BSAC Open Circuit Gas density table for dive gases at 1.4 bar PO_2

Gas density in grams / litre ($g.L^{-1}$) based upon 0 degrees C & 1.000 bar as defined by BS 8547

- Oxygen = 1.4102
- Helium = 0.1764
- Nitrogen = 1.2346

Equivalent Narcotic Depth (END) is calculated as in BS 8547 and references nitrogen only as narcotic.

Depth (m)	Gas mix (O_2 / He)	Gas density ($g.L^{-1}$)	END (m)
35	31 % Nitrox	5.80	29
35	31 /12	5.23	22
40	28 % Nitrox	6.42	36
40	28 / 23	5.20	21
45	25 / 15	6.16	32
45	25 / 31	5.23	20
50	23 / 23	6.19	31
50	23 / 39	5.17	19
55	21 / 30	6.20	30
55	21 / 45	5.17	18
60	20 / 36	6.22	29
60	20 / 50	5.18	17
65	18 / 42	6.16	27
65	18 / 54	5.21	16
70	17 / 46	6.22	27
70	17 / 58	5.21	15
75	16 / 50	6.24	26
75	16 / 61	5.25	14
80	15 / 54	6.21	25
80	15 / 65	5.16	12
85	14 / 58	6.13	23
85	14 / 67	5.23	12
90	14 / 60	6.24	23
90	14 / 70	5.18	10
95	13 / 63	6.20	22
95	13 / 72	5.20	10
100	12 / 65	6.25	21
100	12 / 74	5.20	9
105	12 / 68	6.17	19
105	12 / 76	5.19	7
110	11 / 70	6.16	18
110	11 / 78	5.14	6
115	11 / 72	6.15	17
115	11 / 79	5.22	6
120	10 / 73	6.24	17
120	10 / 80	5.27	5
125	10 / 75	6.19	15
125	10 / 82	5.19	3
130	10 / 77	6.12	13
130	10 / 83	5.23	2

BSAC Open Circuit table of standard gases at 1.4 bar PO_2 for use as dive gas.

This smaller table has been constructed to display recommended standard gases. The gas mixtures are not necessarily optimum but have been rounded up or down to give easily recognized helium percentages whilst being within the safe gas density range.

Depth (m)	Gas mix (O_2 / He)	Gas density ($g.L^{-1}$)	END (m)
40	28 / 20	5.26	23
50	23 / 35	5.43	22
60	20 /45	5.55	21
70	17 / 55	5.46	18
80	15 / 60	5.63	18
90	14 / 65	5.71	17
100	12 / 70	5.66	14
110	11 / 75	5.52	10
120	10 / 80	5.27	5
130	10 / 80	5.23	2

Notes;

1. **Recommended gas density values**

   Research conducted by Gavin Anthony and Prof. Simon J Mitchell and published in 2015 in the paper "Respiratory Physiology of Rebreather Diving" established that high breathing gas density can result in;

   - increased CO_2 retention due to reduced respiratory function and increased work of breathing caused by reduced equipment performance
   - airway contraction or closure in extreme cases
   - a higher potential for Immersion Pulmonary Oedema

   The research identifies two critical values of breathing gas density;

   - 5.2 $g.L^{-1}$ is the optimum breathing gas density at which the diver should not experience any physiological effects
   - 6.3 $g.L^{-1}$. Is the upper limit and is deemed to be the breathing gas density at which physiological effects begin to occur. Above this value these physiological effects as defined above become increasingly severe until a critical point may be reached.

   The paper addresses gas densities in rebreather diving however it is similarly relevant for open circuit diving.

2. How to use these tables

Enter the table using the left column for the relevant depth.

The second column denotes the gas mixture. The full table contains two rows for each depth, the upper row gives a value that equates to the upper gas density of 6.3 $g.L^{-1}$. The lower row (highlighted) gives a value that equates to the optimum gas density of 5.2 $g.L^{-1}$.

Choose the gas mixture that will give the gas density you require.

For depths and gas mixtures that fall between the table increments you will need to interpolate.

The third row gives a breathing gas density resulting from the depth and gas mixture in columns 1 and 2.

The fourth column denotes the END resulting from the depth and gas mixture. This value is rounded up or down to the nearest whole number.

3. Relationship between gas density and END

Observation of the table shows that as depth increases so the END decreases proportionately for any given gas mixture.

From this it can clearly be seen that **gas density is the defining factor in gas choice**.

Put another way, if one chooses a gas mixture based upon the widely accepted safe END of 30 metres the gas density is likely to be significantly above the optimum value of 5.2 $g.L^{-1}$ and greater than the upper limit of 6.3 $g.L^{-1}$.

The deeper the depth the gas density will be proportionately higher for any given depth and END therefore **gas density is the defining factor in gas choice**.

For example, at a depth of 100 metres and a PO_2 of 1.4 bar produces a gas mixture of 12 % oxygen, 58 % helium and 30 % nitrogen (Trimix 12 / 58). This results in an acceptable END of 30 metres but an unacceptably high gas density of 7.0 $g.L^{-1}$.

A depth of 130 metres, PO_2 of 1.4 bar and acceptable END of 29 metres produces a gas mix of Trimix 10 / 58 but an unacceptably high gas density of 7.5 $g.L^{-1}$.

All heliox mixtures have an END = 0.