U.S. NAVY EXPERIMENTAL DIVING UNIT
U.S. NAVAL GUN FACTORY
WASHINGTON,25, D.C.

25 SEPTEMBER 1950

COMPUTATION OF HELIUM-OXYGEN DECOMPRESSION TABLES

REPORT NO. 7-50

AD 609-257

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SUB-TASK 4

REPORT NO. 7-50

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INTRODUCTION

The following example is computed by the method followed in the Helium-Oxygen Decompression tables, Revised 1950. The original tables employed oxygen at 60 and 50 feet. In order to reduce the incidence of oxygen toxicity, the oxygen stops have been moved up to 50 and 40 feet. Otherwise, the computation methods of the authors of the original tables, Rear Admiral C. B. Momsen, U.S. Navy, and Captain K. R. Wheland, U.S. Navy, have been followed.

The tables are computed to the nearest foot - less than 0.5 is dropped, 0.5 or more is considered an additional foot.

When computing the time of the final stop, any fraction of a minute is considered an additional minute.

At stops other than the final stops, the saturation loss of the controlling tissue governs. Whether or not to consider a fraction of a minute must be determined by inspection. This last step is necessary because tissue loss is rounded off to the nearest foot.

A complete understanding of the "Time Unit" and its relationship is the "Percentage Factor of Saturation and Desaturation" is essential. This is covered in the explanation of Table II in the appendix.

For the definition of "Partial Pressure", see the explanation of Table 1.

Any questions concerning the computation should be referred to Commander G. G. Molumphy, U.S. Navy.

PART A

SATURATION OF ALL TISSUES FOR TIME OF DIVE

Partial Pressure, 310 feet
Time of Dive, 10 minutes
(283 ⁄27) 10 min. time of dive (20 min. elasped time)

1 TISSUE	2 % SAT.	3 SAT. EFF.	4 PP INC.	5 PP AIR	6 TOTAL PP
5	93.7	283	265	27	292
10	75	283	212	27	239
20	50	283	142	27	169
30	37	283	105	27	132
40	29.3	283	83	27	110
50	24.2	283	68	27	95
60	20.6	283	58	27	85
70	18	283	51	27	78

COL 1 Tissues considered in Helium-Oxygen Diving.

COL 2 Percentage saturation of the tissues after a 10 minute work dive, taken from Table II A. In computing the tables, all dives are considered work dives, and the time is doubled. Thus, a decompression table for a ten minute dive is computed for a 20 minute time interval. Time of Dive is the total time from leaving the surface to leaving the bottom.

COL 3 Partial Pressure Increase Saturation Effect, or PP of dive minus 27 feet. The body is saturated with nitrogen upon leaving the surface, considered to be at sea level, or one atmosphere, absolute. As the oxygen content of air is about 21 percent, the partial pressure of the inert gases in the air amount to 33 x 1.00 - (.21 - .02) or, 33 X 81%, or 26.73 feet, which carried to the nearest foot, is 27 feet. See equation for Table I.

This figure, subtracted from the total Partial Pressure of the decompression table, will give the total increase of Partial Pressure of inert gases or "Partial Pressure Increase Saturation Effect", exerted on the diver while on the bottom.

For any particular dive, the Partial Pressure Increase Saturation Effect may be determined as follows:

(a) Assume a depth of 300 feet, and a 77 - 23 percent Helium-Oxygen Mix.

(b) Substituting in the formula P.P. Inc. Sat. Eff.

= D 1.00 - (02% - .02)

= 300 1.00 - (.23 -.02)

= 300 (1.00 - .21)

= 300 X .79

= 237

A 2 percent oxygen loss is assumed.

(c) The total P.P. of the dive will be (237 ≠ 27), or 264 feet.

COL 4 Product of columns 2 and 3.

COL 5 Partial Pressure of all other gases (AOG) except oxygen in air at atmospheric pressure. For computation, see Note 3 above.

COL 6 The sum of columns 4 and 5, or the total PP of AOG in the various tissues after a 10 minute work dive.

PART B

TIME TO FIRST STOP

The "Time to First Stop" is based upon the below listed factors, which in turn, are explained in the following similiarly numbered sections:

1. The maximum depth possible with the given PP.
2. The oxygen percentage required for the maximum depth.
3. The depth of the first stop for the 10 minute time of dive.
4. Table of Rate of Ascent (Table III).

SECTION 1

The maximum depth of a dive with any given Partial Pressure Decompression Table depends upon the oxygen content of the gas being used. The greater the oxygen percentage, the deeper a diver can go on a given table. This is evident from the definition of Partial Pressure as expressed in the formula of Table I.

However, because of its toxic properties, the partial pressure of oxygen is limited to 2.3 atmospheres effective or 76 feet. To determine the maximum depth with a given partial pressure and a given value of effective oxygen, substitute in the following formula:

$$\text{Depth (MAX)} = \frac{(\text{PP AOG} \not{/} \text{PP 02})}{1.02} - 33$$

The factor of 1.02 compensates for the assumed 2 percent oxygen loss in the computation of partial pressure.

Thus, to determine the maximum depth with any given Partial Pressure Decompression Table, substitute in the above formula, using the maximum oxygen PP permissable, or 76 feet.

In the example being computed, the maximum depth is:

$$\text{D (MAX)} = \frac{(310 \not{/} 76)}{1.02} - 33$$

$$= \frac{386}{1.02} - 33$$

$$= 378 - 33$$

$$= 345 \text{ feet}$$

SECTION 2

The maximum percentage of oxygen for any depth is determined by the following formula:

$$02\%(\text{Max}) = \frac{(2.3 \times 33) \text{ or } 76}{D \text{ (gauge)} \neq 33}$$

Using the maximum depth for a PP or AOG of 310, as determined above, the maximum oxygen $= \frac{76}{345 \neq 33}$

$$= \frac{76}{378}$$

$$= 20.1 \% 02$$

SECTION 3

It has been determined that bubble formation will not occur if the maximum PP of AOG in the most highly saturated tissue, called the "Controlling Tissue", is not allowed to exceed 1.7 times the absolute depth of the stop. Referring to column 6 of the computations in part A, it is seen that the Controlling Tissue is the 5 minute tissue with a total PP of 292 feet. Maintaining the 1.7 to 1 ratio the indicated, or "First Trial First Stop", $= \frac{292}{1.7} - 33$

$$= 172 - 33$$

$$= 139$$

As only even 10 foot marks are used in decompression, the First Trial First Stop will be 140 feet.

This stop may be determined by inspection from Table VI. Enter column 6 of the table with the total PP of the controlling tissue, and unless it falls on a tabulated value, read off the depth in column 1 corresponding to the next higher tabulated value.

With the values determined above enter Table III and computed "Time to First Stop".

Depth - 345

Trial 1st Stop - 140

02% - 20

345 - 200 $\frac{145}{75}$ 1.93

200 - 150 $\frac{50}{50}$ 1.00

150 - 140 $\frac{10}{40}$ .25

3.18, or 4 minutes

This is the minimum time for the ascent from bottom to the First Trial Stop. To provide adequate time for the diver to get on the stage, which with favorable sea conditions is frequently lowered half way from the first stop to the bottom, an additional minute is added. Thus, the "Time to First Stop" will be 5 minutes. For uniformity, all times to first stop for any given partial pressure table are the same, although the depth of the first stop for longer exposures may be 30 or 40 feet deeper than that for the 10 minute exposure.

PART C

CHECK OF FIRST TRIAL FIRST STOP AND DETERMINATION OF SECOND TRIAL FIRST STOP

The changes in tissue saturation during the ascent from the bottom to the first stop are of considerable magnitude. They are computed, using the "Time to First Stop" and the average partial pressure between the maximum depth possible and the first stop.

For all stops following the first, this is not done, and the time of ascent between stops as determined from Table III is included in the subsequent stop.

140 - 230 - 5

1 TISSUE	2 PP	3 AV PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
5	292	230	-62	50	-31	261
10	239	230	- 9	29.3	- 3	236
20	169	230	≠61	15.8	≠10	179
30	132	230	≠98	10.8	≠11	143
40	110	230	≠120	8.3	≠10	120
50	95	230	≠135	6.6	≠ 9	104
60	85	230	≠145	5.5	≠ 8	93
70	78	230	≠152	4.8	≠ 7	85

COL 2 PP AOG in tissues upon leaving the bottom - from Section A, Column 6.

COL 3 Average PP exerted on the diver during the ascent from the bottom to the first stop:

PP at bottom 310
PP at 140 feet 149 (Table IV column 2)

$$\text{Average PP } \frac{459}{2} = 229.5 \text{ Use } 230$$

As stated in the explanation of Table IV, Column 2, a 14 percent, effective, oxygen content is assumed for all published decompression tables. This assumption provides a safety factor when the mixture used contains more than 16 percent oxygen, and permits the use of a single decompression schedule for each time of dive for a particular partial pressure.

COL 4 Difference between columns 2 and 3. A minus value indicates that the tissue will desaturate, a plus that it will saturate.

COL 5 From Table II B.

COL 6 Product of columns 4 and 5.

COL 7 Sum of columns 2 and 6, or saturation of all tissues upon reaching the First Trial First Stop.

The desaturation of the 5 minute tissue during the 5 minute ascent from the bottom is considerable, and it may be that the first stop can be shallower without exceeding the established 1.7 to 1 Ratio.

Upon arriving at 140 feet, the 5 minute tissue is still the controlling tissue. Determine the Second Trial First Stop as follows:

$$\frac{\text{(Saturation of Controlling Tissue)}}{1.7} - 33$$

$$5 \text{ Tissue} = \frac{261}{1.7} - 33$$

$$= 154 - 33$$

$$= 121, \text{ use } 130 \text{ feet}$$

As previously shown the Second Trial First Stop may be determined by inspection from table IV, Column 6.

PART D

CHECK OF SECOND TRIAL FIRST STOP AND DETERMINATION OF THIRD TRIAL FIRST STOP

130 - 225 - 5

1 TISSUE	2 PP	3 AV PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
5	292	225	-67	50	-34	258
10	239	225	-14	29.3	- 4	235
20	169	225	≠56	15.8	≠ 9	178

COL 1 The 5 minute tissue controls. The 10 and 20 minute tissues are included only to show the relative changes taking place during the time of ascent.

COL 2 PP in tissues upon leaving bottom, from Section A, Column 6.

COL 3 Average PP exerted on the diver during ascent from bottom to 130 feet.

PP at bottom 310
PP at 130 140 (Table IV Column II)

$$\text{Average PP} \quad \frac{450}{2} = 225$$

COL 4 Difference between columns 2 and 3.

COL 5 From Table II B.

COL 6 Product of columns 4 and 5.

COL 7 Sum of columns 2 and 6.

To check the Second Trial First Stop, divide the controlling tissue saturation by the governing ratio.

$$5 \text{ Tissue} = \frac{258}{1.7} - 33$$

$$= 152 - 33$$

$$= 119 \quad \text{Use 120 feet}$$

Thus, the diver may be brought to 120 feet, the Third Trial First Stop. An inspection of Table III shows that 5 minutes is adequate for the time of ascent.

PART E

CHECK OF THIRD TRIAL FIRST STOP, DETERMINATION OF FIRST STOP, AND COMPUTATION OF CHANGES IN THE TISSUE SATURATION BETWEEN BOTTOM AND FIRST STOP

120 - 221 - 5

1 TISSUE	2 PP	3 AV PP	4 DIFF PP	5 % SAT	6 PP CHANGES	7 FINAL PP
5	292	221	-71	50	-36	256
10	239	221	-18	29.3	- 5	234
20	169	221	≠52	15.8	≠ 8	177
30	132	221	≠89	10.8	≠10	142
40	110	221	≠111	8.3	≠ 9	119
50	95	221	≠126	6.6	≠ 8	103
60	85	221	≠136	5.5	≠ 7	92
70	78	221	≠143	4.8	≠ 7	85

The 5 minute tissue controls, with a final PP of 256. From an inspection of Table IV, Column 6, it is seen that the first stop cannot be less than 120 feet without exceeding the 1.7 to 1 ratio of tissue saturation to surrounding pressure. Thus, 120 feet is the first stop.

PART F

THE FIRST STOP - 120 FEET

The length of the first stop is routinely 7 minutes unless more time is required.

120 - 132 - 7

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
5	256	132	-124	62.1	-77	179
10	234	132	-102	38.4	-39	195
20	177	132	- 45	21.5	-10	167
30	142	132	- 10	14.9	- 1	141
40	119	132	≠ 13	11.4	≠ 1	120
50	103	132	≠ 29	9.2	≠ 3	106
60	92	132	≠ 40	7.8	≠ 3	95
70	85	132	≠ 47	6.6	≠ 3	88

COL 2 From Final PP, Section E.

COL 3 From Table IV, Column 2.

PART G

THE SECOND STOP - 90 FEET

90 - 106 - 1

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
5	179	106				
10	195	106	-89	6.6	- 6	189
20	167	106	-61	3.4	- 2	165
30	141	106	-35	2.2	- 1	140
40	120	106	-14	1.7	0	120
50	106	106	0	1.3	0	106
60	95	106	⁄11	1.1	0	95
70	88	106	⁄18	.9	0	88

COL 2 The 10 tissue is more highly saturated than the 5 tissue and is now the controlling Tissue. The 5 tissue may be dropped from all future computations.

COL 3 To determine the depth of the second stop, remembering that the 1.7 to 1 ratio must be observed, divide the saturation of the controlling Tissue by 1.7 and subtract 33 feet.

$$\text{Thus, 10 Tissue} = \frac{195}{1.7} - 33$$

$$= 115 - 33$$

$$= 82 \text{ feet} - \text{Use } 90$$

COL 5 Stops subsequent to the second will be made at each 10 foot depth. The diver must remain at 90 feet, the second stop, until the saturation of the controlling tissue is within the 1.7 to 1 ratio of the 80 foot stop.

10 Tissue	195	(Final PP, Section F)
1.7 Ratio of 80 feet	192	(Table IV Column 6)
Difference	3	

Thus the diver must remain at this stop until the 10 tissue looses 3 feet. From column 4 above, the difference in PP between the 10 minute tissue and the PP of the 90 foot stop is - 89 feet. Therefore, the percentage of the Difference in PP to be lost, or the "Percentage Factor of Desaturation" is 3/89, or 3.37%.

The relationship of the Percentage Factor of Saturation or Desaturation to the Time Unit and to the Time Interval is described in the explanation of Table II. It may be restated as follows:

The Percentage Factor of Saturation or Desaturation is a function of the Time Unit. The Time Unit equals the Time Interval divided by the Tissue Time.

Enter Table II with the Percentage Factor of Desaturation computed above, 3.37%, use 3.4% and determine the corresponding Time Unit - 0.05.

$$\text{Since, Time Unit} = \frac{\text{Time Interval}}{\text{Tissue Time}}$$

Time Interval = Time Unit X Tissue Time or

= 0.05 X 10

= 0.5 minutes. Use 1

The length of the stop may also be determined by inspection from Table II B. Enter the 10 minute tissue line with the Percentage Factor of Desaturation, 3.4 percent. The next higher percentage is 6.6 in the 1 minute column.

PART H

THE THIRD STOP - 80 FEET

80 - 97 - 3

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
10	189	97	-92	18.7	-17	172
20	165	97	-68	9.8	- 7	158
30	140	97	-43	6.6	- 3	137
40	120	97	-23	5	- 1	119
50	106	97	- 9	4	0	106
60	95	97	≠ 2	3.4	0	95
70	88	97	≠ 9	2.9	0	88

COL 2 The 10 tissue controls.

COL 5 The controlling tissue has 189 feet of inert gas. It must lose until it is within 1.7 times the absolute depth of the next, 70 foot, stop.

10 Tissues = 189

(70 ≠ 33) X 1.7 = $\frac{175}{14}$ (or From Table IV Column 6)

Difference

Percentage Factor of Desaturation = 14/92 = 15.2%
From Table II 15.2% = .238 Time Units
0.238 X 10 = 2.38 Use 3 minute for time of Third Stop

On, entering table II B on the 10 minute tissue line, find the next higher percentage in the 3 minute column.

PART I

THE FOURTH STOP - 70 FEET

70 - 89 - 3

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
10	172	89	-83	18.7	-16	156
20	158	89	-69	9.8	- 7	151
30	137	89	-48	6.6	- 3	134
40	119	89	-30	5	- 2	117
50	106	89	-17	4	- 1	105
60	95	89	- 6	3.4	0	95
70	88	89	≠ 1	2.9	0	88

COL 2 The 10 tissue still controls.

COL 5 10 tissue - 172 172
1.7 (60 ≠ 33) 158 (From Table IV Column 6)
14

% Factor of Desaturation = 14/83 = 16.86% - .26 Time Units
.26 X 10 = 2.6 - Use 3 minutes

PART J

THE FIFTH STOP - 60 FEET

60 - 80 - 5

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
10	156	80	-76			
20	151	80	-71	15.8	-11	140
30	134	80	-54	10.8	- 6	128
40	117	80	-37	8.3	- 3	114
50	105	80	-25	6.6	- 2	103
60	95	80	-15	5.5	- 1	94
70	88	80	- 8	4.8	0	88

COL 5 As the saturation of the 10 and 20 minute tissue are nearly equal both should be considered in determining the length of this stop.

10 T		20 T	
156		151	
141		141	
15	= 19.73%	10	= 14.0%
76		71	
= .318 Time Units		= .22 Time units	
10 X .318 - 3.18		20 X .22 = 4.4	
use 4 minutes		use 5 minutes	

Thus, the 20 tissue is now controlling.

The 10 tissue may be dropped from the computations.

PART K

THE SIXTH STOP - 50 FEET

At 50 feet, the gas supply is shifted to oxygen, and the diver ventilates 25 cubic feet to clear the hose and helmet of the helium-oxygen mixture. The time of this stop is a minimum of 10 minutes and for computation purposes is divided into two periods. During the first three minutes, the breathing medium is considered to be helium-oxygen and during the remainder of the stop, oxygen. As an additional safety factor, the oxygen is considered to contain 20 percent inert gas. When surface decompression is employed, this safety feature compensates for any slight leakage of air into the oxygen mask while at the recompression chamber stops.

50 - 71 - 3

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
20	140	71	-69	9.8	-7	133
30	128	71	57	6.6	-4	124
40	114	71	43	5	-2	112
50	103	71	32	4	-1	102
60	94	71	23	3.4	-1	93
70	88	71	17	2.9	-0	88

COL 3 Helium-oxygen is considered to be the breathing medium during this period.

50 - 17 - 7

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP	5 % SAT	6 PP CHANGE	7 FINAL PP
20	133	17	-116	21.5	-25	108
30	124	17	-107	14.9	-16	108
40	112	17	- 95	11.4	-11	101
50	102	17	- 85	9.2	- 8	94
60	93	17	- 76	7.8	- 6	87
70	88	17	- 71	6.6	- 5	83

COL 3 The breathing medium is considered to be 80 percent oxygen and 20 percent inert gas during this period.

COL 7 The 20 tissue may be dropped.

PART L

THE LAST STOP - 40 FEET

40 - 15 - 52

1 TISSUE	2 PP	3 STOP PP	4 DIFF PP
30	108	15	-93
40	101	15	-86
50	94	15	-79
60	87	15	-72
70	83	15	-68

COL 1 The 20 tissue may be dropped.

COL 5 The surface is considered to be sea level, or 33 feet, absolute. Thus, all tissues must lose at this stop until they are within (1.7 X 33) or 56 feet.

Tissues	30	40	50	60	70
PP	108	101	94	87	83
Limiting PP	56	56	56	56	56
PP Loss	52	45	38	31	27
Diff PP	93	86	79	72	68
% Sat	55.91	52.32	48.10	43.05	39.70
Time Unit	1.183	1.07	.948	.815	.73
Tissue Time	30	40	50	60	70
Time Interval	35.4	42.8	47.4	48.9	51.1

The 70 tissue controls, and the time of the stop is 52 minutes.

PART M

The completed decompression table is as follows:

PARTIAL PRESSURE 310 FEET
TIME OF DIVE 10 MINUTES

TO FIRST STOP	MINUTES
*120	5
90	7
80	1
70	3
60	3
50	5
40	10
	52

*Take one extra minute between the first and second stop.

The time of ascent, except from the bottom to the first stop, which is tabulated in the decompression schedule, is included in the time of the subsequent stop and is dependent upon the rate of ascent as given in Table III.

The distance from the First Stop to the Second Stop is 30 feet. With a low percentage of oxygen in the diver's gas supply, the ascent could not be made within the one minute provided for in the decompression table without exceeding the rate of ascent as given in Table III. For this reason, one minute is added to the time of the 90 foot stop. This additional minute is not included in the computations of the 90 foot or subsequent stops.

In the example computed, the 50 foot stop is 10 minutes. This period is composed of the following listed three intervals:

1. The time of ascent from 60 to 50 feet.
2. The time required to ventilate 25 cubic feet of oxygen.
3. The time on closed circuit breathing oxygen.

The last minute of the 40 foot stop is used to surface the diver.

Surface decompresion procedure is as follows:

1. Give tabulated decompression to and including the 50 foot stop.

2. Take the diver to 40 feet and remain for a period equal to the 50 foot stop.

3. Surface the diver in 1 minute.

4. Undress the diver and take him to 40 feet in the recompression chamber as quickly as possible. The maximum time allowed from the 40 foot water stop to the 40 foot chamber stop is 5 minutes.

5. Keep the diver in the chamber for the tabulated length of the 40 foot stop.

6. Surface the diver during the last 5 minutes of the stop at a uniform rate.

APPENDIX

TABLE I - PARTIAL PRESSURE

EXPLANATION

Helium-Oxygen decompression tables used are based on the pressure exerted by the inert gases in the diver's breathing mixture. The pressure is called the "Partial Pressure of all other Gases except Oxygen". It is referred to as "PP AOG", or simply as "Partial Pressure", and is usually expressed in terms of feet of salt water.

In any mixture of gases, the partial pressure exerted by a given gas is equal to the total pressure multiplied by its percentage of the total. Thus, in a mixture composed of 80 percent helium and 20 percent oxygen at a depth of 100 feet, the partial pressure of the helium would be 80 feet.

CONSTRUCTION

$$PP = (D \neq 33)\ 1.00 - (P - 0.02)$$

Where PP = Partial Pressure

D = Depth, gauge

P = Percentage of Oxygen in Mixture

A 2 percent oxygen loss is assumed.

EXAMPLE:

Depth, gauge = 380 feet

Mixture used = 83% Helium, 17% Oxygen

Substituting in formula above:

$$PP = (380 \neq 33)\ 1.00 - (0.17 - 0.02)$$

$$= 413\ (1.00 - 0.15)$$

$$= 413 \times .85$$

$$= 351.05$$

$$= 351 \text{ Feet}$$

USE

To determine the partial pressure decompression table to be used, enter the table with the depth of water, gauge, and the oxygen percentage of the mixture. Interpolate both in depth and oxygen percentage.

EXAMPLE:

Depth, gauge = 297 feet

Oxygen percentage = 20

	19	20	21
290	268	265	262
297		270.6	
300	276	273	270

OR

	19	20	21
290	268		262
297	273.6	270.6	267.6
300	276		270

The Partial Pressure of the dive is 270.6, use the 280 partial pressure table.

It is usually quicker to determine partial pressure from the formula given in the proceeding section.

$$\text{Depth} = \begin{array}{r} 297 \\ +33 \\ \hline 330 \end{array} \qquad \text{Percent } 02 - 2 = \begin{array}{r} 100 \\ -18 \\ \hline 82 \end{array} \qquad \begin{array}{l} \\ \\ \text{X} \end{array} \qquad = 270.6$$

TABLE I TABLE OF PARTIAL PRESSURES

02 PERCENTAGE OF He02 MIXTURE IN USE

DEPTH	13	15	17	19	21	23	25
40	65	64	62	61	59	58	56
50	74	72	71	69	67	66	64
60	83	81	79	77	75	73	72
70	92	90	88	85	83	81	79
80	101	98	96	94	92	89	87
90	109	107	105	102	100	97	95
100	118	116	113	110	108	105	102
110	127	124	122	119	116	113	110
120	136	133	130	127	124	121	118
130	145	142	139	135	132	129	126
140	154	151	147	144	140	137	133
150	163	159	156	152	148	145	141

TABLE OF PARTIAL PRESSURE

TABLE I (CONT)

02 PERCENTAGE OF He02 MIXING IN USE

DEPTH	13	15	17	19	21	23	25
160	172	168	164	160	156	152	149
170	181	177	173	168	164	160	156
180	190	185	181	177	173	168	164
190	198	194	190	185	181	176	172
200	207	203	198	193	189	184	179
210	216	211	207	202	197	192	187
220	225	220	215	210	205	200	195
230	234	229	224	218	213	208	203
240	243	238	232	227	221	216	210
250	252	246	241	235	229	224	218
260	261	255	249	243	237	231	226
270	270	264	258	251	245	239	233
280	279	272	266	260	254	247	241
290	287	281	275	268	262	255	249
300	296	290	283	276	270	263	256
310	305	298	292	285	278		
320	314	307	300	293	286		
330	323	316	309	301	294		
340	332	325	317	310	302		
350	341	333	326	318	310		
360	350	342	334	326	318		
370	359	351	343	334	326		
380	368	359	351	343	335		
390	376	368	360	351			
400	385	377	368	359			
410	394	385	377	368			
420	403	394	385	376			
430	412	403	394	384			
440	421	412	402				
450	430	420	401				
460		429	419				

TABLE II - THE PERCENTAGE FACTOR OF SATURATION AND DESATURATION AS A FUNCTION OF THE TIME UNIT

EXPLANATION

In Helium-Oxygen diving, the Tissues used are the 5, 10, 20, 30, 40, 50, 60, and 70 minute tissues. "Tissue Time" is the number of minutes required for the particular tissue to half saturate or to half desaturate. For example, the 10 minute tissue will become 50 percent saturated in 10 minutes, 75 percent saturated in 20 minutes, and 87.5 percent saturated in 30 minutes.

(A) To determine the percentage of saturation or desaturation for a given tissue during a given period of time, first determine the "Time Units" involved as follows:

$$\text{Time Units} = \frac{\text{Time Interval}}{\text{Tissue Time}}$$

Assume a Time of Dive 40 (80) minutes and determine the Time Units for the 10, 40, and 70 minute tissues.

10 Minute Tissue

$$\text{Time Units} = \frac{80}{10}$$

$$= 8 \text{ Time Units}$$

40 Minute Tissue

$$\text{Time Units} = \frac{80}{40}$$

$$= 2 \text{ Time Units}$$

70 Minute Tissue

$$\text{Time Units} = \frac{80}{70}$$

$$= 1.1428 \text{ Time Units}$$

(use 1.14)

(B) To determine the percentage factor of saturation or desaturation for the 10, 40, and 70 minute tissues for an Exposure Time of 80 minutes, enter Table II with the Time Units as determined in A above.

Tissue	Time Units	Percentage
10	8	100
40	2	75
70	1.143	54.5 + (0.3 X 0.3) - 54.49 or 54.6

The relationship may be expressed as follows:

"Time Interval" divided by "Tissue Time" equals "Time Units". "Time Units" is a function of the "Percentage Factor of Saturation or Desaturation".

PERCENTAGE FACTOR OF DESATURATION AS A FUNCTION OF THE TIME UNIT

Time: Unit:	0	1	2	3	4	5	6	7	8	9
0.0	---	0.5	1.3	2.0	2.7	3.4	4.0	4.7	5.3	6.0
0.1	6.6	7.3	8.0	8.6	9.2	9.8	10.4	11.0	11.7	12.3
0.2	12.9	13.5	14.1	14.7	15.3	15.8	16.4	17.0	17.6	18.2
0.3	18.7	19.3	19.8	20.4	21.0	21.5	22.0	22.5	23.1	23.7
0.4	24.2	24.7	25.2	25.7	26.3	26.8	27.3	27.8	28.3	28.8
0.5	29.3	29.7	30.2	30.7	31.2	31.7	32.2	32.6	33.0	33.5
0.6	34.0	34.4	34.9	35.3	35.8	36.2	36.7	37.1	37.5	38.0
0.7	38.4	38.8	39.3	39.7	40.1	40.5	40.9	41.3	41.7	42.2
0.8	42.5	42.9	43.3	43.7	44.1	44.5	44.9	45.3	45.6	46.0
0.9	46.3	46.7	47.1	47.5	47.8	48.2	48.5	48.9	49.3	49.6
1.0	50.0	50.3	50.6	51.0	51.3	51.6	52.0	52.3	52.6	52.9
1.1	53.3	53.6	53.9	54.3	54.5	54.8	55.2	55.5	55.8	56.1
1.2	56.4	56.7	57.0	57.3	57.6	57.9	58.2	58.5	58.8	59.1
1.3	59.3	59.6	59.3	60.2	60.5	60.7	61.0	61.3	61.5	61.8
1.4	62.1	62.3	62.6	62.8	63.1	63.3	63.6	63.8	64.1	64.3
1.5	64.6	64.8	65.0	65.3	65.5	65.7	66.0	66.3	66.5	66.7
1.6	66.9	67.2	67.4	67.6	67.9	68.1	68.3	68.5	68.7	69.0
1.7	69.2	69.4	69.6	69.8	70.0	70.2	70.4	70.6	70.8	71.0
1.8	71.2	71.4	71.6	71.8	72.0	72.2	72.4	72.6	72.8	72.9
1.9	73.2	73.3	73.5	73.7	73.9	74.1	74.3	74.5	74.6	74.8
2.0	75.0	75.2	75.3	75.5	75.6	75.8	76.0	76.2	76.4	76.5
2.1	76.6	76.8	76.9	77.1	77.3	77.4	77.6	77.8	77.9	78.0
2.2	78.2	78.4	78.5	78.6	78.8	79.0	79.2	79.4	79.5	79.6
2.3	79.7	79.9	80.0	80.1	80.3	80.4	80.5	80.6	80.8	80.9
2.4	81.1	81.3	81.4	81.5	81.6	81.7	81.8	82.0	82.1	82.3
2.5	82.4	82.5	82.6	82.7	82.8	83.0	83.1	83.2	83.3	83.4
2.6	83.5	83.6	83.7	83.9	84.0	84.1	84.3	84.4	84.5	84.6
2.7	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4	85.5	85.6
2.8	85.7	85.8	85.9	86.0	86.1	86.2	86.3	86.4	86.5	86.6
2.9	86.6	86.7	86.8	86.9	87.0	87.1	87.2	87.3	87.4	87.5
3.0	87.5	87.6	87.7	87.8	87.9	88.0	88.0	88.1	88.2	88.3
3.1	88.4	88.5	88.5	88.6	88.7	88.8	88.9	89.0	89.0	89.1
3.2	89.2	89.3	89.4	89.4	89.5	89.5	89.6	89.7	89.8	89.8
3.3	89.9	90.0	90.0	90.1	90.2	90.2	90.3	90.4	90.5	90.5
3.4	90.6	90.6	90.7	90.8	90.8	90.9	90.9	91.0	91.0	91.1
3.5	91.2	91.2	91.3	91.4	91.4	91.5	91.5	91.6	91.6	91.7
3.6	91.8	91.8	91.9	91.9	91.9	92.0	92.0	92.0	92.1	92.2
3.7	92.2	92.3	92.4	92.4	92.5	92.5	92.5	92.5	92.6	92.6
3.8	92.7	92.8	92.8	92.9	92.9	93.0	93.0	93.0	93.1	93.1
3.9	93.2	93.2	93.3	93.4	93.4	93.5	93.5	93.5	93.6	93.6
4.0	93.7	93.7	93.8	93.8	93.9	93.9	94.0	94.0	94.0	94.1
4.1	94.1	94.1	94.2	94.2	94.2	94.3	94.4	94.4	94.4	94.5
4.2	94.5	94.5	94.5	94.6	94.7	94.7	94.8	94.8	94.8	94.9
4.3	94.9	95.0	95.0	95.0	95.0	95.1	95.1	95.1	95.2	95.2
4.4	95.3	95.3	95.4	95.4	95.4	95.5	95.5	95.5	95.5	95.5
4.5	95.6	95.6	95.6	95.7	95.7	95.7	95.8	95.8	95.8	95.8
4.6	95.9	95.9	95.9	96.0	96.0	96.0	96.0	96.0	96.0	96.0
4.7	96.0	96.1	96.1	96.1	96.2	96.2	96.2	96.2	96.3	96.3
4.8	96.3	96.3	96.3	96.4	96.4	96.4	96.4	96.5	96.5	96.5
4.9	96.5	96.5	96.5	96.5	96.5	96.6	96.6	96.6	96.6	96.7
5.0	96.7	96.7	96.8	96.8	96.8	96.8	96.9	96.9	96.9	96.9
5.1	97.0	97.0	97.0	97.0	97.0	97.1	97.1	97.1	97.2	97.2
5.2	97.2	97.2	97.2	97.2	97.3	97.3	97.3	97.4	97.4	97.4
5.3	97.4	97.5	97.5	97.5	97.5	97.6	97.6	97.6	97.6	97.6
5.4	97.7	97.7	97.7	97.7	97.7	97.7	97.8	97.8	97.8	97.8
5.5	97.8	97.8	97.9	97.9	97.9	97.9	97.9	97.9	98.0	98.0
5.6	98.0	98.0	98.0	98.0	98.0	98.0	98.1	98.1	98.1	98.1
5.7	98.1	98.1	98.1	98.1	98.2	98.2	98.2	98.2	98.2	98.2
5.8	98.2	98.2	98.3	98.3	98.3	98.3	98.3	98.3	98.4	98.4
5.9	98.4	98.4	98.4	98.4	98.4	98.4	98.5	98.5	98.5	98.5
6.0	98.5	98.5	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6

EXPLANATION OF TABLE II - A

Table II A, "Percentage Saturation for Times of Dives Used in Computing the Helium-Oxygen Decompression Tables, as a Function of Time", is derived from Table II. All dives in the decompression schedules are considered work dives, and are computed for twice the tabulated "Time of Dive". Thus, a 20 minute decompression schedule is based upon a 40 minute "Time of Dive". Time Unit values greater than 6.9 are considered 100 percent saturation in this table.

The method of computation is as follows:

> Assume a 20 minute Time of Dive. Use 40 minutes or double time. Computed the Time Units. Then enter Table II and determine the Percentage Factor of Saturation.

Time of Dive - 20 Minute (WORK)

Tissue	Time Unit Equation	Time Unit Value	Percentage Saturation
5	40/5	8	100
10	40/10	4	93.7
20	40/20	2	75
30	40/30	1.333	60.3
40	40/40	1	50
50	40/50	0.80	42.5
60	40/60	0.667	37
70	40/70	0.57	32.6

TABLE II A

"PERCENTAGE SATURATION FOR TIMES OF DIVES USED IN COMPUTING THE HELIUM-OXYGEN DECOMPRESSION TABLES AS A FUNCTION OF TIME"

TIME WORK / TIME REST	10 / 20	20 / 40	30 / 60	40 / 80	60 / 120	80 / 160	100 / 200	120 / 240	140 / 280
5	93.7	100	100	100	100	100	100	100	100
10	75	93.7	98.5	100	100	100	100	100	100
20	50	75	87.5	93.7	98.5	100	100	100	100
30	37	60.3	75	84.4	93.7	97.5	99	100	100
40	29.3	50	64.6	75	87.5	93.7	96.7	98.5	100
50	24.2	42.5	56.4	66.9	81.1	89.2	93.7	96.3	97.
60	20.6	37	50	60.2	75	84.4	90.1	93.7	96.
70	18	32.6	44.6	54.5	69.4	79.5	86.2	90.7	93.
80	15.8	29.3	40.5	50	64.6	75	82.4	87.5	91.
90	14.2	26.5	37	46	60.3	70.8	78.6	84.4	88.
100	12.9	24.2	34	42.5	56.4	66.9	75	81.1	85.

TIME WORK / TIME REST	160 / 320	180 / 360	200 / 400	220 / 440	240 / 480
5	100	100	100		
10	100	100	100		
20	100	100	100		
30	100	100	100		
40	100	100	100		
50	99	100	100		
60	97.5	98.5	99	100	100
70	95.8	97	98.1	99	100
80	93.7	95.6	96.7	97.8	100
90	91.5	93.7	95.4	96.5	100
100	89.2	9118	93.7	95.3	100

TABLE II B

Table II B, "Percentage Factor of Desaturation for Times Spent at Decompresison Stops other than 40 Feet as a Function of Time" is derived from Table II. The manner of computation is similar to that used in deriving from Table II A, except that actual times are used. The range of this Table covers the final stops.

TABLE II B

PERCENTAGE FACTOR OF DESATURATION FOR TIMES SPENT AT DECOMPRESSION STOPS OTHER THAN 40 FEET AS A FUNCTION OF TIME

	TIME IN MINUTES								
	1	2	3	4	5	6	7	8	9
5	12.9	24.2	34	42.5	50	56.4	62.1	66.9	71.2
10	6.6	12.9	18.7	24.2	29.3	34	38.4	42.5	46.3
20	3.4	6.6	9.8	12.9	15.8	18.7	21.5	24.2	26.8
30	2.2	4.5	6.6	8.8	10.8	12.9	14.9	16.8	18.7
40	1.7	3.4	5	6.6	8.3	9.8	11.4	12.9	14.4
50	1.3	2.7	4	5.3	6.6	8	9.2	10.4	11.7
60	1.1	2.2	3.4	4.5	5.5	6.6	7.8	8.8	9.8
70	.9	1.9	2.9	3.8	4.8	5.7	6.6	7.6	8.5
80	.7	1.7	2.5	3.4	4.2	5	5.8	6.6	7.5
90	.6	1.5	2.2	3	3.7	4.5	5.2	5.9	6.6
100	.5	1.3	2	2.7	3.4	4	4.7	5.3	6

	10	11	12	13	14	15	16	17	18	19
5	75	78.2	81.1	83.5	85.7	87.5	89.2	90.6	91.8	92.7
10	50	53.3	56.4	59.3	62.1	64.6	66.9	69.2	71.2	73.2
20	29.3	31.7	34	36.2	38.4	40.5	42.5	44.5	46.3	48.2
30	20.6	22.4	24.2	25.9	27.7	29.3	30.9	32.5	34	35.5
40	15.8	17.3	18.7	20.1	21.5	22.8	24.2	25.5	26.8	28.1
50	12.9	14.1	15.3	16.4	17.6	18.7	19.8	21	22	23.1
60	10.8	11.9	12.9	13.9	14.9	15.8	16.8	17.8	18.7	19.6
70	9.4	10.2	11.1	12.1	12.9	13.7	14.6	15.5	16.2	17.1
80	8.3	9.1	9.8	10.6	11.4	12.2	12.9	13.7	14.4	15.2
90	7.4	8.1	8.8	9.5	10.1	10.8	11.5	12.2	12.9	13.6
100	6.6	7.3	8	8.6	9.2	9.8	10.4	11	11.7	12.3

TABLE II B (Cont)

TIME IN MINUTES

	20	21	22	23	24	25	26
5	93.7						
10	75						
20	50						
30	37						
40	29.3						
50	24.2	25.2	26.3	27.3	28.3	29.3	30.2
60	20.6	21.5	22.4	23.3	24.2	25.1	25.9
70	18	18.7	19.5	20.3	21.1	21.9	22.6
80	15.8	16.6	17.3	18.1	18.7	19.5	20.1
90	14.2	14.9	15.5	16.1	16.8	17.5	18.1
100	12.9	13.5	14.1	14.7	15.3	15.8	16.4

TABLE III

RATE OF ASCENT FOR HELIUM-OXYGEN DIVING

DEPTH ASCENT BEGINS	10	15	20	25	30	35	40	45
600	50							
550	50							
500	40							
450	40	ALL OTHERS - 75 FEET PER						
400	30							
350	30	MINUTE						
300	20	50						
250	20	50						
200	10	40	50					
150	10	30	40	50				
100	10	20	30	40	50			
50	10	10	20	20	30	30	40	50

INTERPOLATE FOR 02% OF GAS

EXAMPLE Depth 325; 02% - 21.2 (Use 21%)

Rate of Ascent From 325 - 200 feet = 75 Feet per minute
" " " " 200 - 150 = 55 Feet per minute
" " " " 150 - 100 = 42 Feet per minute
" " " " 100 - 50 = 32 Feet per minute
" " " " 50 - Surface = 20 Feet per minute

TABLE IV - USEFUL TABLES

Col 1 ⁄ 7 Depth, gauge.

Col 2 The partial pressures of all other Gases except oxygen, PP AOG, in a Helium-Oxygen mixture composed of 16 percent oxygen and 84 percent helium at various depths. A 2 percent oxygen loss is assumed, leaving an effective 14 percent oxygen content. This percentage is assumed for all stops in decompression tables up to and including 410 feet of partial pressure.

Col 3 The same as Column 2 except that a 12 percent oxygen and 88 percent helium mixture is assumed.

Col 4 Depth, absolute, multiplied by 1.5.

Col 5 Depth, absolute, multiplied by 1.6.

Col 6 Depth, absolute, multiplied by 1.7. In the computation of decompression schedules up to and including 410 feet of partial pressure, tissue saturation is not permitted to exceed 1.7 times the absolute depth of any stop.

Col 8 PP AOG in a Helium-Oxygen mixture composed of 82 percent oxygen and 18 percent helium. A 2 percent oxygen loss is assumed, leaving an effective 80 percent oxygen content. This percentage is assumed for all oxygen stops.

TABLE IV

1	2	3	4	5	6	7	8
	PARTIAL PRESSURE		(D ⁄ 33) X RATIO				PP
DEPTH	14% 02 Eff	10% 02 Eff	1.5 X 1	1.6 X 1	1.7 X 1	DEPTH	80% 02 Ef
0	28	30	50	53	56	0	7
10	37	39	65	69	73	10	9
20	46	48	80	85	90	20	11
30	54	57	95	101	107	30	13
40	63	66	110	117	124	40	15
50	71	75	125	133	141	50	17
60	80	84	140	149	158	60	19
70	89	93	155	165	175	70	
80	97	102	170	181	192	80	
90	106	111	185	197	209	90	
100	115	120	200	213	226	100	
110	123	129	215	229	243	110	
120	132	138	230	245	260	120	
130	140	147	245	261	277	130	
140	149	156	260	277	294	140	
150	158	165	275	293	311	150	
160	166	174	290	309	328	160	
170	175	183	305	325	345	170	
180	183	192	320	341	362	180	

TABLE IV (CONT)

1	2	3	4	5	6	7
	PARTIAL PRESSURE		(D ≠ 33 X RATIO			
DEPTH:	14% 02 Eff	10% 02 Eff	: 1.5 X1	1.6 X 1	1.7 X1	DEPTH :
190	192	201	335	357	379	190
200	201	210	350	373	396	200
210	209	219	365	389	413	210
220	218	228	380	405	430	220
230	226	237	395	421	447	230
240	235	246	410	437	464	240
250	243	255	425	453	481	250
260	252	264	440	469	498	260
270	261	273	455	485	515	270
280	269	282	470	501	532	280
290	278	291	485	517	549	290
300	286	300	500	533	566	300
310	295	309	515	549	583	310
320	304	318	530	565	600	320

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

Officer in Charge
Navy Experimental Diving Unit
Washington, D. C. 20374

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

COMPUTATION OF HELIUM-OXYGEN DECOMPRESSION TABLES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Final

5. AUTHOR(S) *(First name, middle initial, last name)*

G. G. Molumphy

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
25 September 1950	26	0

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	EDU Evaluation Report 7-50
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT

Unlimited distribution

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY

13. ABSTRACT

The completed Decompression Schedule - Additional Minute between first and second Stop - Surface Decompression Procedure

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	W
Computation of Helium-Oxygen Decompression Tables						