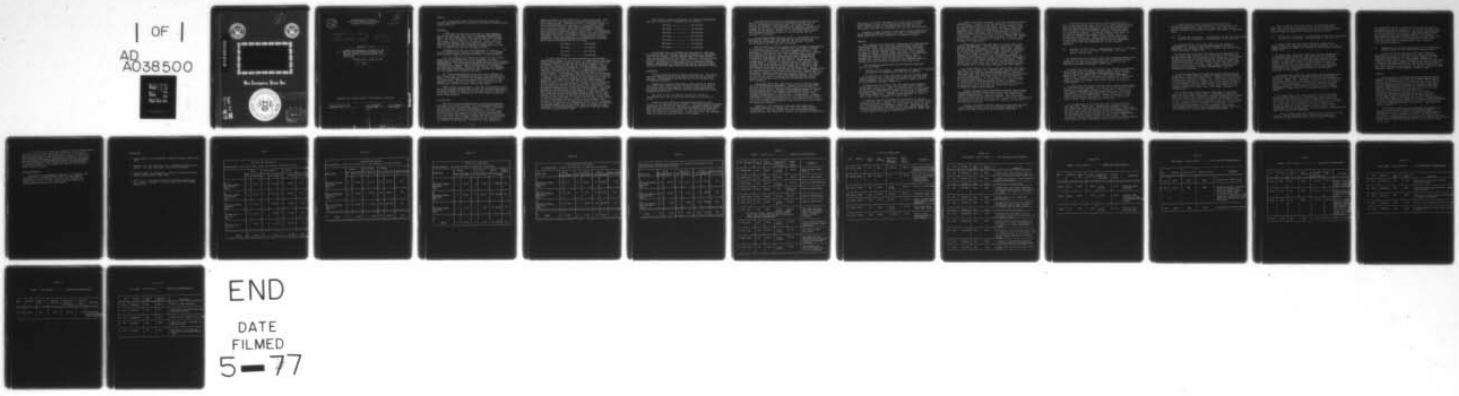
AD-A038 500 NAVY EXPERIMENTAL DIVING UNIT PANAMA CITY FLA F/G 6/19
SURFACE DECOMPRESSION, DERIVATION AND TESTING OF DECOMPRESSION --ETC(U)
1945 O VAN DER AUE, E BRINTON, R J KELLAR

UNCLASSIFIED NEDU-5-45 NL

| OF |
AD
A038500



END

DATE
FILMED
5-77

NAVY EXPERIMENTAL DIVING UNIT

DEPARTMENT OF THE NAVY
NAVY EXPERIMENTAL DIVING UNIT
PANAMA CITY, FLORIDA 32407

IN REPLY REFER TO:

(14) NEDU-5-45 (12) 28p.

REPORT NO. 5-45

(6) SURFACE DECOMPRESSION, DERIVATION AND TESTING OF DECOMPRESSION TABLES WITH SAFETY LIMITS FOR CERTAIN DEPTHS AND EXPOSURES.

PROJECT X-476 (Sub. No. 98)

(11) 1945

Approved for public release; distribution unlimited.

(10) O. E. VAN DER AUE, CDR, MC, USN
E. S. BRINTON, LT, MC, USN
R. J. KELLAR, LT, MC, USN

A

OBJECT:

(1) To test the depth and time exposure limits for surface decompression as set forth in the Bureau of Ships Diving Manual 1943. (1)

SUMMARY:

(1) A total of 282 dives were made in this project. our of the depth and time limits for surface decompression quoted in the diving manual were tested. The tables tested were - 100 feet for 85 min.; 130 feet for 55 min.; 150 feet for 38 min.; and 170 feet for 30 minutes. Work, rest, wet tank and dry chamber dives were made in these tests. Work dives in the wet tank using standard decompression were also made as controls for each of the above depths.

(2) Resulting from all dives made were 27 cases of caisson disease which required recompression and 25 cases of mild caisson disease which did not require recompression.

(3) The incidence of "bends" was higher for the control dives that were decompressed on the standard U.S. Navy Decompression Table than it was for those that were given surface decompression. Of 81 standard decompression work dives, 24.69% terminated with "bends" requiring treatment or "mild bends" not requiring treatment. Using the same tables and identical work but with surface decompression the incidence of "bends" or "mild bends" was 21.43% for 98 dives.

(4) Surface decompression work dives were followed by more "bends" and "mild bends" than surface decompression rest dives, an incidence of 21.43% for 98 work dives and 10.68% for 103 rest dives. There was no appreciable difference in the incidence of "bends" or "mild bends" resulting from the dry chamber and wet tank runs for the 100 foot table.

(5) Evidence is presented to show the relationship between the site of bends symptoms and the part of the body exercised. Localized symptoms of bends occur most frequently in that part of the body which is subjected to the most vigorous exercise while under pressure.

INTRODUCTION:

The use of surface decompression has never been popular throughout the field of diving. It was considered that this procedure greatly increased the hazard of "bends", therefore, it generally was used only for emergencies. In 1935, Hawkins and Shilling (2) did the pioneer work in this field and formulated a procedure for using surface decompression. Their procedure was to bring the diver directly to the surface at a rate of 50 feet a minute, undress him and place him into a recompression chamber within an average time interval of 3.0 minutes on the surface. Pressure was then applied to a

depth equivalent to the first stop of the original dive, from which the diver was subsequently decompressed according to the standard tables. However, the old C & R Diving Tables (3) were followed which held strictly to a decompression ratio of 2-1 for all tissues. From their experimental results, they established fixed depths and time exposure limits to which surface decompression may be safely used. In calculating the theoretical tissue saturation present on initial surfacing, they found that when the 20 minute tissues did not exceed a saturation of 145 atm "absolute", no compressed-air illness developed. They accordingly placed the following limits for which surface decompression was to be used:

100 feet.....90 minutes

150 feet.....45 minutes

156 feet.....42 minutes

162 feet.....39 minutes

In 1937, the Bureau of Ships adopted the new standard decompression tables (1) now in use. In these tables, the first stop is determined by ignoring the 5 and 10 minutes tissue and following a 2.8 to 1 ratio for the 20 minute tissue and a 2 or 1.75 to 1 ratio for the 40 and 75 minute tissues. Hence, te first stop of the new tables is at a much shallower depth than the first stop of the "old" C & R tables which followed a strict 2-1 ratio for all tissues including the 5 and 10 minute tissues. For example, a dive of 150 feet for 50 minutes in the "old" C & R tables shows the first stop to be 50 feet for 7 minutes while in the new tables the first stop is 30 feet for 16 minutes. In addition to having a first stop twenty foot deeper for this dive, the "old" tables also show a decompression time of 16 minutes longer. Because of this difference in the depth and duration of the first stops, the Bureau of Ships recommended the following procedure and time-depth limits for surface decompression in the 1943 Diving Manual. The diver ascends to the first stop in the water at a rate of 25 feet per minute and is partially decompressed at this stop for the time indicated in the appropriate stnadard table. He is then brought to the surface at the rate of 25 feet per minute where the helmet belt and shoes are rapidly removed and is then placed in the recompression chamber in the shortest possible time interval. The pressure is immediately raised to the equivalent of the first water stop and undressing of the diver is completed. The decompression time of the first stop is repeated and the ramainder of the decompression is completed in the dry chamber following the appropriate table.

The limits of depth and exposure for surface decompression are given on page 172 of reference (1) as follows:

100 feet.....85 minutes

110 feet.....75 minutes

120 feet.....60 minutes

130 feet.....55 minutes

140 feet.....45 minutes

150 feet.....40 minutes

170 feet.....30 minutes

The authors have no knowledge of any practical work ever having been done to validate the above procedure in conjunction with the new tables. Surface decompression has been used by many diving activities in the field. However, all have deviated from the standard procedure as set forth in the 1943 Diving Manual. The purpose of this project was to determine whether surface decompression is hazardous and whether the above depth and time limits are safe following the new decompression tables.

PROCEDURE:

A total of 282 dives were made in this project. The divers used the standard Navy deep sea diving dress for dives in the wet tank. Recompression was carried out in the standard Navy recompression chamber.

Twenty-five subjects were used in this project of whom 21 were first class divers and the remainder second class divers. All divers were in good physical condition with body specific gravities ranging from 1.100 to 1.054 and cardiovascular scores ranging from 51 to 81.

The water in the tank was not heated and varied in temperature from 38°F to 64°F with an average of 51°F for all dives.

Lifting weights while on the bottom was used as a form of work in the wet tank working dives. A 70 pound weight (58 pounds submerged) was lifted from the deck to a submerged bench 26 inches high 10 times each minute. This was considered to be heavy work. This type of work was carried out for the total period of time that the diver was on the bottom. In the rest dives, the subjects moved as little as possible while on the bottom.

A standard time interval of 5 minutes from the stop in the water to the first stop in the recompression chamber for all surface decompression dives was used. The ideal length of time on th surface is "the shortest time possible", however, the average time in most diving activities is approximately 3 to 4 minutes on the surface. Gouze, (4), in his work, had variable time ranges on the surface from 3.5 to 14 minutes with an average of 6.3 minutes.

Of the seven depths and time limits in the Bureau of Ships Diving Manual 1945, four were selected for our tests namely, 100 feet for 85 minutes; 130 feet for 55 minutes; 150 feet for 38 minutes and 170 feet for 30 minutes.

The 100 foot dive for 85 minutes with a standard decompression of 6 minutes at 30 feet; 28 minutes at 20 feet; and 21 minutes at 10 feet was tested first. It was thought advisable at the beginning of this project to make dry chamber runs first, having one subject work and one rest. For each five minute period, work consisted of riding a stationary bicycle equipped with a tachymeter registering the equivalent of 25 MPH for three minutes and then resting for two minutes. Decompression was accomplished at a rate of 25 feet per minute to the first stop. A first stop of 6 minutes at 30 feet was then completed. The subjects were then brought to the surface at a rate of 25 feet per minutes and allowed to remain on the surface for a period of 4 minutes total time since leaving the first stop. Recompression was then started and the 30 foot depth was again reached within one minute, making a total time of 5 minutes from the 30 foot stop of the dive to 30 feet in the recompression chamber. The first stop at 30 feet for six minutes was repeated and then decompression was completed at 20 feet for 28 minutes and 10 feet for 21 minutes.

Comparable dives were then made in the wet tank following the same decompression procedure. Weight lifting was performed while on the bottom instead of bicycle riding as was done in the dry chamber dives. Because of the high percentage of "bends" that developed from these surface decompression dives, it was thought advisable to run similar depth and time dives using standard decompression in the wet tank. Unexpectedly, a higher percentage of "bends" was encountered with standard decompression than with surface decompression dives indicating that the error was in the original decompression table and not due to the surface decompression procedure.

Because of this experience with the first table, the succeeding tables to be tested were first run using standard decompression. The dry chamber runs were eliminated leaving three runs for each table to be tested; one standard decompression

with work, one surface decompression at rest and one surface decompression at work, all three runs being made in the wet tank. Tables tested in this manner were the 130 foot for 35 minutes; 150 feet for 38 minutes and 170 feet for 30 minutes.

Gaseous nitrogen contents of the urine, blood examinations, blood pressures and pulse rates were done in conjunction with these dives and will be submitted in subsequent reports.

RESULTS:

The results of all dives were classified into three groups; those with "bends" which required recompression; those with "mild bends" which were also indicative of bubble formation but did not require recompression; and normal dives. Of the 27 cases of "bends" treated, there were only 3 who presented evidence of central nervous system involvement. The remaining 24 cases had symptoms of localized pain in one or more extremities. The 25 cases of "mild bends" which were not treated with recompression usually had mild symptoms such as a severe skin rash or fleeting transient mild joint pains.

The following detailed results were obtained from each type of dive tested.

I. 100 feet for 85 minutes. Decompression 30 feet for 6 minutes; 20 feet for 28 minutes and 10 feet for 21 minutes.

A. Twenty-two rest dives were made in the dry chamber using surface decompression. The method followed was that outlined under procedure. Of this group, one case of "bends" and four of "mild bends" developed. (Table IA).

B. Twenty-one work dives in the dry chamber using surface decompression were made. Here the subjects rode a bicycle 25 MPH for 3 minutes and rested two minutes while on the bottom. Of this group, five cases of "bends" and three of "mild bends" developed. (Table IB). Compared to the rest dives, (Table IA), this group resulted in a 19.26% greater incidence of "bends" nad a 3.90% lesser incidence of "mild bends".

C. Eighteen Standard Decompression work dives in the wet tank were then made. Weight lifting was done during these dives as described under procedure. Of this group six cases of "bends" and 3 of "mild bends" developed. (Table IC). Compared to the surface decompression work dives in the dry chamber (Table IB), this group resulted in a 9.53% greater incidence of "bends" and a 2.39% greater incidence of "mild bends".

D. Twenty work dives were made in the wet tank using surface decompression. Weight lifting was performed identically as for the standard decompression dives. Of this group 5 cases of "bends" and 1 case of "mild bends" developed. (Table ID). Compared to the standard decompression wet tank dives with identical work (Table IC), this group resulted in a 8.33% lesser incidence of "bends" and a 11.67% lesser incidence of "mild bends". Further comparison with the results from surface decompression work dives in the dry chamber (Table IB), there was a 1.20% greater incidence of "bends" and a 9.28% lesser incidence of "mild bends".

E. Twenty-one rest dives were made in the wet tank using surface decompression. Of this group, two cases of "bends" and one case of "mild bends" developed (Table IE). Compared to the standard decompression wet tank work dives (Table IC), this group resulted in a 23.81% lesser incidence of "bends" and a 11.91% lesser incidence of "mild bends". Further comparison of this group with the surface decompression wet tank work dives (Table ID), shows a 15.48% lesser incidence of "bends" and a 0.24% lesser incidence of "mild bends". Final comparison of this group with the surface decompression dry chamber rest dives (Table IA) shows a 4.98% greater incidence for "bends" and a 13.42% lesser incidence for "mild bends".

F. A grand total of 102 dives were made to test this depth and time limit. (Table IF). Summarizing, eighteen were work dives (wet) followed by standard decompression. Forty-one were work dives (wet and dry) followed by surface decompression and forty-three were rest dives (wet and dry) followed by surface decompression. Of the eighteen work dives followed by standard decompression, 50.00% resulted in either "bends" or "mild bends". This percentage is high as compared to 34.15% from work dives (wet and dry) followed by surface decompression and 18.60% from rest dives (wet and dry) followed by surface decompression.

These findings present significant evidence that surface decompression as done using this table is less hazardous than standard decompression. They also reveal that work on the bottom increases the incidence of "bends". But, the obvious conclusion that can be made from these results is that the standard decompression table for this depth and exposure is inadequate when hard work is done.

Another interesting finding made from this group of dives is the relation of the location of "bends" symptoms to the part of the body involved in the exercise prescribed.

In testing this table with all types of working dives both in the dry and wet tank, 16 cases of "bends" occurred which required recompression. (Table VI). In the dry chamber dives where the work was accomplished by riding a bicycle (cases 2 to 6 inclusive), 60% of the bends cases had localized pains in the lower extremities. In the wet chamber dives where the work was accomplished by weight lifting (cases 7 to 17 inclusive), 80.00% of the "bends" cases had localized pains in the upper extremities. These findings offer significant evidence that localized bends symptoms occur most frequently in the part of the body subjected to the most vigorous exercise.

II. 130 feet for 55 minutes. Decompression 30 feet - 13 minutes; 20 feet - 28 min.; 10 feet - 28 minutes. All dives made in the wet tank.

A. Twenty-two work dives were made using standard decompression. Weight lifting was done during these dives as described under procedure. Of this group, three cases of "bends" and one case of "mild bends" developed. (Table IIA).

B. Twenty-two work dives were made using surface decompression as described under procedure. Weight lifting was performed identically as for the standard decompression dives. Of this group no cases of "bends" and 2 of "mild bends" developed. (Table IIB). Compared to the standard decompression dives with identical work (Table IIA), this group resulted in a 13.64% lesser incidence of "bends" and a 4.55% greater incidence of "mild bends".

C. Twenty-two rest dives were made using surface decompression as described under procedure. Of this group, no cases of either "bends" or "mild bends" developed. (Table IIC). Compared to the standard decompression work dives (Table IIA), this group resulted in a 13.64% lesser incidence of "bends" and a 4.54% lesser incidence of "mild bends". Further comparison of this group with the surface decompression work dives (Table IIB) shows a 9.09% lesser incidence of "mild bends".

D. A grand total of 66 dives were made to test this depth and time limit (Table IID). Summarizing, twenty-two were work dives (wet) followed by standard decompression, twenty-two were work dives (wet) followed by surface decompression and twenty-two were rest dives (wet) followed by surface decompression. Of the twenty=two work dives followed by standard decompression 18.18% resulted in either "bends" or "mild bends". This percentage is high as compared to 9.09% from surface decompression work dives and 0.00% from surface decompression rest dives.

These findings present significant evidence that surface decompression using this table is less hazardous than standard decompression. They also reveal that work on the bottom increases the incidence of "bends" for otherwise identical dives.

III. 150 feet for 38 minutes. Decompression 20 feet for 28 minutes; 10 feet for 30 minutes. All dives made in the wet tank.

A. Twenty-one work dives were made using the standard decompression. Weight lifting was performed as previously described. Of the group, two cases of "bends" and two of "mild bends" developed. (Table IIIA).

B. Twenty work dives were made using surface decompression as described under procedure, the first stop of 28 minutes at 20 feet being made in the water and then repeated in the chamber. Weight lifting was performed identically as for the standard decompression dives. Of this group, two cases of "bends" and two of "mild bends" developed. (Table IIIB). Here the results were consistent with the group given standard decompression. (Table IIIA), however, the total decompression time was extended by 28 minutes.

C. Twenty rest dives were made using surface decompression as above. Of this group, no cases of "bends" and one case of "mild bends" developed. (Table IIIC). Compared to the standard decompression work dives (Table IIIA), this group resulted in a 9.52% lesser incidence of "bends" and a 4.52% lesser incidence of "mild bends", Further comparison of this group with the surface decompression work dives (Table IIIB) shows a 10.00% lesser incidence of "bends" and a 5.00% lesser incidence of "mild bends".

D. A grand total of 61 dives was made made to test this depth and time limit (Table IIID). Summarizing, twenty-one were work dives (wet) followed by standard decompression, twenty were work dives (wet) followed by surface deocmpression and twenty were work dives (wet) followed by surface decompression Of the twenty-one work dives followed by standard decompression 19.04% resulted in either "bends" or "mild bends". This percentage approximates the 20.00% incidence from surface decompression work dives and is considerably higher than the 5% incidence from surface decompression rest dives.

These findings shows that surface decompression using this table is no more hazardous than standard decompression. They also confirm the opinion that work on the bottom increases the incidence of "bends" for otherwise identical dives.

IV. 170 feet for 30 minutes. Decompression 20 feet for 24 minutes; 10 feet for 27 minutes. All dives made in the wet tank.

A. Twenty dives were made using standard decompression. Weigh lifting was performed as previously described. Of this group, no cases of "bends" and 3 cases of "mild bends" developed. (Table IVA).

B. Fifteen work dives were made using surface decompression as described under procedure, the first stop of 24 minutes at 20 feet being made in the water and then repeated in the camber. W ight lifting was performed identically as for the standard decompression dives. Of this group, no cases of "bends" and one case of "mild bends" developed. (Table IVB). Compared to the standard decompression dives with identical work (Table IVA), this group resulted in a 8.33% lesser incidence of "mild bends".

C. Eighteen rest dives were made using surface decompression Of this group, one case of "bends" and one of "mild bends" developed. (Table IVC). Compared to the standard decompression work dives (Table IVA), this group resulted in a 5.555% greater incidence of "bends" and a 9.445% lesser incidence of "mild bends". Further comparison of this group with the surface decompression work dives (Table IVB) shows a 5.555% greater incidence of "bends" and a 1.115% lesser incidence of "mild bends".

D. A grand total of 53 dives was made to test this depth and time limit (Table IVD). Summarizing, twenty were work dives (wet) followed by standard decompression, fifteen were work dives (wet) followed by surface decompression and eighteen were rest dives (wet) followed by surface decompression. Of the twenty work dives followed by standard decompression, 15.00% resulted in either "bends" or "mild bends". This percentage is high as compared to 6.67% from surface decompression work dives and 11.11% rest dives.

These findings show that surface decompression using this table is no more hazardous than standard decompression. However, in this group of cases, the incidence of "bends

is unexpectedly slightly increased in the resting surface decompression dives as compared to the work dives which were otherwise identical in procedure. Individual susceptibility of the same divers during each of these dives might explain this variation from the expected results. One subject (Ati Table XII) developed "bends" from his resting dive and came out uneventfully from his working dive, both dives being made with surface decompression under identical environmental conditions.

V. Comparison of standard decompression and surface decompression with work and rest for all tables tested.

A total of 81 wet tank work dives using standard decompression were made as controls in testing these four depth and time limits. Of these, twenty subjects (24.69%) developed either "bends" or "mild bends". (Table VA). In comparison with this finding, 98 work dives (dry and wet) using surface decompression resulted in twenty-one cases (21.43%) of "bends" and "mild bends" while for 103 rest dives (dry and wet) using surface decompression, only eleven subjects (10.68%) developed "bends" or "mild bends". (Table V, B&C).

COMMENT:

This project has established the fact that the use of surface decompression is as safe as standard decompression. However, it is very significant that further work sould be done in revising the present standard decompression tables. From the results of this project, it is evident that the standard decompression prescribed is inadequate when hard work is done on the bottom particularly for dives of long duration. The standard 100 foot dive for 85 minutes resulted in the greatest number of "bends. This table theoretically brings the controlling tissue to the surface with a saturation of 73 feet absolute. It is evident that if more time were spent in decompression, to bring the controlling tissue to the surface with a saturation of 66 feet absolute thus abiding by the recognized ratio of 2 to 1 for body desaturation, the hazard of bends would be greatly reduced.

The present method for doing surface decompression as set forth in the Bureau of Ships Diving Manual 1943, appears to be safe, providing the standard decompression is sufficient. In many instances, however, the first stop in the water is undoubtedly too long and defeats the purpose for which surface decompression is employed. With many of the tables, almost half of the total decompression time is spent at the first stop.

In order to derive a safe and practical surface decompression table, an entirely new calculation would have to be made to regulate the depth and time of the first stop in the water and the subsequent stops in the recompression chamber. Utilizing oxygen during the period of recompression would greatly reduce the time spent in decompressing and further retard the hazard of bubble formation. In a future project, the Experimental Diving Unit hopes to derive such a new surface decompression table utilizing oxygen.

ACKNOWLEDGEMENTS:

The authors are indebted to Captain O. K. O'Daniel, USN and Captain A. R. Behnke,MC,USN, for their many helpful suggestions in this project. They are also indebted to Walter Squire, C. T. M. (PA) for his able assistance and supervision in carrying out this project.

REFERENCES:

1. Diving Manual, Navy Department, Bureau of Ships, Chapter XIV, 1943.

2. Hawkins, J.A. and Shilling, C.W.: Surface Decompression of Divers. U.S. Nav. Med. Bull. 34:311-317 July 1936.

3. Diving Manual, Navy Department, Bureau of Construction and Repairs, SEction XII, 3670, 1924.

4. Couze, F.J.: A Method and Study of Surface Decompression As a Routine Proceudre. U.S. Nav. Med. Bull. 42:578-580, March 1934.

TABLE I

100 Feet for 85 Minutes Decompression: 30 Ft for 6 Min; 20 Ft for 28 Min; 10 Ft for 21 Min							
	Bends		Mild Bends		Normal		
	No	Percent	No	Percent	No	Percent	TOTAL DIVES
A Surface Decomp. Dry Chamber Rest.	1	4.54	4	18.18	17	77.28	22
B Surface Decomp. Dry Chamber Work.	5	23.80	3	14.23	13	61.92	21
C Standard Decomp. Wet Tank Work	6	33.33	3	16.67	9	50.00	18
D Surface Decomp. Wet Tank Work.	5	25.00	1	5.00	14	70.00	20
E Surface Decomp. Wet Tank Rest.	2	9.52	1	4.76	18	85.72	21
F TOTAL	19	18.62	12	11.76	71	69.62	102

TABLE II.

130 Feet for 55 Min Decompression: 30 Ft for 13 Min; 20 Ft for 28 Min; 10 Ft for 28 Min.							
	Bends		Mild Bends		Normal		
TYPE DIVE	No	Percent	No	Percent	No.	Percent	TOTAL DIVES
A Standard Decomp. Wet Tank Work	3	13.64	1	4.54	18	81.82	22
B Surface Decomp. Wet Tank Work	0	0.00	2	9.09	20	90.91	22
C Surface Decomp. Wet Tank Rest	0	0.00	0	0.00	22	100.00	22
D TOTAL	3	4.545	3	4.545	60	90.91	66

TABLE III

150 Ft for 38 Minutes Decompression: 20 Ft for 28 Min; 10 Feet for 30 Minutes							
TYPE DIVE	Bends		Mild Bends		Normal		TOTAL DIVES
	No	Percent	No	Percent	No	Percent	
A Standard Decomp. Wet Tank Work	2	9.52	2	9.52	17	80.96	21
B Surface Decomp. Wet Tank Work	2	10.00	2	10.00	16	80.00	20
C Surface Decomp. Wet Tank Rest	0	0.00	1	5.00	19	95.00	20
D TOTAL	4	6.56	5	8.19	52	85.25	61

TABLE IV

170 Feet for 30 Minutes

Decompression: 20 Feet for 24 Min.; 10 Feet for 27 Minutes

TYPE DIVE	Bends		Mild Bends		Normal		TOTAL DIVES
	No	Percent	No	Percent	No	Percent	
A Standard Decomp. Wet Tank Work	0	0.00	3	15.00	17	85.00	20
B Surface Decomp. Wet Tank Work	0	0.00	1	6.67	14	93.33	15
C Surface Decomp. Wet Tank Rest	1	5.555	1	5.555	16	88.89	18
D TOTAL	1	1.89	5	9.43	47	88.68	53

TABLE V

Comparison of standard decompression and surface decompression with work and rest for all tables tested.

TYPE DIVE	Bends		Mild Bends		Normal		TOTAL DIVES
	No	Percent	No	Percent	No	Percent	
A Standard Decomp. Wet Tank Work	11	13.58	9	11.11	61	75.31	81
B Surface Decomp. Wet and Dry Work	12	12.25	9	9.18	77	78.57	98
C Surface Decomp. Wet and Dry Rest	4	3.88	7	6.80	92	89.32	103
TOTAL	27	9.57	25	8.87	230	81.56	282

TABLE VI

BENDS - 100 Ft Dives - - - - - - - - REQUIRING RECOMPRESSION

Int.	Decomp.	Wet or Dry	Rest or Work	Time From Dive to Treatment	Depth of Relief	SYMPTOMS
1. Ray.	Surf.	Dry	Rest	7 hrs 31 min	50 ft	Pain in both ankle joints.
2. Col.	Surf.	Dry	Work	80 min	50 ft	Pain in left elbow.
3. Joh.	Surf.	Dry	Work	3 hr 54 min	100 ft	Pain in left shoulder.
4. Aus.	Surf.	Dry	Work	3 hr	60-70 ft 19 min	Pain in both knees.
5. Ham.	Surf.	Dry	Work	50 min	20 ft	Pain in right knee.
6. Ski.	Surf.	Dry	Work	8 hr 32 min	10 ft	Pain in left foot.
7. Por.	Std.	Wet	Work	8 hr 29 min. (After 1/2 hr at 165 ft, did not obtain relief until 100 ft stop was reached on treatment table during decompression.	10 ft	Pain and soreness over back of right elbow in region of distal tendon-triceps.
8. Pac.	Std.	Wet	Work	1 hr 24 min	18 ft	Pain in left elbow in area of biceps tendon insection.
9. Joh.	Std.	Wet	Work	1 hr 49 min	30 ft	Soreness of both shoulders.
10. She.	Std.	Wet	Work	1 hr 33 min	32 ft	Soreness of left shoulder over deltoid region and triceps muscles.
11. Aus.	Std.	Wet	Work	2 hr 55 min	50 ft	Skin bends over thoracic area; pain in left shoulder.

TABLE VI (Continued)

Int.	Decomp.	Wet or Dry	Rest or Work	Time From Dive to Treatment	Depth of Relief	SYMPTOMS
12. Pau.	Std.	Wet	Work	1 1/2 hrs	165 ft	Rash with mottling around entire waist blurring of vision.
13. Ham.	Surf.	Wet	Work	---	25 ft	Pain in left elbow on reaching 10 ft after 23 min recompression.
14. Col.	Surf.	Wet	Work	9 hr 32 min	165 ft	Pain in right ankle.
15. Abe.	Surf.	Wet	Work	49 min	150 ft	Numbness right leg.
16. Hen.	Surf.	Wet	Work	21 hr	20 ft	Pain in right wrist, right elbow, right shoulder.
17. Aus.	Surf.	Wet	Work	11 hr 25 min	60 ft	Skin rash; pain right knee joint.
18. Pau.	Surf.	Wet	Rest	2 1/2 hr	20 ft	Pain in both shoulders and in left elbow.

TABLE VII

MILD BENDS - 100 FT DIVES - - - NOT REQUIRING RECOMPRESSION

	Int.	Decomp.	Wet or Dry	Rest or Work	SYMPTOMS
1.	Ham.	Surface	Dry	Rest	Slight pain left shoulder and rt. wrist - transient pain in left wrist
2.	Pau.	Surface	Dry	Rest	Slight pain left shoulder;transient pain rt. shoulder.
3.	Col.	Surface	Dry	Rest	Slight pain in left knee.
4.	Ati.	Surface	Dry	Rest	Slight pain left knee; transient typically located under the patella and under both sides of patellar ligament.
5.	Ple.	Surface	Dry	Work	Slight pain in rt. wrist and rt. deltoid.
6.	Col.	Surface	Dry	Work	Itching and rash over rt. shoulder girdle and top of left shoulder - transient pain rt. knee joint.
7.	Pau.	Surface	Dry	Work	Rash over arms and trunk.
8.	Hol.	Standard	Wet	Work	Soreness deltoid muscle at its insertion, same soreness in back of arm over triceps.
9.	Ham.	Standard	Wet	Work	Slight itching on volar aspect of left wrist - slight fleeting pains in left wrist joint and forearm muscles.
10.	Col.	Standard	Wet	Work	Slight pain in longitudinal arch of rt. foot anterior to heel about area of talocalcaneous joint; slight pains lateral aspect of rt. ankle joint.
11.	Col.	Surface	Wet	Work	Itching of left ankle; mild pain right knee region of fibular head.
12.	Aus.	Surface	Wet	Rest	Slight mottling of skin left waist level.

TABLE VIII

BENDS - 130 Ft DIVES - - - - - - REQUIRING RECOMPRESSION

Int.	Decomp.	Wet or Dry	Rest or Work	Time From Dive to Treatment	Depth of Relief	SYMPTOMS
1 Mey.	Std.	Wet	Work	1 hr 58 min	25 ft	Pain in right shoulder.
2 Ham.	Std.	Wet	Work	12 min	50 ft	Pain in left forearm muscles just below level of elbow.
3 Sim.	Std.	Wet	Work	2 hr 25 min	25 ft	Pain in left deltoid area.

TABLE IX

MILD BENDS - 130 Ft DIVES - - - - - NOT REQUIRING RECOMPRESSION

Int.	Decomp.	Wet or Dry	Rest or Work	SYMPTOMS
1. Col.	Std.	Wet	Work	Slight pain right wrist.
2. Cun.	Surf.	Wet	Work	Fleeting pains in various joints on right side involving wrist, elbow, knee and ankle. Had headache on surfacing. Skin rash over right deltoid and upper arm (anteriorly and laterally).
3. Ham.	Surf.	Wet	Work	Slight pain in left wrist.

TABLE X

BENDS - 150 Ft DIVES - - - - - - - - - -REQUIRING RECOMPRESSION

Int.	Decomp.	Wet or Dry	Rest or Work	Time From Dive to Treatment	Depth of	SYMPTOMS
1. Den.	Std.	Wet	Work	44 min	20 ft	Dizzy, blurred vision, pale and lacked coordination in walking.
2. Ati.	Std.	Wet	Work	20 min	15 ft	Severe pain in right shoulder i subdeltoid bursa area.
3. Mey.	Surf.	Wet	Work	5 min	90 ft	Pain rt. elbow region origin brachio radialis recompression in dry chamber, th subsided to dul ache. Pain excr iating on final surfacing.
4. Ati.	Surf.	Wet	Work	3 1/2 hrs	165 ft	Pain rt. should

TABLE XI

MILD BENDS - 150 FT DIVES - - - - - NOT REQUIRING RECOMPRESSION

	Int.	Decomp.	Dry or Wet	Rest or Work	SYMPTOMS
1.	Por.	Standard	Wet	Work	Skin itch and rash over left anterior chest.
2.	Cun.	Standard	Wet	Work	Severe itching and rash over chest and abdomen.
3.	Sch.	Surface	Wet	Work	Pain in rt. wrist which disappeared in about 15 minutes.
4.	Ski.	Surface	Wet	Work	Mild pain in biceps area of rt. arm
5.	Sch.	Surface	Wet	Rest	Generalized skin itch. Pain in rt. wrist.

TABLE XII

BENDS - 170 Ft DIVES - - - - - - - REQUIRING RECOMPRESSION

Int.	Decomp.	Dry or Wet	Rest or or Work	Time From Dive to Treatment	Depth of Dive	SYMPTOMS
1. Ati.	Surf.	Wet	Rest	20 min	5 ft	Generalized pain throughout right shoulder.

TABLE XIII

MILD BENDS - 170 FT DIVE - - - - - REQUIRING RECOMPRESSION

	Int.	Decomp.	Wet or Dry	Rest or Work	SYMPTOMS
1.	Mey.	Standard	Wet	Work	Pain in right shoulder.
2.	Cun.	Standard	Wet	Work	Marbleized rash over back and anterior abdomen.
3.	Hla.	Standard	Wet	Work	Swelling of fingers of rt. hand
4.	Wil.	Surface	Wet	Work	Rash over arms, soreness rt. deltoid area.
5.	Cun.	Surface	Wet	Rest	Mild pain in rt. shoulder localized in deltoid muscle area.