created in the surface return hose due to gas density.

To compensate for the increased gas density and high differential pressure, the topside end of the return hose is attached to a back-pressure regulator system which allows a back pressure to be applied to the hose, reducing this differential pressure, allowing the exhaust regulator second stage to operate with less exhalation effort.

The amount of topside back pressure needed is based on what is required to enable the diver to breathe and exhale at the extreme work rates above 60 RMV while maintaining the helmet exhalation pressure below 18 mbr. The back pressure required is determined using a specially designed table. See “1.13.4 Table” on page SUPR-13.

The table and the topside back pressure system is desirable whenever the diver is breathing at heavy work rates and diving deeper than 100 fsw (30.48 msw) to keep exhalation pressure below the KMDSI 18 mbr limit and to avoid gas from escaping from the overpressure relief and water purge valves installed on the helmet. Exhausting into the water in a contaminated water situation is not desirable and defeats the primary purpose of using a surface return line helmet that vents to the surface (topside). A topside back pressure system will prevent inadvertent activation of these valves on the KM Diamond.

1.13.1.1 Topside Exhaust Back Pressure System Operation

Minimum requirements for a Topside Exhaust Back Pressure System:

- A means to secure both the primary and stand by diver's exhaust hose to the unit.
- A Flow meter per diver.
- Means of increasing and decreasing exhaust back pressure.

For optimal exhaust performance (minimum exhalation effort), the topside exhaust back pressure is set according to the flow reading on the flow meter in use and the diver's depth. As an example, a diver at a depth of 100 fsw (30.48 msw) working at the extreme breathing rate of 60 RMV or higher without using the topside back pressure control system, the exhalation pressure would be in a range of 14–16 mbr. With the proper back pressure, it would be in the 6–8 mbr range.

The recommended topside exhaust control system must be capable of controlling the exhaust pressure based on the depth and respiratory rate. One example of a topside back pressure system is the DL-TSC-00 from Dive Lab, Inc. This system is a two-diver system and consists of a simple manifold assembly with back pressure regulator, two flow meters, with shut off valves, and two 0–100 psig pressure gauges. The divers exhaust hose connects to the topside exhaust system via a ½" brass quick connect. The exhaust enters the adjustable back pressure regulator and is regulated according to the depth and divers' breathing rate as shown on the flow meters.

In addition, the flow meter system allows for the calculation of the diver's respiratory work rate which can be useful for planning air usage. By always beginning the dive with zero back pressure and adjusting for optimal back pressure based on depth and flow optimizes for low exhalation effort, this minimizes possible gas from escaping from the valve in the over pressure relief valve and Water Purge Assembly.

1.13.1.2 Calculating Work of Breathing

As previously mentioned, the topside back pressure exhaust system is not necessary for minimizing exhaust pressure at depths less than 100 fsw (30 msw), however depending on the diver's respiratory work rate, it can be used starting at depths of 30 fsw to monitor the divers RMV.

As an example, a diver is at a depth of 60 fsw (18 msw) the exhaust flow on the flow meter shows a flow of between 75–95 lpm. The console operator checks the exhaust table and selects the closest depth to the diver's depth and the peak flow, then slowly adjusts the regulator for a back pressure according to the reading on the chart. With the flow meter showing a flow between 75–95 lpm and taking the high number, 95 lpm and dividing it by the depth in ATA (2.8), it will give the respiratory work rate of the diver also known as RMV. The calculation will look like this:
Depth (60 fsw +33 fsw) ÷ 33 = 2.8 ATA.
(95 lpm ÷ 2.8 ATA) = 33.9 RMV. The result is the diver's work of breathing is 33.9 respiratory minute volume which is considered to be in the heavy work category.

1.13.2 Instructions

Step 1
Determine Depth

Step 3
Find the closest matching flow reading from the table

110	33.5	4.33	Flow LPM	45–65	85–110	115–150	150–185	180–235	230–290	280–350
			BP (psig)	26–28	30–32	31–35	32–36	34–39	36–41	37–41

Step 2
Take the average reading from your flow meter. Example is 180 to 210. The average flow is 195

Step 4
Recommended Back Pressure Regulator Setting

1.13.3 Abbreviations and Formulas

Abbreviations

ATA – Atmospheres Absolute
FSW – Feet Sea Water
LPM – Liters Per Minute
MSW – Meter Sea Water
RMV – Respiratory Minute Volume

Formulas

(Depth + 33) ÷ 33 = ATA
FSW ÷ 3.28 = MSW
LPM ÷ ATA = RMV

To calculate RMV with the greatest accuracy, simply take the highest and lowest flow reading, add them together, then divide by 2. Take the result and divide by the diver's depth in ATA.

1.13.4 Table

FSW	MSW	ATA	BP-Back Pressure (psig) LPM-Liters Per Minute	RMV 10–15	RMV 20–24	RMV 30–34	RMV 37–40	RMV 48–50	RMV 60–63	RMV 73–75
10	3	1.3	Flow LPM	n/a*	n/a*	n/a*	40–60	35–90	55–105	70–120
			BP (psig)	n/a*	n/a*	n/a*	1–2	1–2	1–2	1–2
20	6.09	1.6	Flow LPM	n/a*	n/a*	35–65	40–80	55–100	80–120	105–135
			BP (psig)	n/a*	n/a*	1–2	1–2	1–2	2–3	3–5
30	9.1	1.9	Flow LPM	n/a*	30–55	50–75	55–90	75–110	100–130	115–160
			BP (psig)	n/a*	1–2	2–3	2–3	3–4	3–5	4–6
40	12.2	2.21	Flow LPM	10–40	40–60	45–80	70–95	90–125	120–150	140–180
			BP (psig)	2–3	3–4	4–5	4–6	5–7	6–8	7–9
50	15.2	2.51	Flow LPM	15–45	50–70	70–85	85–105	110–135	140–170	170–200
			BP (psig)	3–4	4–6	5–7	5–8	7–9	8–13	9–13
60	18.3	2.82	Flow LPM	25–45	55–70	75–95	95–120	125–150	155–185	190–230
			BP (psig)	5–7	7–9	9–10	9–12	11–14	11–14	15–18
70	21.3	3.12	Flow LPM	30–45	65–80	85–105	110–130	135–170	170–210	200–250
			BP (psig)	7–8	10–13	13–14	13–17	15–18	15–20	16–20
80	24.4	3.42	Flow LPM	35–50	70–85	90–110	120–145	150–190	185–225	225–275
			BP (psig)	11–13	14–16	16–18	17–19	18–22	20–23	21–24
90	27.4	3.72	Flow LPM	35–55	75–95	100–125	125–155	150–200	200–245	245–300
			BP (psig)	17–20	21–24	22–25	24–28	26–30	27–31	27–33
100	30.5	4.03	Flow LPM	40–60	80–105	110–135	135–170	170–220	220–260	260–330
			BP (psig)	22–24	25–28	28–31	28–32	29–33	33–36	31–37
110	33.5	4.33	Flow LPM	45–65	85–110	115–150	150–185	180–235	230–290	280–350
			BP (psig)	26–28	30–32	31–35	32–36	34–39	36–41	37–41
120	36.6	4.63	Flow LPM	56–65	90–120	120–155	150–200	200–250	250–320	300–380
			BP (psig)	29–32	32–35	34–37	35–40	37–43	39–44	39–45
130	39.6	4.93	Flow LPM	50–75	95–130	130–170	165–210	210–270	270–340	320–400
			BP (psig)	32–35	36–40	39–42	39–43	42–47	44–48	44–50
140	42.7	5.24	Flow LPM	55–80	100–135	145–170	170–220	220–290	280–350	340–425
			BP (psig)	33–35	38–41	40–44	42–45	43–48	45–50	45–51
150	46	5.55	Flow LPM	55–80	110–145	145–190	170–240	230–310	300–380	355–450
			BP (psig)	37–40	41–44	44–47	43–49	47–51	50–56	50–57
160	49	5.84	Flow LPM	55–75	110–150	150–195	190–250	240–320	310–390	370–470
			BP (psig)	38–41	42–45	43–45	45–50	48–51	49–54	51–58
165	50.3	6	Flow LPM	60–85	115–155	155–205	195–260	245–330	320–410	380–480
			BP (psig)	41–43	44–48	47–50	49–53	50–55	53–59	54–60

*At this depth and RMV flow accuracy cannot be accurately determined.