for both the diver's comfort and to aid in offsetting hypothermia. The lymphasomes could also be used as an emergency ration, e.g. in lost bell situations and for the treatment of hypothermia.

Future exploitation of the lymphasomes might include the use of their drug delivery properties to administer specific metabolic stimulants to fat metabolism, or drugs which can control thermoregulatory responses. The lymphasome concept thus represents control of hypothermia by stimulating normal physiological functions. Such an approach is particularly relevant to the problems associated with diver hypothermia.

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The address of SEA TECHNOLOGY is Suite 1000, 1117 North 19th Street, Arlington, Virginia 22209, U.S.A.

HEAT LOSS AND THE WET SUIT

A recent study of Korean women divers at Korea's Kosin Medical College has useful implications for any cold water diver.

The researchers found that wet suits provide "unexpectedly high insulation" when worn by resting divers in water as cold as 15°C, but as soon as the divers undertook mild exercise the insulation value quickly dissipated.

The lesson? If a diver clad in a wet suit needs rescue and cannot escape from cold water he should remain still rather than swim, and so avoid heat loss and slow down the development of hypothermia.

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HEAT LOSS AND DIET

In a study performed by the medical faculty at the Institute of Physiology in Buenos Aires, Argentine, the reaction to immersion in 72°F water was studied in ten healthy male volunteers who ingested a balanced diet for three weeks (then were tested), followed by successive testing after three week diets of high carbohydrate, high protein, and high fat. Caloric intake was maintained from diet to diet.

The researchers concluded that the "reaction to cold water immersion was demonstrable for all groups, but more efficient in subjects who had received either balanced or high carbohydrate diets", suggesting that high protein or high fat diets reduce cold adaptation. But one has to wonder. Would an Eskimo agree?

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LESSENING THE RISK OF DECOMPRESSION SICKNESS

John Lippmann

ADDING SAFETY TO THE U.S. NAVY TABLES

Many divers have devised methods to add some degree of extra safety to their U.S. Navy (USN) Table calculations. Some methods are obviously better than others. I have chosen some methods that I know of to present in the following section. These methods should provide quite a lot of extra safety, but still cannot be guaranteed to prevent decompression sickness.

I believe that sport divers are better off using a more appropriate set of tables At present I know of two tables, which are based on the U.S. Navy system, which I think should be used instead of the USN tables for sport diving purposes. They are the "Huggins Tables" and the "Bassett Tables". There are also tables, based on other systems, that may be more suitable than the U.S. Navy Tables. These are the DCIEM and Buehlmann Tables.

<u>Methods for making no-decompression dives safer</u>

A Choose an initial no decompression limit (NDL) by choosing the NDL for the next greater table depth. For

example the NDL for a dive to 21 m is 50 minutes. To add safety for this dive take the NDL for 24 m (40 minutes) as your initial NDL. For a dive to 31 m look up the NDL for 36 m rather than the NDL for 33 m. So the initial NDL for this dive is 15 minutes (rather than 20 minutes).

This procedure converts the USN limits into limits which are often very similar to those of Bassett and Huggins.

B Reduce this initial NDL further for any decompression sickness predisposing factor(s). For a dive to 21 m the initial NDL is 40 minutes. If I expect to get cold I will reduce this time by at least 4 minutes (10% reduction). If I am 7 kg overweight I will take off another 10% (4 minutes). Now my actual no-decompression bottom time becomes 40-4-4 = 34 minutes.

This limit is now quite similar to the DCIEM and Swiss limits.

C Ascend at about 10 m/minute.

D Stop at between 3 and 6 m for 3-5 minutes before surfacing.

E Use the total dive time (total time underwater) for the actual dive done to find the repetitive group (RG) after the dive.

Example 1.

You are planning to do two no-decompression dives, the first to 20 m followed 3 hours later by a dive to 16 m. Using the suggested safety factors, find the allowable no-decompression bottom time. Assume that there are no predisposing factors for decompression sickness present. Before you go any further get your copy of the USN tables and see if you get the right answers.

1 As 20 m is between 18 and 21 m look up the NDL for 24 m (ie. next greater depth increment). This limit is 40 minutes which is the maximum allowable bottom time for the proposed dive.
2 Ascend at 10 m per minute.
3 Do a safety stop at 3-6 m for say 3 minutes.
4 Total dive time = 40 (bottom time) + 3 (stop time) + 2 (ascent time) = 45 minutes.
5 To find the repetitive group after the dive look up 21 m (the actual dive) for 45 minutes (total dive time) which gives group I.
6 Repetitive group after a surface interval of 3 hours is D.
7 The proposed depth of the second dive is 16 m. The residual nitrogen time (RNT) for group D for a dive to 16 m (more than15 m and less than 18 m) is 24 minutes.
8 The proposed depth of the second dive is 16 m so look up the NDL for 21 m (ie. next greater depth increment) which is 50 minutes.
9 Allowable bottom time is 50 (NDL) - 24 (RNT) = 26 minutes.
10 Leave the bottom after 26 minutes.
11 Ascend at 10 m per minute.
12 Stop at 3-6 m for 3-5 minutes.

The unmodified USN times for the two dives would be 50 minutes and 30 minutes.

Example 2.

You are planning to do two no-decompression dives, the first to 33 m followed 5 hours later by a dive to 30 m. Using the suggested safety factors, find the allowable no-decompression bottom time. Again assume that there are no predisposing factors for decompression sickness present.

1 Look up NDL for 36 m (the next greater depth increment). The limit is 15 minutes, which is the maximum allowable bottom time for this dive.
2 Ascend at 10 m per minute.
3 Do a safety stop at 3 to 6 m for 5 minutes.
4 Total dive time = 15 (bottom time) + 5 (stop time) + 3.3 (ascent time) = 24 minutes (rounded to next minute above.)
5 To find the repetitive group after the dive look up the actual dive of 33 m for 24 minutes, as this is outside the NDL for 33m (20 minutes) look in the full U.S. Navy decompression table, which gives group H
6 Repetitive group after a surface interval of 5 hours is B.
7 The proposed depth of the second dive is 30 m. The residual nitrogen time in group B for 30 m is 7 minutes.
8 The proposed depth of the second dive is 30 m so look up NDL for 33 m (ie. next greater depth increment)which is 20 minutes.
9 Allowable bottom time = 20 (NDL) - 7 (RNT) = 13 minutes
10 Leave the bottom after 13 minutes.
11 Ascend at 10 m per minute.
12 Stop at 3 to 6 m for 5 minutes.

The unmodified USN times for these dives would be 20 minutes and 18 minutes.

F Another method which is often suggested is to first reduce the USN NDL by 10% for each predisposing factor present. Then ensure that you leave the bottom with sufficient time left to ascend at 10 m per minutes and to reach the surface before this reduced NDL expires.

I believe that this method is often not conservative enough and that the previous method, although more complicated, should be used in preference to this method. For example, for a single dive to 18 m method F allows a maximum (ie. not allowing for predisposing factors) no-decompression bottom time of 58 minutes. This 58 minutes is significantly longer than the times suggested by the Swiss, Canadian, Huggins and Bassett Tables.

Methods for making decompression dives safer

A Choose the decompression schedule by adding one

depth increment and one bottom time increment to the schedule for the dive you wish to do. For example for a dive to 17 m for a bottom time of 65 minutes use the schedule for 21 m for 80 minutes.

B Reduce your ascent rate to 10 m per minute.

C Select your RG according to the decompression done, if you decompressed as for 21 m for 80 minutes for a dive to 17 m for 65 minutes, your RG is M.

D If you get cold or work hard during the dive then you should increase your decompression time by adding another bottom time increment. This would mean for the previous dive decompressing as for a dive to 21 m for 90 minutes. This will often give decompression well in excess of other tables but, if air is available and the conditions are right, it is a cheap insurance!

Example 1.

You are planning a decompression dive to 27 m for a bottom time of 38 minutes. What decompression schedule should you use?

1 Select the schedule for the next greater tabled depth increment which will be 30 m and for the next longer time increment which will be 50 minutes. This requires stops of 2 minutes at 6 m and 24 minutes at 3 m.
2 Ascend at 10 m per minute.
3 The RG after the dive will be L.

Example 2.

You are planning a decompression to 36 m for a bottom time of 20 minutes. The water is cold and you expect to work hard during the dive. What decompression schedule should you select?

1 Initially add one depth and one time increment. This gives 39 m for 25 minutes.
2 Then add another bottom time increment to cater for the cold and exercise. This gives 39 m for 30 minutes. The decompression required is a stop at 6 m for 3 minutes followed by a stop at 3 m for 18 minutes.
3 The RG after the dive is M.

SAFER ALTERNATIVES BASED ON THE U.S. NAVY TABLES

The Huggins Tables

In 1976 Dr Merril Spencer published a report in which he stated that he had found that divers who were exposed to some of the U.S. Navy no-decompression limits, developed high counts of "silent bubbles" (venous gas emboli) during and after ascent from depth. The bubbles were detected using a Doppler Ultrasonic Bubble Detector. He believed that the bubbles resulted from the release of excess nitrogen in the divers' bodies. On the basis of this work, Spencer recommended new no-decompression limits (NDLs), which were calculated in an attempt to prevent bubble formation after a dive. These limits are shown in Table 1. Subsequent studies carried out by Dr Andrew Pilmanis and Dr Bruce Bassett confirmed Spencer's findings.

TABLE 1

NO-DECOMPRESSION LIMITS, IN MINUTES, OF THE USN, SPENCER AND BASSETT TABLES

Depth m	Depth ft	U.S. Navy	Spencer	Bassett
9	30	-	225	220
10.5	35	310	165	180
12	40	200	135	120
15	50	100	75	70
18	60	60	50	50
21	70	50	40	40
24	80	40	30	30
27	90	30	25	25
30	100	25	20	20
33	110	20	15	15
36	120	15	10	12
39	130	10	5	5

These findings confirmed a growing concern in the sport diving community that the U.S. Navy No-Decompression Limits are not as safe for the sport diver as they should be. As a result, in 1981, Karl Huggins generated a new set of no-decompression tables which are based on Spencer's recommendations. These new no-decompression tables published by the Michigan Sea Grant College Program became known as the "Huggins Tables". They are designed in an attempt to prevent the formation of bubbles, asymptomatic or otherwise.

The Huggins Tables are based on the same concepts and format as the U.S. Navy Tables. Using the same six theoretical tissue groups as the Navy tables, with half-times of 5, 10, 20, 40, 80 and 120 minutes, Huggins determined the new, lower critical nitrogen levels (M values) corresponding to the shortened NDLs recommended by Spencer. Huggins also determined new Repetitive Group Designators which represent the nitrogen levels in all six tissue groups, rather than just in the 120 minute tissue as in the USN tables. This makes these tables far more suitable for multi-level diving.

These tables have not been officially tested, but are more conservative than the U.S. Navy Tables when used to find the limits for single and repetitive no-decompression dives.

They consist of a Repetitive Group Table, a Surface Interval Table and a Residual Nitrogen Table and are reproduced on page 73.

THE HUGGINS TABLES reproduced with acknowledgements to the Michigan Sea Grant College Program.

SURFACE INTERVAL TABLE

NEW GROUP	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	12:00 0:10	12:00 2:31	12:00 3:42	12:00 4:43	12:00 5:23	12:00 5:57	12:00 6:21	12:00 6:49	12:00 7:09	12:00 7:30	12:00 7:46	12:00 8:01	12:00 8:18	12:00 8:27
B		2:30 0:10	3:41 1:20	4:42 2:21	5:22 3:01	5:56 3:35	6:20 3:59	6:48 4:27	7:08 4:47	7:29 5:08	7:45 5:24	8:00 5:39	8:17 5:56	8:26 6:05
C			1:19 0:10	2:20 1:04	3:00 1:44	3:34 2:18	3:58 2:42	4:26 3:10	4:46 3:30	5:07 3:51	5:23 4:07	5:38 4:22	5:55 4:39	6:04 4:48
D				1:03 0:10	1:43 0:50	2:17 1:24	2:41 1:48	3:09 2:16	3:29 2:36	3:50 2:57	4:06 3:13	4:21 3:28	4:38 3:45	4:47 3:54
E					0:49 0:10	1:23 0:43	1:47 1:07	2:15 1:35	2:35 1:55	2:56 2:16	3:12 2:32	3:27 2:47	3:44 3:04	3:53 3:13
F						0:42 0:10	1:06 0:34	1:34 1:02	1:54 1:22	2:15 1:43	2:31 1:59	2:46 2:14	3:03 2:31	3:12 2:40
G							0:33 0:10	1:01 0:34	1:21 0:54	1:42 1:15	1:58 1:31	2:13 1:46	2:30 2:03	2:39 2:12
H								0:33 0:10	0:53 0:30	1:14 0:51	1:30 1:07	1:45 1:22	2:02 1:39	2:11 1:48
I									0:29 0:10	0:50 0:29	1:06 0:45	1:21 1:01	1:38 1:17	1:47 1:26
J										0:28 0:10	0:44 0:26	1:00 0:42	1:16 0:58	1:25 1:07
K											0:25 0:10	0:41 0:24	0:57 0:40	1:06 0:49
L												0:23 0:10	0:39 0:24	0:48 0:33
M													0:23 0:10	0:32 0:18
N														0:17 0:10

NEW GROUP	20	30	35	40	50	60	70	80	90	100	110	120	130
A	12	8	7	6	5	4	4	3	3	3	3	2	2
B	28	18	16	14	11	9	8	7	6	6	5	5	4
C	45	29	25	21	17	14	12	9	8	6	6	5	5
D	65	41	34	30	23	19	15	10	8	7	6	5	5
E	86	53	44	37	28	22	17	12	9	8	7	6	5
F	111	66	53	43	32	24	19	14	11	9	7	6	6
G	140	80	62	49	36	27	22	17	12	10	8	7	6
H	175	96	73	57	40	30	24	19	14	11	9	8	7
I	219	113	86	65	45	34	26	21	16	12	10	8	7
J	279	132	103	75	51	38	29	23	18	13	11	9	8
K	369	154	122	88	57	43	32	26	20	15	12	10	8
L	-	178	139	103	64	47	35	28	22	18	13	11	9
M	-	207	158	124	71	52	40	30	25	20	15	12	10
N	-	225	165	135	75	53	41	31	26	21	16	13	11

DEPTH

DEPTH (FT.)	NO DECOM. LIMITS	BOTTOM TIME AND REPETITIVE GROUP CODE													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
20	-	10	25	40	60	85	110	135	170	215	275	325			
30	225	5	15	25	40	50	65	75	95	110	130	150	175	205	225
35	165	5	15	20	30	40	50	60	70	85	100	120	135	155	165
40	135	5	10	20	25	35	40	45	55	60	70	85	100	120	135
50	75	-	10	15	20	25	30	35	37	40	50	55	60	70	75
60	50	-	5	10	15	20	23	25	27	30	35	40	45	47	50
70	40	-	5	10	13	15	17	20	23	25	27	30	33	35	40
80	30	-	5	7	→	10	13	15	17	20	→	25	27	→	30
90	25	-	-	5	7	→	10	→	13	15	17	→	20	23	25
100	20	-	-	-	5	7	→	→	10	→	→	13	15	17	20
110	15	-	-	-	-	5	→	7	→	→	10	→	→	13	15
120	10	-	-	-	-	-	5	→	→	7	→	→	10		
130	5	-	-	-	-	-	5								

* NEW *

NO-DECOMPRESSION TABLES

Michigan Sea Grant College Program

The University of Michigan • Michigan State University

The Bassett Tables

Dr Bruce Bassett, a physiologist, was commissioned by the U.S. Air Force to validate some schedules for flying after diving. He had to construct a set of tables which would allow a diver to be flown to an altitude of 3,000 metres immediately after surfacing from a dive.

Using the mathematics of the U.S. Navy tables, Bassett calculated a set of equivalent no-decompression dives, after which a diver would not reach the critical nitrogen levels (maximum supersaturation ratios) of the U.S. Navy table, until reaching 3,000 m. Bassett placed "divers" in a chamber for various periods of time before "surfacing" them, and then reducing the pressure to its equivalent at 3,000 m. The divers did not do an 18 m for 60 minutes dive. Instead they spent 20 minutes at 18 m and then ascended to 3,000 metres. Bassett believed that the calculated nitrogen pressures in the theoretical half-time tissues on reaching 3,000 metres were identical to that of surfacing after an 18 m for 60 minutes dive.

If the U.S. Navy tables were safe, these shorter dives followed by decompression to altitude should have been safe. They were not, as Bassett's divers had a bends incidence of about 6%, and silent bubbles were detected in about 30% of the divers. This was unacceptable. Bassett's results were similar to those of Dr Merril Spencer in Seattle, who had tested the U.S. Navy NDLs in a chamber, and found a comparable bends incidence and silent bubble count.

These two sets of dry chamber data and the knowledge that the U.S. Navy divers always added depth and time increments before calculating decompression, led Dr Bassett to re-calculate his dive schedule using lesser maximum nitrogen values (M values). That is, he reduced the allowable supersaturation in the various half-time tissues and so got shorter NDLs. When Bassett tested his revised decompression procedures in the chamber there were no bends.

Bassett issued a new set of No-Decompression Limits which are more conservative, and which he believed are far more appropriate for sport diving, than the U.S. Navy NDLs. Bassett also recommended that "all dives greater than 30 ft (9 m) end with 3-5 minutes at 10-15 ft (3-5 m)". He also suggested that the total time underwater be used (rather than just bottom time) to determine the repetitive group after a dive.

Alarmed by the increasing incidence of decompression sickness in Australia, John Knight and John Lippmann, seeking to encourage the use of Bassett's limits, created a repetitive dive table which John Knight eventually published. The table, shown on page 75, incorporates Bassett's limits, his recommendations and other safe diving practices designed to reduce the risk of decompression sickness. They are available commercially in Australia and fit easily into the pocket of a buoyancy compensator.

These tables have not been officially tested, but are more conservative than the U.S. Navy Tables when used to find the limits for single and repetitive no-decompression dives.

Features of the table are:

1 An ascent rate of 10 m/minute is recommended, as slow ascents seem to produce fewer cases of decompression sickness. Bassett's limits were calculated on an ascent rate rate of 18 m/minute so this slower ascent is not essential but should provide extra safety.

2 A safety stop of 3-5 minutes at 3-5 m is recommended after all dives deeper than 9 m whenever possible.

3 The total time underwater, rather than just the bottom time, is used to calculate the repetitive group after a dive.

4 (a) The Bassett NDLs are given in the third column of Table 1. The rest of Table 1 is for finding the repetitive group (using the total time underwater) at the end of the dive.

(b) Table 2 is a slightly abbreviated form of the U.S. Navy Surface Interval Table.

(c) To calculate the allowable bottom times for repetitive dives, Table 3, John Knight simply subtracted the U.S. Navy Residual Nitrogen Times from the Bassett limits rather than from the U.S. Navy NDLs as is normally done.

5 A decompression table is provided as a back-up should the need arise. The decompression table provided is to cater for the situation where a diver accidently overstays his no-decompression time. The times in this table (Table 4 on page 75) are those from the U.S. Navy table with an extra 5 minutes added to the 3 m stop. It is certainly not a recommended decompression table to be used for decompression diving but should be more than adequate to cover a diver in the sitution described.

6 The system allows two dives without any calculations. For a third dive deeper than 9 m one does a similar calculation to that with the U.S. Navy tables. For third or subsequent dives to 9 m or less no further calculation is required; one can dive to the 9 m NDL of 220 minutes.

Example 1.

What is the maximum allowable bottom time for a single or first no-decompression dive to 20 m?

1 Enter Table 1 from the left at the exact, or next deeper depth. In this case enter at 21 m. Move right to column 3 (Bassett Bottom Time Limits) to find the allowable bottom time. It is 40 minutes. This means that you must leave the bottom after a maximum of 40 minutes, ascend at about 10 m/minute and stop at 3-5 m for say 3 minutes

READ THIS BEFORE USING THE TABLES

1. Bottom time starts on leaving the surface and stops on starting the ascent.
2. Use the deepest depth of the dive as the depth of the dive for calculation.
3. If the deepest depth of the dive is between two depths in the table use the greater depth for calculations.
4. If the time is between two times in the table use the longer time for calculations.
5. After a dive calculate the repetitive group.
6. After the surface interval calculate the new repetitive group.
7. Using the planned depth of the next dive enter the repetitive dive table to find the no-decompression bottom time available for that repetitive group and depth.

ASCENT RATE 10m A MINUTE.

ON ALL DIVES DEEPER THAN 9m (30ft) DO A 3-5 MINUTE SAFETY STOP AT 3-5 M.

USE THE TOTAL TIME UNDERWATER (BOTTOM TIME + ASCENT TIME + SAFETY STOP TIME) TO FIND THE REPETITIVE GROUP AT THE END OF THE DIVE.

TABLE 4
MODIFIED AIR DECOMPRESSION TABLE*

Depth m	Depth feet	Bottom Time minutes	Decompression Stops minutes at 10 feet	Repetitive group
18	60	70	7	K
		80	12	L
21	70	60	13	K
		70	19	L
24	80	50	15	K
		60	22	L
27	90	40	12	J
		50	23	L
30	100	30	8	I
		40	20	K
33	110	25	8	H
		30	12	J
36	120	20	7	H
		25	11	I
39	130	15	6	F
		20	10	H
42	140	15	7	G
		20	11	I
45	150	5	5	C
		10	6	E

* FOR THOSE WHO ACCIDENTALLY EXCEED THE NO-DECOMPRESSION LIMITS

TO CALCULATE THE REPETITIVE GROUP AFTER A REPETITIVE DIVE.

3rd DIVES BELOW 9m(30 feet) ARE NOT RECOMMENDED.
A REPETITIVE DIVE IS ANY DIVE WITHIN 12 HOURS OF THE LAST DIVE.

1. Subtract the actual bottom time of the repetitive dive from the bottom time available in table 3 to get an answer in minutes.
2. Subtract this time difference from the Bassett Bottom Time limits in table 1. The answer is the equivalent bottom time of the repetitive dive.
3. Add the ascent time and the safety stop time to the answer in 2. This is the equivalent total time underwater of the repetitive dive.
4. Use this time to enter table 1 to find the repetitive group at the end of the dive.

A 2B PENCIL WRITES WELL ON THIS PLASTIC AND IS EASILY RUBBED OUT.

	EXAMPLE	2nd dive	3rd dive*
Repetitive Group before the dive.	B		
Proposed depth of dive	24 m		
Bottom time available	22 min	min	min
- Actual bottom time	20 min	min	min
= Difference	2 min	min	min
Bassett Bottom Time limit	30 min	min	min
- Difference	2 min	min	min
= Equivalent Bottom Time	28 min	min	min
+ Ascent time	3 min	min	min
+ Safety stop time	5 min	+ 5 min	+ 5 min
= Equivalent total time underwater	36 min	min	min
Repetitive group at the end of the dive	I		

The RESIDUAL NITROGEN TIME can be found by subtracting the MAXIMUM TIME AVAILABLE FOR A REPETITIVE DIVE (Table 3) from the BASSETT BOTTOM TIME LIMITS (column 3 of table 1).

DR BRUCE BASSETT'S REVISED BOTTOM TIMES "NO DECOMPRESSION" DIVE TABLE

ARRANGED FOR REPETITIVE DIVES BY JOHN KNIGHT & JOHN LIPPMANN

BEFORE USING THIS TABLE READ THE OTHER SIDE.

ACENT RATE 10m A MINUTE

ON ALL DIVES DEEPER THAN 9m (30ft) DO A 3-5 MINUTE SAFETY STOP AT 3-5m. USE THE TOTAL TIME UNDERWATER (BOTTOM TIME + ASCENT TIME + SAFETY STOP TIME) TO FIND THE REPETITIVE GROUP AT THE END OF THE DIVE.

The times in *italics* in the table are OUTSIDE the Bassett Bottom Time limits but are included for ease of calculating the repetitive group using the TOTAL TIME UNDERWATER.

TABLE 1.

Depth M	Depth feet	Bassett Bottom Time Limits	Time Underwater											
9	30	220	15	30	45	60	75	95	120	145	170	205	*250*	*310*
10	35	180	5	15	25	40	50	60	80	100	120	140	*160*	*190*
12	40	120	5	15	25	30	40	50	70	80	100	110	*130*	*150*
15	50	70		10	15	25	30	40	50	60	70	*80*	*90*	*100*
18	60	50		10	15	20	25	30	40	50	*55*	*60*		
21	70	40		5	10	15	20	30	35	40	*45*	*50*		
24	80	30		5	10	15	20	25	30	35	*40*			
27	90	25		5	10	12	15	20	25	*30*		*40*		
30	100	20		5	7	10	15	20	*22*	*25*	30			
33	110	15			5	10	13	15	*20*	*25*				
36	120	12			5	10	12	*15*		*20*	*25*			
39	130	10			5	8	10	*15*		*20*				
42	140	5			5	7	*10*		*15*					

Repetitive group at the end of the dive: A B C D E F G H I J K L

TABLE 2

	A	B	C	D	E	F	G	H	I	J	K	L
	0:10											
	12:00	A										
	2:11	0:10	B									
	12:00	2:10		B								
	2:50	1:40	0:10		C							
	12:00	2:49	1:39			C						
	5:49	2:39	1:10	0:10			D					
	12:00	5:48	2:38	1:09				D				
	6:33	3:23	1:58	0:55	0:10				E			
	12:00	6:32	3:22	1:57	0:54					E		
	7:06	3:58	2:29	1:30	0:46	0:10					F	
	12:00	7:05	3:57	2:28	1:29	0:45						F
	7:36	4:26	2:59	2:00	1:16	0:41	0:10					
	12:00	7:35	4:25	2:58	1:59	1:15	0:40	G				
	8:00	4:50	3:21	2:24	1:42	1:07	0:37	0:10				
	12:00	7:59	4:49	3:20	2:23	1:41	1:08	0:36	H			
	8:22	5:13	3:44	2:45	2:03	1:30	1:00	0:34	0:10			
	12:00	8:21	5:12	3:43	2:44	2:02	1:29	0:59	0:33	I		
	8:41	5:41	4:03	3:05	2:21	1:48	1:20	0:55	0:32	0:10		
	12:00	8:40	5:40	4:02	3:04	2:20	1:47	1:19	0:54	0:31	J	
	8:59	5:49	4:20	3:22	2:39	2:04	1:36	1:12	0:50	0:29	0:10	
	12:00	8:58	5:48	4:19	3:21	2:38	2:03	1:35	1:11	0:49	0:28	K
	9:13	6:03	4:36	3:37	2:54	2:20	1:50	1:26	1:05	0:46	0:27	0:10
	12:00	9:12	6:02	4:35	3:36	2:53	2:19	1:49	1:25	1:04	0:45	0:26

ABBREVIATED U.S.N. SURFACE INTERVAL TABLE

Enter the table from the top using the appropriate repetitive group. Move across to the left until the appropriate interval is found then move down the column and out of the table into the REPETITIVE DIVE TABLE (Table 3)

TABLE 3

	A	B	C	D	E	F	G	H	I	J	K	L
Depth M	Depth feet	MAXIMUM BOTTOM TIME AVAILABLE FOR A REPETITIVE DIVE										
9	30	213	203	195	183	171	159	147	133	119	104	82
12	40	113	103	95	83	71	59	47	33	19	4	
15	50	64	57	49	41	32	23	14	4			
18	60	45	39	33	26	20	14	6				
21	70	36	31	25	20	14	9	3				
24	80	26	22	17	12	7	2					
27	90	22	18	14	9	5	1					
30	100	17	13	10	6	2						
33	110	12	9	5	2							
36	120	9	6	3								
39	130	7	4	2								
42	140	3										

Each of these times takes the diver to the equivalent of the Bassett Bottom Time limits for that depth. If these times are accidentally exceeded, add the excess time to the Bottom Time Limit for that depth in Table 1, then use Table 4 to decompress.

before surfacing.

2 To find the RG after the dive you must use the total dive time of 40 (Bottom time) + 2 (approximate. ascent time) + 3 (stop time) = 45 minutes. Move to the right across the 21 m row of Table 1 until finding the exact or next greater tabled total dive time, then move down the column to get the RG. In this case 45 minutes is tabled and moving down the 45 minute column gives a RG of I.

Example 2.

You have dived to 18 m for a bottom time of 40 minutes. You ascended slowly and did a safety stop en-route to the surface. After a 2 hour surface interval you wish to dive to 15 m. What is the maximum allowable bottom time for the 15 m dive?

1 For the first dive the NDL was 50 minutes, so you could have had a maximum bottom time of 50 minutes if required. You have spent 40 minutes bottom time, ascended slowly and done a safety stop, so the total time underwater should have been about 45 minutes. To find the RG after the first dive enter Table 1 at the row for 18 m, move right to find 45 minutes, which is not in the table, so in this case take 50 minutes, and move down to find the RG at the end of the dive. It is group H.

2 To find the new RG after the surface interval continue downwards to H on Table 2. Move across the H row, to the left, until finding the times which incude 2 hours, in this case 1:42-2:23. Move down this new column to find the group at the end of the surface interval which is Group E.

3 To find the maximum allowable no-decompression bottom time for the repetitive dive continue down the E column until intersecting the row corresponding to 15 m. You find the figure 32. This means that you can have a bottom time of 32 minutes at 15 m before ascending slowly, doing a safety stop and surfacing. Your total time underwater would be about 37 minutes.

4 Note that the maximum allowable bottom time for the second dive brings you to the Bassett single dive NDL for that depth (found in column 3 of Table 1). That is 32 minutes at 15 m for this repetitive dive is equivalent to 70 minutes (the Bassett limit for a single 15 m dive taken from Table 1) at 15 m for a first dive. The difference between the 70 minutes and the 32 minutes is the time already considered spent at 15 m before the second dive begins (Residual Nitrogen Time).

Example 3.

Three hours after the second dive in Example 2 you wish to dive to 12 m. What is the maximum allowable no-decompression bottom time for the dive?

1 You must first find the RG after the last dive. This dive was equivalent to a single dive to 15 m for a bottom time of 70 minutes. Adding the ascent and safety stop time of about 5 minutes, the equivalent total time underwater is 70 + 5 = 75 minutes. Now enter Table 1 from the left at 15 m and move across to the right to find the "equivalent time underwater" of 75 minutes. As this is more than 70 minutes take 80 minutes and move down the column, you get a RG of J.

2 Enter Table 2 from the right at J and find the surface interval of 3 hours. It lies between 2:21-3:04. Move down this column to get the RG after the surface interval, which is E.

3 Continue down into Table 3 until intersecting the row corresponding to the depth of the next dive (12 m). The number 71 is the allowable bottom time, in minutes, for this third dive.

Example 4.

During the last dive, after spending only 50 minutes of the allowable bottom time of 71 minutes at 12 m, you ascend slowly and stop for 3 minutes at 5 m. What is your RG after the dive?

1 Your 50-minute bottom time was 21 minutes shorter than the 70-minute limit for this repetitive dive. This repetitive dive of 50-minute is equivalent to a single 12 m dive of 120 - 21 = 99 minutes (i.e. 21 min. shorter than the single dive NDL of 120 minutes). Your equivalent time underwater is approximately 99 + 1 + 3 = 103 minutes.

2 To find your RG after the dive enter Table 1 at 12 m and move to the right until finding the time underwater of 103 minutes. Taking 110 minutes and moving down you get an RG of J.

Example 5.

Before a repetitive dive your RG is A. You had planned to dive to 30 m for 17 minutes as allowed, but after 15 minutes you notice that you have to 33 m. A glance at Table 3 shows that you were only allowed 12 minutes at this depth, so you have overstayed the 33 m limit by 3 minutes. What decompression is necessary?

1 This repetitive dive of 12 minutes at 33 m is equivalent to a single dive of 15 + 3 = 18 minutes (i.e. 3 minutes longer than the NDL for 33 m).
2 Turn to Table 4 and enter from the left at 33 m. Moving right the decompression is found to be 8 minutes at 3 m and the RG after the dive is I.

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