

Scuba Learning Module 20

Decompression theory

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Dive tables

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Dive computers

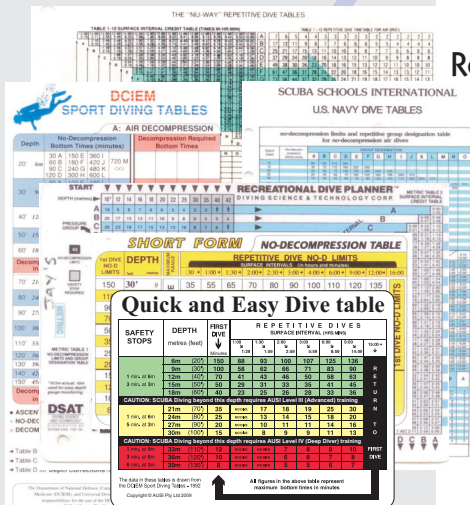
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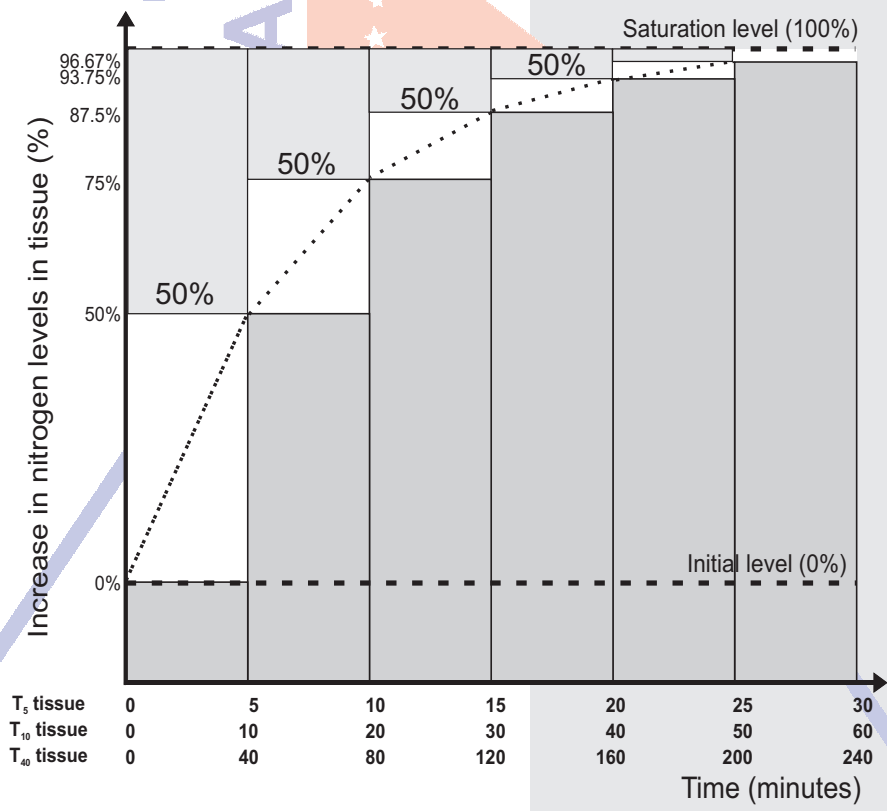


Haldane’s tables

In 1906 the British Admiralty appointed J.S. Haldane to develop a decompression table:

- After experimentation involving goats, Haldane published his first set of tables in 1908
- Haldane based his table on the following assumptions:
 - The body could tolerate approximately a 2:1 pressure ratio drop without forming bubbles, eg. 30m to 10m (100' to 33'), 10m to 0m (33' to 0')
 - Nitrogen uptake and elimination occurred at equal rates
 - The body could be represented by five theoretical tissue types with half times of 5, 10, 20, 40 and 75 minutes (known as T5, T10, T20, T40 and T75)

Although many of Haldane's assumptions have been shown to be incorrect, the concept of his model is still the basis for most dive computers and tables used today



Decompression is an inexact science with much unknown but safe diving practices will significantly reduce the probability of symptomatic bubbles forming (ie DCI)

Many tables and computers are available on the market and should always be consulted when planning dives

Fundamentals

Most modern dive tables and computers are based on the following principals:

- Maximum no-decompression time is the point at which diver can return to surface at the recommended ascent rate without exceeding a set ratio of supersaturation (when the level of nitrogen in the tissues exceeds the level of nitrogen in the air)
- Once no-decompression times are exceeded decompression stops are introduced so diver can return to stop depth at the recommended ascent rate without exceeding a set ratio of supersaturation
- Decompression stop times are calculated so diver can return to next shallowest stop depth and finally to surface at recommended ascent rate without exceeding a set ratio of supersaturation
- Repetitive dive calculations are based on the theoretical amount of nitrogen still present in the diver's body from previous dives

Summary

Most modern tables and computers are based on Haldane's model but the tissue half-times, number of tissue types and allowable supersaturation pressure ratios are varied:

Examples:

1. US Navy Tables (1957):
Uses six Tissue Half Times - 5, 10, 20, 40, 80, 120 min
2. SUUNTO EON computer:
Uses nine Tissue Half Times - 2.5, 5, 10, 20, 40, 80, 120, 240, 480 min

First dive

- The diver has not dived for the period of time required to return their tissue nitrogen levels to normal:
 - Time required depends on decompression table or computer being used

No-decompression dive

- A dive not exceeding the no-decompression time limit and hence not requiring any mandatory decompression stops (safety stops are not mandatory) during ascent:
 - The amount of time available depends on depth, previous dives and the decompression table or computer being used

Decompression diving

- A dive exceeding the no-decompression time limit and hence requiring mandatory decompression stops during ascent:
 - The amount of time and depth of decompression stops depends on many factors, including: depth, time, previous dives and the decompression table or computer being used

Repetitive dive

- Any dive conducted whilst excess nitrogen remains in the tissues as a result of the previous dive (or dives):
 - The available no-decompression time is reduced by excess nitrogen

Some computers automatically adjust to altitude

Altitude diving

- In most cases, diving at an elevation greater than 300 metres (999 feet) above sea-level is considered as altitude diving
- Maybe specified differently for individual tables or computers (eg. BSAC have a chart of altitude and atmospheric pressure which needs to be consulted)

Flying (or altitude) after diving

(includes going over hills or mountains)

- Sufficient safe time must be allowed for sufficient out-gassing of excess nitrogen
- There are recommended safe times before going to altitude after diving:
 - Tables and computers have different methods of calculating the safe time
- ★ Divers Alert Network recommend at least 18 hours after the last dive

Multi level dive

- A multi level dive is a dive that is planned and conducted where significant time is spent at two or more depths:
 - Standard tables are generally designed for rectangular profiles

Ascent rate

- Usually given as an acceptable range or a maximum allowable value:
 - Varies from table to table and may change with depth
- Divers Alert Network recommend a maximum of 9m (30') per minute

Safety stops

- Recommended stops during ascent at specified depths (near the surface) for specified times

Multi-level diving can be conducted on most computers

Safety stops reduce the ascent rate near the surface where the relative pressure change is greatest

Decompression stops

- Mandatory stops during ascent at specified depths for specified times:
 - Chest must be at depth of stop
 - Only required when no-decompression times have been exceeded
 - Allows reduction of tissue nitrogen levels so that the ratio of nitrogen in tissues to ambient pressure doesn't become excessive

Repetitive group designation

- Used by tables to indicate the amount of nitrogen remaining in tissues at any time:
 - A letter is usually used with "A" being the smallest amount of nitrogen and subsequent letters "B", "C", etc representing increasing amounts of nitrogen

Residual nitrogen time

- Used by tables to indicate amount of time for a single dive at a particular depth required to produce the same amount of nitrogen in the diver's tissues as their current repetitive group designator:
 - When a repetitive dive is conducted the residual nitrogen time for the depth of the dive is subtracted from the no-decompression time giving a new adjusted no-decompression time

Surface interval

- Time between reaching the surface at the end of one dive and leaving the surface at the beginning of the next dive:
 - Electronic timers, or dive computers, the surface interval is the time from reaching a depth of about one metre (3') at the end of one dive and passing a depth of about one metre (3') at the beginning of the next dive

Dive time

- Time between leaving the surface at the beginning of a dive and reaching the surface at the end of the dive:
 - Electronic timers or dive computers the dive time is the time from passing a depth of about one metre (3') at the beginning of a dive and reaching a depth of about one metre (3') at the end of the dive

Bottom Time

- Time spent submerged from start of dive to beginning of final ascent to the surface:
 - Variations of this definition exist, particularly in reference to whether or not safety stops are included in bottom time

Emergency Decompression

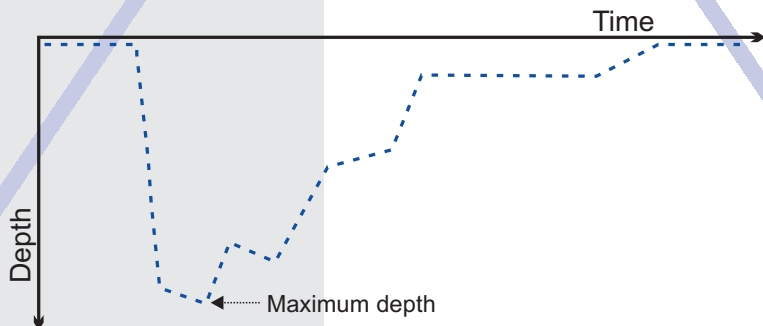
- Decompression stops conducted when no-decompression limits are accidentally exceeded on no-decompression tables

Predisposing Factors

- Factors which may increase an individual's susceptibility to decompression illness and which should be taken into account when planning dives

Depth

- Maximum depth reached at any stage of the dive



- Used to minimise risk of Decompression Illness (DCI)
- Cannot guarantee prevention of DCI

- US Navy (1957) or derivatives of, such as:
 - The “NU-WAY” Repetitive Dive Tables*
 - NAUI Dive Tables*
 - SSI Tables*
- The Huggins Tables
- The Bassett Tables
- PADI Recreational Dive Planner*
- Buehlmann/Hahn
- The BSAC (British Sub-Aqua Club) '88 Decompression Tables*
- DCIEM* (Defence and Civil Institute of Environmental Medicine—Canada)
- Single short-form tables:
 - Quick & Easy Dive (QED) Table*
 - Gain Wong—Short Form No-Decompression Table
- The PADI Wheel

Note: * most commonly used tables

THE "NU-WAY" REPETITIVE DIVE TABLES

TABLE 1-12 SURFACE INTERVAL CREDIT TABLE (TIMES IN HOURS)

Surface Interval (Hours)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	
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BOTTOM TIMES FOR SURVIVAL DIVES

Depth (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	
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TABLE 1-13 NO DECOMPRESSION LIMITS - LIMITS AND REPETITIVE GROUP DESIGNATION TABLE FOR NO DECOMPRESSION DIVES

NO DECOMPRESSION LIMITS FOR NO DECOMPRESSION DIVES

TABLE 1-13 REPETITIVE DIVE TIMES FOR SURVIVAL DIVES

Depth (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	
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NO DECOMPRESSION LIMITS - LIMITS AND REPETITIVE GROUP DESIGNATION TABLE FOR NO DECOMPRESSION DIVES</

The "NU-WAY" Repetitive Dive Tables, an adaption of the US Navy tables, were once commonly used

Work sheet

(See Appendix A for answers)

- What are the no-decompression limits for the following depths?
Please make comments where applicable.

Depth	QED	DCIEM	US Navy	PADI RDP
8m (27')				
11m (36')				
19m (63')				
24m (80')				
28m (93')				
35m (117')				
40m (133')				
45m (150')				

- What repetitive group would you be in after the following single dives?
Please make comments where applicable.

Depth	Time	DCIEM	US Navy	PADI RDP
8m (27')	45 min			
11m (36')	30 min			
19m (63')	15 min			
24m (80')	20 min			
28m (93')	12 min			
35m (117')	8 min			
40m (133')	3 min			
45m (150')	5 min			

Work sheet

(See Appendix A for answers)

- I. Calculate the maximum no-decompression dive times allowed for the following dive sequences:

(a) **Dive 1:** 27m (90') for 18 minutes

Surface Interval: 2 hours 30 minutes

Dive 2: 18m (60') for X minutes

(b) **Dive 1:** 32m (107') for 10 minutes

Surface Interval: 3 hours

Dive 2: 25m (83') for Y minutes

Surface Interval: 1 hour 30 minutes

Dive 3: 15m (50') for Z minutes

Please make comments where applicable.

Times	QED	DCIEM	US Navy	PADI RDP
X			★	
Dive Group			★ ★	
Y			★	
Dive Group				
Z				
Final Group				

It is necessary to be able to use the decompression schedules of a table for calculation of decompression where a no-decompression limit has been exceeded

General

- A decompression dive is a dive exceeding the no-decompression time limit, thus requiring mandatory decompression stop during ascent
- The time and depth of decompression stops depends on many factors, including:
 - Depth
 - Time
 - Previous dives
 - The decompression table or computer being used

Warning

Decompression diving:

- Significantly increases the risk of DCI
- Requires specialist training, such as **technical diver training** or **commercial diver training**
- Prevents immediate access to the surface without a high risk of Decompression Illness should something go wrong
- Requires specialist safety equipment, including redundant air systems
- Increases the risk of hypothermia

Although tables may include decompression schedules, these should not be used without specialist training

Work sheet

(See Appendix A for answers)

1. What decompression is required for?

Depth & Time	QED	DCIEM	US Navy	PADI RDP
18m (60') 60 min				
27m (90') 25 min				
33m (110') 20 min				
36m (120') 15 min				

2. What decompression is required for the following two dive sequence?

Dive 1: 36m (120') for 8 minutes

Surface Interval: 2 hours

Dive 2: 27m (90') for 20 minutes

Dive	QED	DCIEM	US Navy	PADI RDP
Dive 1				
Group				
Dive 2				
Group				

3. What decompression is required for the following three dive sequence?

Dive 1: 33m (110') for 15 minutes

Surface Interval: 2 hours 45 minutes

Dive 2: 24m (80') for 15 minutes

Surface Interval: 2 hours

Dive 3: 18m (60') for 15 minutes

Dive	QED	DCIEM	US Navy	PADI RDP
Dive 1				
Group				
Dive 2				
Group				
Dive 3				
Group				

Effects of pressure

- At altitude, the atmospheric pressure is less than sea level.
- The table below gives approximate atmospheric pressure values at various altitudes

Altitude (above sea level)		Atmospheric Pressure	
(metres)	(feet)	(ATA)	(psi)
0	0	1.00	14.70
500	1,640.	0.95	13.97
1,000	3,280	0.90	13.23
1,500	4,920	0.85	12.50
2,000	6,560	0.80	11.76
2,500	8,200	0.75	11.03
3,000	9,840	0.70	10.29
3,500	11,480	0.65	9.55
4,000	13,120	0.60	8.82
4,500	14,760	0.55	8.08
5,000	16,400	0.50	7.35

- Water pressure is not effected by atmospheric pressure
- Water pressure is approximately 3% less in fresh water than salt water:
 - Salt water: 1 atm = 10m (33')
 - Fresh water: 1 atm = 9.7m (30')
- Total pressure is effected by altitude as seen in the following comparison of the pressure at sea level versus that at 5,000 metres (16,400 feet) of elevation

Depth		Total Pressure			
		At Sea Level		At 5000m	
(m)	(feet)	(ATA)	(psi)	(ATA)	(psi)
0	0	1	14.7	0.5	7.4
10	33	2	29.4	1.5	22.1
20	67	3	44.1	2.5	36.8
30	100	4	58.8	3.5	51.5
40	133	5	73.5	4.5	66.2

Critical pressure ratio (CPR)

- Most tables and computers are based on the concept that there is a critical ratio of nitrogen pressure in the air being breathed, to that in the body tissues
- If the critical ratio is exceeded, symptomatic bubbles and hence Decompression Illness will develop
- Maximum no-decompression times, ascent rates, decompression stop times and depths are all based on this critical ratio
- With increased altitude, the ratio of pressure change over depth increases as shown in the example below:

Pressure change ratio from 10 metres (33') to surface, when surface is:

- At sea level:

$$\text{CPR} = 2 \text{ ATA} / 1 \text{ ATA} = 2$$
- At 5,000m (16,400').

$$\text{CPR} = 1.5 \text{ ATA} / 0.5 \text{ ATA} = 3$$
- To allow for this effect most tables and computers adjust the actual depth at altitude to an equivalent deeper depth and use the normal schedules with the adjusted depth
- Ascent rate, and decompression stop depths, are similarly adjusted

Acclimatisation

- During ascent to altitude, our body will contain higher nitrogen levels in the tissues than in the surrounding air
- A 12-24 hour period is required to eliminate this effect
- Until this time, adjustments must be made to the dive times as if dives have already been performed

Work sheet

(See Appendix A for answers)

- Use the DCIEM Sport Diving tables to calculate the effective depth and maximum no-decompression times for the following altitudes and depths:

Altitude	Depth	Effective depth	Maximum No deco
350m (1148')	14m (47')		
1000m (3280')	21m (70')		
1500m (4920')	31m (103')		
2000m (6560')	33m (110')		
2500m (8200')	40m (133')		

- Use the DCIEM Sport Diving tables to calculate the maximum no-decompression dive times allowed for the following dive sequences performed at 1100m (3600') above sea-level:

(a) **Dive 1:** 27m (90') for 18 minutes
Surface Interval: 2 hours 30 minutes
Dive 2: 18m (60') for X minutes

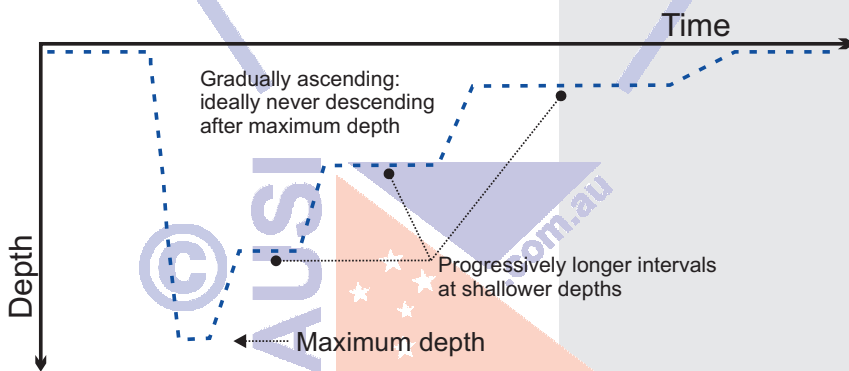
(b) **Dive 1:** 32m (107') for 10 minutes
Surface Interval: 3 hours
Dive 2: 25m (83') for Y minutes
Surface Interval: 1 hour 30 minutes
Dive 3: 15m (50') for Z minutes

Dive	Effective depth	Max no deco	Deco stops	Rep group	Rep factor
(a) 1					
(a) 2					
(b) 1					
(b) 2					
(b) 3					

General

A multi-level dive is a dive that is calculated and conducted where significant planned time is spent at two or more depths:

- Each depth must be successively shallower with the deepest point of the dive at the beginning
- Ideally, the time spent at each level should get successively longer as shown in the profile below:



Methods

- There are three main methods used for calculating multi-level dives using tables:
 - Repetitive group method
 - Repetitive dive method
 - Use of a specialist table (eg. 'The PADI Wheel')
- None of the above methods have been extensively tested and as a general rule, multi-level diving is best achieved using a dive computer conservatively

Special rules

Most multi-level procedures have developed with rules to reduce the level of nitrogen in the body's tissues. These rules can be generalised into a set of guidelines for any multi-level dive:

- Always conduct the deepest part of the dive first and ascend to progressively shallower depths
- Do not exceed the no-decompression times at any level
- Limit the number of steps to four and ascend by at least six metres (20') or the amount specified, if greater
- Keep fourth step shallower than 9m (30')
- Do not exceed 39m (130') at the deepest point of the dive
- Conduct a safety stop of at least three minutes at five metres (15') and include it in the dive calculation
- Allow for a minimum surface interval of one hour between dives
- Do not do more than two dives within 24 hours
- Plan the dive prior to entering the water and dive the plan (be conservative)
- Reduce no-decompression limits to cater for any predisposing factors
- Include the time spent ascending between the levels as time spent at the previous level
- Ascend no faster than 9m (30') per minute (use slower ascent rates near the surface)

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General

Upon returning to the surface at the end of a dive, excess nitrogen remains in the tissues of the diver:

- The amount of nitrogen and where it is (ie. fast or slow tissues) depends on many factors, such as number and depth of dives, exercise and water temperature
- The rate excess nitrogen leaves the body of the diver also depends on many factors, such as existence of bubbles and hydration
- Upon ascent to altitude (where the air pressure is reduced) with excess nitrogen in the tissues, bubbles and hence Decompression Illness can occur
- It is essential to have some guide as to when it is safe to fly after diving, as many divers go on holidays where flying is the only practical method of transport
- Some dive sites require a drive through hills after diving to return home, this must also be considered

Determining time to fly

- Many methods have been developed for determining when it is safe to fly or ascend to altitude after diving
- Many of these methods are complex and confusing, making mistakes likely
- Methods vary in required surface intervals from as little as two hours up to as much as 48 hours
- Some methods are based on a cabin pressure in a commercial airliner (approximately 0.75 ATA, however cabin pressures can get as low as 0.58 ATA)
- Many dive computers give times to fly which are not very conservative and do not allow for the possibility of asymptomatic bubbles (which are known to exist after most dives) expanding



The simplest and most conservative method is to wait a minimum of 18 hours before flying or going to altitude, as recommended by Divers Alert Network

Operation

- Consult manual before using for first time
- Manually switched computers must be turned on before descent
- Always use conservatively
- In case of failure have a backup dive plan and system:
 - Ascend slowly ($< 9\text{m}$ (30') per min) to between 6m (20') and 3m (10')
 - Stop for as long as air supply will safely allow
- Don't share a computer between two divers
- Use safe dive profiles (eg don't plan decompression dives)
- Avoid multiple ascents
- Always plan for and conduct safety stops where possible
- If diving at altitude set the correct altitude mode
- Do not use with any gas mixture other than air

Care and maintenance

- Wash thoroughly in fresh water after use
- Have serviced annually by a qualified service technician
- Replace battery as soon as low battery warning appears or if going on dive holiday or near limit of battery life
- Carry a spare battery, if appropriate

Function

- Used to minimise risk of Decompression Illness (DCI)
- Cannot guarantee prevention of DCI

Types

- Standard
- Air integrated
- Hoseless air integrated

Standard features

- Dive time
- Current depth
- Maximum depth
- Remaining no decompression time
- Planning mode
- Ascent rate

Additional features

- Altitude modes
- Remaining air time or no-decompression time (whichever is the least)
- Decompression stop depths and times
- Decompression ceilings
- Nitrogen tissue loading bar graph
- Audible warnings for such things as:
 - Low air
 - Low battery
 - Rapid ascent rate
 - Low remaining no-decompression time
- Decompression for gases other than air



Theory

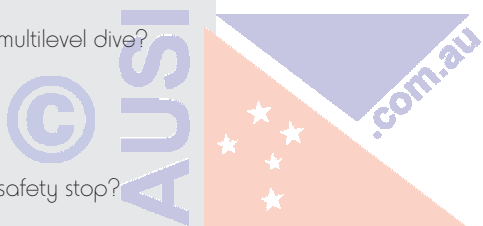
- Decompression is an inexact science as such many factors can increase a diver's chances of suffering Decompression Illness
- Many of the factors that predispose a diver to DCI can be avoided but some cannot
- If predisposing factors are identified they can be allowed for in a number of different ways:
 - Treat the dive as being deeper than it actually is
 - Reduce the planned bottom time of the dive
 - Treat a repetitive dive surface interval as being shorter than it really is
 - Any combination of the above, or
 - **Don't dive**

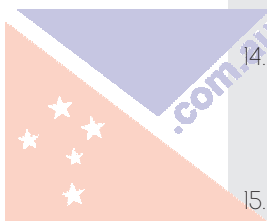
Examples

Below are some examples of possible predisposing factors, the list is by no means exhaustive:

- Fatigue
- Age greater than 40
- Cold water
- Repetitive diving
- Previous bends
- Obesity
- Lack of fitness
- Being Female
- Dehydration/hangovers
- Exercise before, during and after dive
- Rapid ascents (>9m (30') per minute)
- Patent Foramen Ovale (PFO)

1. What is a no-decompression dive?
2. What is a decompression dive?
3. What is a repetitive dive?
4. What is considered diving at altitude?
5. What is a multilevel dive?
6. What is a safety stop?
7. What is a decompression stop?
8. What is a repetitive group designation?
9. What is residual nitrogen time?
10. What is surface interval?
11. What is bottom time?





For questions 12 to 15, use the following data:

Dive 1: 33m (110ft.) for 10 min.

Surface interval: 2hrs. 20 min.

Dive 2: 24m (80ft.) for **X** min.

Surface interval: 3hrs. 30 min.

Dive 3: 15m (50ft) for **Y** min.

12. Using US Navy Table calculate X and Y for the above dive sequence, and give the repetitive dive group after each dive
13. Using the PADI Recreational Dive Planner calculate X and Y for the above dive sequence, and give the repetitive dive group after each dive.
14. Using the DCIEM Table calculate X and Y for the above dive sequence, and give the repetitive dive group after each dive.
15. Using the QED Table calculate X and Y for the above dive sequence.
16. When multi-level diving, how many steps should the dive be limited to?
17. What is the simplest and most conservative method for determining safe fly time?
18. List five standard features of a diving computer.
19. List 10 considerations when using a computer.
20. List 10 predisposing factors of Decompression Illness.