

COMMERCIAL DIVING OPERATIONS

I. INTRODUCTION

Parks and Recreation employees may have to conduct underwater diving operations to perform assigned work. This regulation will establish the minimum requirements to safely perform such assigned work.

This regulation applies to all employees who are assigned to complete SCUBA diving Mode I and Mode II SCUBA operations.

II. SCOPE AND APPLICATION

This regulation will identify general methods for eliminating or controlling hazards, safeguarding divers, and for regulating diving and related support operations. Surface Supplied Air diving operations are prohibited by city employees. City SCUBA diving operations shall not exceed depths of 35 feet. For other SCUBA Operation limitations see section **X. Scuba Diving Procedures**. Fire Department personnel shall refer to their internal procedures for dive operations.

III. DEFINITIONS

- A. *Bottom Time*: The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver begins ascent.
- B. *Decompression Chamber*: A pressure vessel for human occupancy such as a surface decompression chamber, closed bell, or deep diving system used to decompress divers and to treat decompression sickness.
- C. *Decompression Sickness*: A condition with a variety of symptoms which may result from gas or bubbles in the tissues of divers after pressure reduction.
- D. *Decompression Table*: A profile or set of profiles of depth-time relationships or ascent rates and breathing mixtures to be followed after a specific depth time exposure or exposures.
- E. *Dive Team*: Divers and support employees involved in a diving operation, including the designated person-in-charge.
- F. *Diver*: An employee working in water using underwater apparatus which supplies compressed breathing gas at the ambient pressure.
- G. *Diving Mode*: A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas). Mode I – untethered buddy diving; Mode II- tethered, buddy diving; Mode II- tethered, single diver.
- H. *Hyperbaric Conditions*: Pressure conditions in excess of surface pressure.
- I. *Liveboating*: The practice of supporting a surfaced-supplied air or mixed gas diver from a vessel which is underway.

- J. *No-decompression Limits:* The depth-time of the “no-decompression limits and repetitive dive group designation table for no-decompression air dives”, U.S. Navy Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.
- K. *Treatment Table:* A depth-time and breathing gas profile designed to treat de-compression sickness.
- L. *Umbilical:* The composite hose bundle between a dive location and a diver, which supplies the diver with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions and includes safety line between the diver and the dive location.

IV. GENERAL REQUIREMENTS

A. Each diver must:

1. Be at least 18 years of age.
As part of the initial diver certification, complete a divers medical questionnaire to determine individual's fitness to dive.
2. Complete an annual test of diver physical fitness as defined by city requirements (see section IX. Training).
3. Complete and maintain diving training and certifications as defined by city requirements (see section IX. Training).

B. Safe Practices Manual

Any department involved in diving operations shall develop and maintain a Safe Practices Manual. The Safe Practices Manual shall be made available at the dive location to each dive team member. The Safe Practices Manual shall contain a copy of this regulation and a copy of the OSHA Commercial Diving Operations Standard, Subpart T. For SCUBA Diving Mode, the safe practices manual shall include the following:

- Safety procedures and checklists for diving operations.
- Assignments and responsibilities of the dive team members.
- Equipment procedures and checklists; and
- Emergency procedures for fire, equipment failure, adverse environmental conditions, and medical illness and injury.

V. REQUIRED MEDICAL EVALUATIONS

Diving activities can place a physiological strain on the human body that varies with the type and duration of underwater work being completed. Prior to engaging in diving operations, the employee shall complete the necessary portions of the Divers Medical Evaluation Questionnaire (Exhibit A). The questionnaire is used to determine if the employee is physically able to perform work and use the equipment selected. After completing the questionnaire, the employee shall drop off or mail the questionnaire to the city's preferred provider or personal physician for review. The chosen provider will evaluate the questionnaire and provide Risk and Safety with a medical opinion on the employee's ability to participate in dive operations. If an employee initially is not cleared to participate in dive operations, a follow-up medical examination will be conducted by a health care professional with the City's preferred provider or employee's personal physician that includes any tests, consultation, or diagnostic procedures that are deemed necessary to make a final determination whether or not the employee can safely participate in dive operations. It will be the employee's responsibility to schedule the follow-up medical examination. The department will cover the cost of the initial examination and follow-up medical examination (if required) only if the employee uses the city's preferred medical provider. Risk and Safety will forward results of the medical questionnaire to the employee and the dive team leader in accordance with on-site record keeping requirements.

Divers will have to complete the Divers Medical Evaluation Questionnaire at the following intervals:

- Initially, prior to participating in dive training and/or dive operations.
- At one-year intervals (annually) thereafter; and
- After any injuries, hyperbaric treatments, or any episode of unconsciousness related to diving activities. Medical removal or suspension from diving should be based on a physician written report whether the diver is medically fit or unfit for diving.

VI. DIVE TEAM RESPONSIBILITIES

Each dive team member should be assigned tasks in accordance with the employee's experience or training. Employees undergoing training should be assigned limited duties under the direct supervision of an experienced dive team member. Dive operation specific duties shall be outlined in the diving operation pre-job brief of the scuba diving checklist and dive hazard analysis form.

A. **Diver**

A qualified diver performing underwater activities relating to the dive operation. Diver responsibilities are as follows:

- Completing dive operations in accordance with the city's safe practice manual.
- Reporting to the dive team leader any issues or safety concerns related to the diving operation including report of any injuries.
- Conducting pre and post diving inspections of diving equipment.
- Conducting dive operations within his or her scope of experience and training.

B. Dive Team Leader

An appropriately qualified diver designated by the dive team as the dive team leader for each dive or series of dives. Dive team leader responsibilities are as follows:

- The dive team leader shall be at the dive location during the diving operation and shall not be stationed at another dive location.
- Managing the diving operation of the team.
- Ensuring all divers are qualified and all certifications and training are up to date for each member of the dive team.
- Preparing and reviewing the safety practices manual and pre-dive briefing and hazard analysis with the dive team.
- Ensuring the safety of the dive team and reporting any diving related injuries.
- Maintaining dive logs for the dive team.

C. Standby Diver

An appropriately qualified diver, who is part of the dive team and has the level of experience and training with the assigned diving operation. The standby diver shall have their diving gear at the dive location, setup and ready for use.

D. Dive Tender

A surface support person responsible for:

- Handling a single diver's umbilical and for maintaining voice and/or standard line signal communications.
- Monitoring surface conditions, such as weather, current, river flow, recreational vessel traffic, the public, and any other potential hazards that might disrupt or jeopardize the dive operation.

Note: Commercial SCUBA air diving with one (1) diver in the water requires a minimum of three (3) dive team members:

1. A designated person-in-charge/Dive Team Leader
2. A Standby Diver
3. Line-tended Diver

A dive tender who is a qualified diver can be the standby diver; for a three-person dive-team, the Dive Team Leader would assume tending duties when the standby diver is in the water. A Dive Team Leader also can be the standby diver, provided that: (1) he/she is a qualified diver, and (2) another dive-team member at the dive location is trained and capable of performing necessary Dive Team Leader functions while the Dive Team Leader is in the water as the standby diver.

Commercial SCUBA air diving with two (2) divers in the water requires a minimum of four (4) dive team members:

1. A designated person-in-charge/Dive Team Leader
2. A Standby Diver
3. Two Divers*

*The two (2) divers must be in continuous visual contact with each other or line-tended from the surface. Each diver requires a tending line to the surface if they are required to work against a current exceeding 1 knot.

VII. RESCUE AND EMERGENCY SERVICES

For Decompression Sickness

In case of Emergency call 911	
St. Luke's Clinic – Wound and Hyperbaric 600 N. Robbins Rd. Boise, ID 83702 (208) 489-5800	St. Luke's Clinic – Wound and Hyperbaric 3277 E. Louise Dr. Meridian, ID 83642 (208) 489-5800
St. Al's Clinic – Wound and Hyperbaric Medicine 1055 N. Curtis Road Boise, ID 83706 (208) 302-0800	St. Al's Clinic – Wound and Hyperbaric Medicine 4400 E. Flamingo Ave. #120 Nampa, Idaho 83687 (208) 302-0860
United States Coast Guard, District 13, Seattle, WA National Response Center (800) 424-8802	

VIII. USE, MAINTENANCE, AND CARE OF DIVE GEAR

Dive team members are required to use city provided dive equipment, use of personal dive equipment is not permitted. In addition to pre-dive and post-dive inspections, all diving equipment used by a diver must be professionally inspected by a qualified technician on an annual basis according to OSHA and dive industry standards and/or manufacturers' requirements. The dive team leader or designee

should use the city's current computerized maintenance management/work order system (i.e. VueWorks) to track and store preventative maintenance documentation, equipment inspection documentation, oxygen cylinder refill air sample results etc. Each item of diving life support equipment must have a unique identity (number or designation) so the results of servicing or inspection can be documented.

All dive equipment shall be stored in a manner that will prevent damage. Oxygen cylinders shall be stored in a ventilated area which is protected from excessive heat. Cylinders shall be stored in an upright position and secured to prevent accidental tip-over.

Oxygen Cylinders (Tanks)

The following maintenance is required on all cylinders:

- Rinse tanks and valves after each dive
- Hydrostatic test every five (5) years by a certified facility. Cylinder must be stamped with the date of the last hydro.
- Have an internal visual inspection at intervals not to exceed 12 months.
- Aluminum cylinders shall be visually checked for cracks in the threaded neck area annually.
- Tank valves and manifolds must be inspected and functionally tested annually and overhauled every five (5) years or more often as indicated by inspection, failure, or function test. "J" valves should be function tested annually.
- Whenever a valve is installed on a cylinder, ensure the burst disk is rated for that cylinder pressure.
- Never lubricate or allow oil or grease to get on oxygen connections. Lubricants, cleaning solvents, sealants, threading compounds, etc. shall be oxygen compatible. Refer to the city's compressed gas cylinder safety regulation (Compressed Gas 6.01e) on working with oxygen tanks.

Submersible Pressure Gauges and Consoles

Each depth gauge shall be tested or calibrated against a master reference gauge every 12 months and whenever there is a discrepancy greater than two percent (2%) of full scale between any two equivalent gauges.

IX. TRAINING

A. Each diver must:

1. While employed with the city, complete a dive course and be certified by a nationally recognized dive program and/or agency (i.e. PADI, NAUI). If an

employee has a previous dive certification; the employee must complete a dive course or have an official PADI audit completed. The Dive Team Leader will establish additional training requirements (i.e. Lock Out Tag Out) as necessary to ensure that divers are qualified to safely perform their assignment.

2. Complete a cardiopulmonary resuscitation (CPR/AED) course, comparable to American Red Cross or American Heart Association Adult CPR, and a nationally recognized first aid course. Certifications must be current at the time of dive. Additional emergency medical service training in oxygen administration is required.
3. Complete a minimum of four (4) logged dives in a twelve (12) month period with at least one dive in a six-month period. The dive must be in the mode(s) of diving for which he or she is qualified. At least one dive shall be done under the supervision of the dive team leader or designee every twelve (12) months.
4. Complete a minimum of 40 hours of diving-related training over any two year period.
5. Have the experience and/or training necessary to perform assigned tasks in a safe and healthful manner including the use of tools, equipment and systems relevant to assigned tasks.
6. One member of the dive team shall have dive rescue training and certification and it must be kept current with recommended periodic refresher training every two years. The dive team member with the rescue training and certification shall serve as the standby diver during a dive operation.
7. One member of the dive team shall have swift water rescue training and it must be kept current with any required refresher training. The dive team member with the swift water rescue training shall serve as the standby diver during a dive operation. This training is required only for diving operations in flowing water and not required for diving operations in ponds or swimming pools.
8. Have the experience and/or training regarding the assigned diving mode, diving operations and emergency procedures.

X. SCUBA DIVING PROCEDURES

Because a SCUBA diver has a limited breathing supply, does not usually have voice communication, and often is not monitored or controlled by surface-support personnel, the limits of this mode of diving are more stringent than for other diving modes. Diving procedures shall be created and covered in the Diving Safety Manual Checklist by the Dive Team Leader.

A. **Limitations**

1. SCUBA diving shall not be conducted:
 - The cleaning (dredging) or repair beneath the wave shapers air bladders, hydraulic panels, and associated underwater machinery is strictly prohibited. This work shall be completed by a contractor.
 - One hour before sunset and one hour before sunrise.
 - At depths greater than 35 feet
 - Against currents exceeding one (1) knot unless line tended
 - Ice covered water
 - Water temperatures less than 40degrees
 - In Confined Spaces

B. Dive Procedures

1. A diver-carrier reserved breathing gas supply for each diver is not required as dives will not be greater than 35 feet.
2. A standby diver shall be available while a diver is in the water
3. A diver shall be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operation.

C. Pre-dive procedures should include and cover the following:

1. Emergency Aid
2. First Aid Kit
3. Planning and Assessment
4. Hazardous Activities
5. Employee Briefing
6. Equipment Inspection
7. Warning Signal

D. Procedures During Dive should include and cover the following:

1. Water Entry and Exit
2. Communications
3. Decompression Tables
4. Dive Profiles
5. Hand-Held Power Tools and Equipment
6. Welding and Burning

- 7. Explosives
- 8. Termination of Dive

- E. Post Dive Procedures should include and cover the following:
- 1. Precautions
 - 2. Recompression Capability
 - 3. Record of Dive
 - 4. Decompression Procedure Assessment

XI. AIR DECOMPRESSION

It is the city's policy not to plan or perform decompression diving. In the event of an emergency scenario where the no-decompression limit is exceeded due to entrapment, entanglement, or any other unforeseen events, in-water decompression is permitted in order to avoid injury to the diver(s). The U.S. Navy based Standard Decompression Table shall be used to calculate decompression depths and times.

NOTE: Because of the reduced atmospheric pressure at altitude, the no-decompression limits be adjusted for dives above 1000 feet elevation.

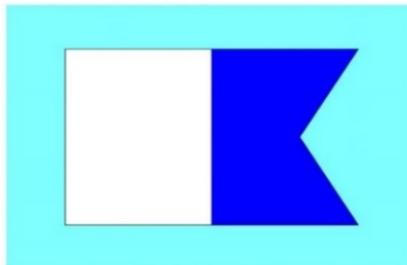
XII. REPETITIVE DIVING

Repetitive diving is a routine procedure in SCUBA. Tables shall be followed to determine a diver's repetitive group. Repetitive dives are those dives made after 10 minutes and less than 12 hours after a diver reaches surface. The diver and the dive team leader must know a diver's repetitive group at all times. When planning repetitive dives, every effort shall be made to dive deep first, then make subsequently shallower repetitive dives. United State Navy based tables should be used.

XIII. WARNING SIGNAL

When diving from surfaces other than vessels such as docks, dikes, and dams, a required warning signal shall be deployed. The warning signal shall be a ridged replica of the international code Flag A and must be at least three (3) feet in height.

International Code Flag "A": Alfa;
Diver below (when stationary);
Keep clear.



XIV. SPECIAL PRECAUTIONS

A. Physically Confined Space Diving

Confined space dives shall not be permitted.

B. Water Conditions

Dive Team Leader should verify water conditions are appropriate prior to commencing a dive operation.

C. Drift Diving

Drift diving shall not be permitted.

XV. CONTRACTOR SERVICES

If a department hires a contractor to perform work that involves a diving operation, the contractor must adhere to all local, state, and federal Commercial Diving Operation requirements. The Parks and Recreation Dive Team shall not participate in joint contractor dive operations.

XVI. RECORDS RETENTION

Record or Document	Retention Period
Safe Practices Manual	Current Document in digital Employee Policy Handbook
Depth-time profile	Until completion of the dive record; or if decompression sickness occurs during the dive, until completion of decompression procedure assessment
Dive Record	1 year; 5 years for records involving decompression sickness
Decompression procedure assessment evaluations	5 years
Equipment inspection and testing records	Current entry or tag, unless the equipment is withdrawn from service (then no retention requirement)
Hospitalization records	5 years

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APPENDICES

Appendix A: Pre and Post Dive Checklist

Appendix B: Pre-Dive Equipment Checklist

Appendix C: Pre-Dive Hazard Analysis

Appendix D: Unlimited/No Decompression Dive Tables and Repetitive Table, US Navy Table

Appendix E: Diver Hand Signal Communication

Appendix F: Altitude Correction, US Navy Sea Level Equivalent Depth

Appendix G: First Aid Kit Content Requirements

Appendix H: SCUBA Emergency Procedures

Appendix A

DIVE TEAM LEADER PRE-DIVE CHECKLIST	YES	NO	COMMENTS
Pre-dive medical checks on all divers completed? (i.e. current state of physical fitness, recent injuries or illnesses)			
Emergency procedures in place and discussed?			
First Aid Kit/AED on scene of dive operation?			
Pre-dive brief completed including the scope of dive?			
Ensure all dive equipment maintenance has been completed and up to date.			
Verify all dive tables, logs, and dive records are available for use.			
Verify all divers have all the required dive equipment and gear.			
Verify required dive flags and signals are displayed.			
Verify diving platform is stable and ready for diving.			
Verify start-up operating procedures have been completed.			
Verify Dive Tender is dressed properly.			
Verify bailout is connected properly.			
Verify Standby Diver ready.			
Verify computer time.			
Diver enter the water. Verify diver completes final in-water checks, leak check, fins, mask seal, and buoyancy.			

DIVE TEAM LEADER POST-DIVE CHECKLIST	YES	NO	COMMENTS
Diver check after exiting water.			
Divers undressed dive gear/equipment removed?			
Post Dive Briefing.			
All dive logs/records have been completed?			
Remarks:			

Dive Team Leader Signature

Date

Appendix B

PRE-DIVE EQUIPMENT CHECKLIST			
(Approved by Dive Leader)			
Buoyancy Control device (BCD)	<u>YES</u>	<u>NO</u>	COMMENTS
Check adjustment/fitment			
Low pressure inflator hose			
Air cylinder firmly attached			
Partially inflate			
Surface marker present?			
Weight	<u>YES</u>	<u>NO</u>	COMMENTS
Correct amount of weight for dive			
Proper distribution of weight			
Check weight releases. (removed in single motion)			
Releases	YES	NO	COMMENTS
Check releases are secure			
All divers inspect others releases			
Familiarize divers with all other divers' releases			
Air	YES	NO	COMMENTS
Test breathe (2-3 breaths) Reg and alternate			
Check air pressure			
Familiarize all divers with all alternate air sources			
Final Check	YES	NO	COMMENTS
Inspect buddy diver's equipment			

Dive Team Leader Signature _____ Dive Team Signatures _____
 _____ Date _____ Date _____

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Appendix C

Pre-Dive Hazard Analysis

Feature: _____ Date: _____ (Haz. Analysis)
 Dive Location: _____ Date: _____ (Examination)
 Dive Purpose: _____
 Dive Area: Lake _____ River _____ Ocean _____ Dam _____ Canal _____ Other _____
 Previous Diving in Area: _____

ITEM	NOTE	OKAY	REMARKS
Access			
Exit			
Depth Actual			
Altitude			
Depth Corrected			
Non Decom Limit			
Temperature			
Maximum BT			
Bottom Condition			
Entanglement			
Weather			
Currents			
Vertical Ascent			
Visibility Water			
Lights Required			
Video Recommended			
Camera Recommended			
Surface Support			
Special Equipment			
Team Coordination			
Dive Plan			
Emergency Equipment			
Hospital			
Physician			
Recom. Chamber			
Ambulance			
Radio/Telephone			
Diver's Experience			

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Conditions:	
Satisfactory:	
Unsatisfactory:	
Dive Team Leader	Date
RDAC Regional Safety Officer	Date
RDAC Member	Date
Dive Master	Date
Personnel:	
Hazardous Energy Control:	
Dive Plan:	

Appendix D

U.S. Navy Dive Tables (Unlimited/No Decompression)

From U.S. Navy Diving Manual, Rev. 4

Depth (feet/meters)	No-Decompression Limits (min)	Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
10	3.0	unlimited	60	120	210	300	797	*									
15	4.6	unlimited	35	70	110	160	225	350	452	*							
20	6.1	unlimited	25	50	75	100	135	180	240	325	390	917	*				
25	7.6	595	20	35	55	75	100	125	160	195	245	315	361	540	595		
30	9.1	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405	
35	10.7	310	5	15	25	40	50	60	80	100	120	140	160	190	220	270	310
40	12.2	200	5	15	25	30	40	50	70	80	100	110	130	150	170	200	
50	15.2	100		10	15	25	30	40	50	60	70	80	90	100			
60	18.2	60		10	15	20	25	30	40	50	55	60					
70	21.3	50		5	10	15	20	30	35	40	45	50					
80	24.4	40		5	10	15	20	25	30	35	40						
90	27.4	30		5	10	12	15	20	25	30							
100	30.5	25		5	7	10	15	20	22	25							
110	33.5	20			5	10	13	15	20								
120	36.6	15			5	10	12	15									
130	39.6	10			5	8	10										
140	42.7	10			5	7	10										
150	45.7	5			5												
160	48.8	5				5											
170	51.8	5				5											
180	54.8	5				5											
190	59.9	5				5											

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Table 9-7. No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives.

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	1102	20	33	47	62	78	97	117	140	166	196	236	285	354	469	992	1102
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	63	7	12	17	22	28	33	39	45	51	57	63					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	33	4	7	11	14	17	21	24	28	31	33						
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	12	2	4	6	9	11	12										
140	10	2	4	6	8	10											
150	8		3	5	7	8											
160	7		3	5	6	7											
170	6			4	6												
180	6			4	5	6											
190	5			3	5												

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Table 9-8. Residual Nitrogen Time Table for Repetitive Air Dives.

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Dive Depth	Repetitive Group at Beginning of Surface Interval															
	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

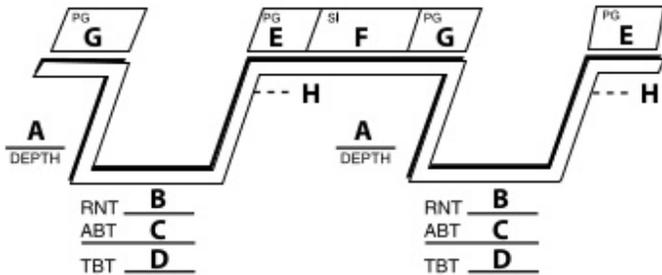
Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.



Repetitive Dive Worksheet



- A** = Depth
- B** = Residual Nitrogen Time
- C** = Actual Bottom Time
- D** = Total Bottom Time
- E** = Pressure Group Designation, Start of Surface Interval
- F** = Surface Interval Time
- G** = Pressure Group Designation, End of Surface Interval
- H** = Safety or Emergency Decompression Stop

 RNT _____ ABT _____ TBT _____			
 RNT _____ ABT _____ TBT _____			
 RNT _____ ABT _____ TBT _____			

Table 9-9. Air Decompression Table.
 (DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

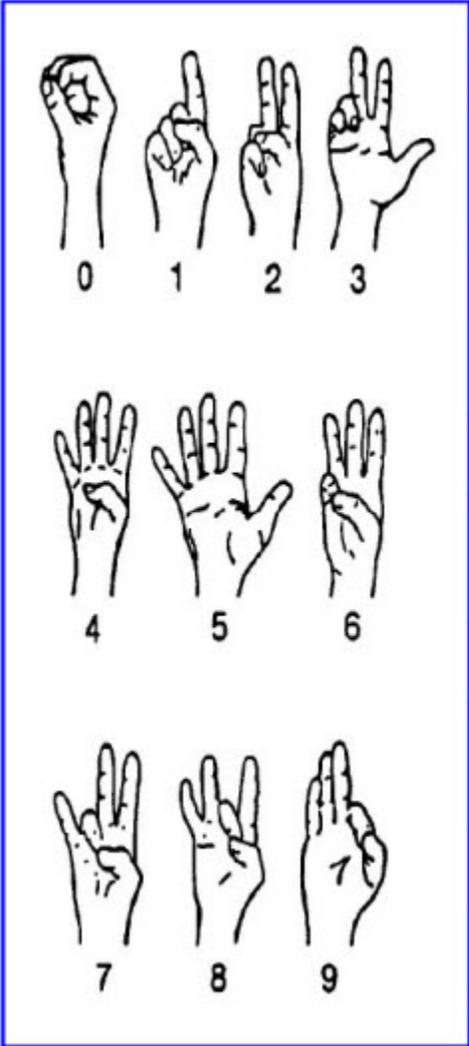
Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O ₂ stop								Total Ascent Time (M:S)	Chamber O ₂ Periods	Repet Group	
			100	90	80	70	60	50	40	30				20
30 FSW														
371	1:00	AIR									0	1:00	0	Z
		AIR/O ₂									0	1:00		
380	0:20	AIR									5	6:00	0.5	Z
		AIR/O ₂									1	2:00		
In-Water Air/O ₂ Decompression or SurDO ₂ Recommended -----														
420	0:20	AIR									22	23:00	0.5	Z
		AIR/O ₂									5	6:00		
480	0:20	AIR									42	43:00	0.5	
		AIR/O ₂									9	10:00		
540	0:20	AIR									71	72:00	1	
		AIR/O ₂									14	15:00		
Exceptional Exposure: In-Water Air Decompression ----- In-Water Air/O ₂ Decompression or SurDO ₂ Required -----														
600	0:20	AIR									92	93:00	1	
		AIR/O ₂									19	20:00		
660	0:20	AIR									120	121:00	1	
		AIR/O ₂									22	23:00		
720	0:20	AIR									158	159:00	1	
		AIR/O ₂									27	28:00		
35 FSW														
232	1:10	AIR									0	1:10	0	Z
		AIR/O ₂									0	1:10		
240	0:30	AIR									4	5:10	0.5	Z
		AIR/O ₂									2	3:10		
In-Water Air/O ₂ Decompression or SurDO ₂ Recommended -----														
270	0:30	AIR									28	29:10	0.5	Z
		AIR/O ₂									7	8:10		
300	0:30	AIR									53	54:10	0.5	Z
		AIR/O ₂									13	14:10		
330	0:30	AIR									71	72:10	1	Z
		AIR/O ₂									18	19:10		
360	0:30	AIR									88	89:10	1	
		AIR/O ₂									22	23:10		
Exceptional Exposure: In-Water Air Decompression ----- In-Water Air/O ₂ Decompression or SurDO ₂ Required -----														
420	0:30	AIR									134	135:10	1.5	
		AIR/O ₂									29	30:10		
480	0:30	AIR									173	174:10	1.5	
		AIR/O ₂									38	44:10		
540	0:30	AIR									228	229:10	2	
		AIR/O ₂									45	51:10		
600	0:30	AIR									277	278:10	2	
		AIR/O ₂									53	59:10		
660	0:30	AIR									314	315:10	2.5	
		AIR/O ₂									63	69:10		
720	0:30	AIR									342	343:10	3	
		AIR/O ₂									71	82:10		

Appendix E
 Diver Hand Signal Communication

From US Navy Dive Manual, Rev 4

	Meaning/Signal	Comment
	STOP Clenched fist.	
	SOMETHING IS WRONG Hand flat, fingers together, palm out, thumb down then hand rocking back and forth on axis of forearm.	This is the opposite of Okay. The signal does not indicate an emergency.
	I AM OKAY or ARE YOU OKAY? Thumb and forefinger making a circle with three remaining fingers extended (if possible).	Divers wearing mittens may not be able to extend three remaining fingers distinctly. Short range use.
	OKAY ON THE SURFACE (CLOSE) Right hand raised overhead giving Okay signal with fingers. OKAY ON THE SURFACE (DISTANT) Both hands touching overhead with both arms bent at 45° angle.	Given when diver is close to pickup boat. Given when diver is at a distance from the pickup boat.
	DISTRESS or HELP or PICK ME UP Hand waving overhead (diver may also thrash hand in water).	Indicates immediate aid is required.
	WHAT TIME? or WHAT DEPTH? Diver points to either watch or depth gauge.	When indicating time, this signal is commonly used for bottom time remaining.
	GO DOWN or GOING DOWN Two fingers up, two fingers and thumb against palm.	
	GO UP or GOING UP Four fingers pointing up, thumb against palm.	
	I'M OUT OF AIR. Hand slashing or chopping at throat. I NEED TO BUDDY BREATHE Fingers pointing to mouth or regulator.	Indicates signaler is out of air. Signaler's regulator may be in or out of mouth.

	Meaning/Signal	Comment
	COME HERE Hand to chest, repeated.	
	ME or WATCH ME Finger to chest, repeated.	
	OVER, UNDER, or AROUND Fingers together and arm moving in and over, under, or around movement.	Diver signals intention to move over, under, or around an object.
	LEVEL OFF or HOW DEEP? Fingers and thumb spread out and hand moving back and forth in a level position.	
	GO THAT WAY Fist clenched with thumb pointing up, down, right, or left.	Indicates which direction to swim.
	WHICH DIRECTION? Fingers clenched, thumb and hand rotating right and left.	
	EAR TROUBLE Diver pointing to either ear.	Divers should ascend a few feet. If problem continues, both divers must surface.
	I'M COLD Both arms crossed over chest.	
	TAKE IT EASY OR SLOW DOWN Hand extended, palm down, in short up-and-down motion.	
	YOU LEAD, I'LL FOLLOW Index fingers extended, one hand forward of the other.	



NIGHT DIVING SIGNALS (Buddy at Distance)

When buddy is near, use regular hand signals in front of light.

 Something is wrong.
I require assistance.
(Large, rapid up-and-down motions with arm extended.)

 I am Okay.
Are you Okay?
(Large, slow circles with light.)

From US Navy Dive Manual, Rev.4

Line-Pull signals

From Tender to Diver		Searching Signals (Without Circling Line)	
1 Pull	"Are you all right?" When diver is descending, one pull means "Stop."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Going Down." During ascent, two pulls mean "You have come up too far; go back down until we stop you."	1 Pull	"Stop and search where you are."
3 Pulls	"Stand by to come up."	2 Pulls	"Move directly away from the tender if given slack; move toward the tender if strain is taken on the life line."
4 Pulls	"Come up."	3 Pulls	"Face your umbilical, take a strain, move right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face your umbilical, take a strain, move left."
3-2 Pulls	"Ventilate."		
4-3 Pulls	"Circulate."		
From Diver to Tender		Searching Signals (With Circling Line)	
1 Pull	"I am all right." When descending, one pull means "Stop" or "I am on the bottom."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Lower" or "Give me slack."	1 Pull	"Stop and search where you are."
3 Pulls	"Take up my slack."	2 Pulls	"Move away from the weight."
4 Pulls	"Haul me up."	3 Pulls	"Face the weight and go right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face the weight and go left."
3-2 Pulls	"More air."		
4-3 Pulls	"Less air."		
Special Signals From the Diver		Emergency Signals From the Diver	
1-2-3 Pulls	"Send me a square mark."	2-2-2 Pulls	"I am fouled and need the assistance of another diver."
5 Pulls	"Send me a line."	3-3-3 Pulls	"I am fouled but can clear myself."
2-1-2 Pulls	"Send me a slate."	4-4-4 Pulls	"Haul me up immediately."

ALL EMERGENCY SIGNALS SHALL BE ANSWERED AS GIVEN EXCEPT 4-4-4

Altitude Correction, US Navy Sea Level Equivalent Depth

Table 9-4. Sea Level Equivalent Depth (fsw).

Actual Depth (fsw)	Altitude (feet)									
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10	10	15	15	15	15	15	15	15	15	15
15	15	20	20	20	20	20	20	25	25	25
20	20	25	25	25	25	25	30	30	30	30
25	25	30	30	30	35	35	35	35	35	40
30	30	35	35	35	40	40	40	45	45	45
35	35	40	40	45	45	45	50	50	50	60
40	40	45	45	50	50	50	55	55	60	60
45	45	50	55	55	55	60	60	70	70	70
50	50	55	60	60	70	70	70	70	70	80
55	55	60	70	70	70	70	80	80	80	80
60	60	70	70	70	80	80	80	90	90	90
65	65	70	80	80	80	90	90	90	100	100
70	70	80	80	90	90	90	100	100	100	110
75	75	90	90	90	100	100	100	110	110	110
80	80	90	90	100	100	100	110	110	120	120
85	85	100	100	100	110	110	120	120	120	130
90	90	100	110	110	110	120	120	130	130	140
95	95	110	110	110	120	120	130	130	140	140
100	100	110	120	120	130	130	130	140	140	150
105	105	120	120	130	130	140	140	150	150	160
110	110	120	130	130	140	140	150	150	160	160
115	115	130	130	140	140	150	150	160	170	170
120	120	130	140	140	150	150	160	170	170	180
125	125	140	140	150	160	160	170	170	180	190
130	130	140	150	160	160	170	170	180	190	190
135	135	150	160	160	170	170	180	190	190	200
140	140	160	160	170	170	180	190	190	200	210
145	145	160	170	170	180	190	190	200	210	
150	160	170	170	180	190	190	200	210		
155	170	170	180	180	190	200	210			
160	170	180	180	190	200	200				
165	180	180	190	200	200					
170	180	190	190	200						
175	190	190	200							
180	190	200	210							
185	200	200								
190	200									
Table Water Stops	Equivalent Stop Depths (fsw)									
10	10	9	9	9	8	8	8	7	7	7
20	19	19	18	17	17	16	15	15	14	14
30	29	28	27	26	25	24	23	22	21	21
40	39	37	36	35	33	32	31	30	29	28
50	48	47	45	43	42	40	39	37	36	34
60	58	58	54	52	50	48	46	45	43	41

Note: **█** = Exceptional Exposure Limit

Penalty Group Upon Arrival at Altitude, US Navy Table

Table 9-5. Repetitive Groups Associated with Initial Ascent to Altitude.

Altitude (feet)	Repetitive Group
1000	A
2000	A
3000	B
4000	C
5000	D
6000	E
7000	F
8000	G
9000	H
10000	I

Note: When travelling from a lower to a higher elevation there will be a reduction of the ambient pressure. Prior to diving at altitude, the diver needs to equilibrate, which can take up to twelve (12) hours. As it may be impractical to wait twelve (12) hours before diving in some situations, the diver will need to correct for Equilibration.

Required Surface Interval Before Ascent to Altitude After Diving, US Navy Table

Table 9-6. Required Surface Interval Before Ascent to Altitude After Diving.

Repetitive Group Designator	Increase in Altitude (feet)									
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
A	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
B	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:42
C	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:48	6:23
D	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:45	5:24	9:59
E	0:00	0:00	0:00	0:00	0:00	0:00	1:37	4:39	8:18	12:54
F	0:00	0:00	0:00	0:00	0:00	1:32	4:04	7:06	10:45	15:20
G	0:00	0:00	0:00	0:00	1:19	3:38	6:10	9:13	12:52	17:27
H	0:00	0:00	0:00	1:06	3:10	5:29	8:02	11:04	14:43	19:18
I	0:00	0:00	0:56	2:45	4:50	7:09	9:41	12:44	16:22	20:58
J	0:00	0:41	2:25	4:15	6:19	8:39	11:11	14:13	17:52	22:27
K	0:30	2:03	3:47	5:37	7:41	10:00	12:33	15:35	19:14	23:49
L	1:45	3:18	5:02	6:52	8:56	11:15	13:48	16:50	20:29	25:04
M	2:54	4:28	6:12	8:01	10:06	12:25	14:57	18:00	21:38	26:14
N	3:59	5:32	7:16	9:06	11:10	13:29	16:02	19:04	22:43	27:18
O	4:59	6:33	8:17	10:06	12:11	14:30	17:02	20:05	23:43	28:19
Z	5:56	7:29	9:13	11:03	13:07	15:26	17:59	21:01	24:40	29:15

Exceptional Exposure Wait 48 hours before ascent

- NOTE 1 When using Table 9-6, use the highest repetitive group designator obtained in the previous 24-hour period.
- NOTE 2 Table 9-6 may only be used when the maximum altitude achieved is 10,000 feet or less. For ascents above 10,000 feet, consult NAVSEA 00C for guidance.
- NOTE 3 The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 8,000 feet. For commercial flights, use a final altitude of 8,000 feet to compute the required surface interval before flying.
- NOTE 4 No surface interval is required before taking a commercial flight if the dive site is at 8,000 feet or higher. In this case, flying results in an increase in atmospheric pressure rather than a decrease.
- NOTE 5 For ascent to altitude following a non-saturation helium-oxygen dive, wait 12 hours if the dive was a no-decompression dive. Wait 24 hours if the dive was a decompression dive.

Appendix G

First Aid Kit (Diving) Recommended Items (Table)

AIRWAY MANAGEMENT ITEMS			
QTY	UOI	ITEM	APPLICATION
2	EA	Oxygen Cylinders (Jumbo D)	Oxygen Administration
1	EA	Resuscitator w/ Elder Valve (or LSP type)	Diver resuscitation
1	EA	Ambu Bag w/reservoir & full face mask	Diver resuscitation
1	EA	Pocket mask (or equivalent)	Rescue Breathing

* adequate for open circuit use from the dive site to the chamber location. Calculate the quantity per diver required is 50 cubic feet per hour of travel to the chamber.

BASIC FIRST AID ITEMS			
QTY	UOI	ITEM	APPLICATION
2	EA	Triangular bandages	Splint / Dressings
2	EA	Splints Moldable (non-pneumatic) 2 sizes	Splinting
12	EA	4x4 Gauze pads, Sterile	Dressing wounds
6	EA	2x2 Gauze pads, Sterile	Dressing wounds / Eye patch
4	EA	Telfa Pads – Non-Stick Gauze	Dressing wounds
2	RL	Roller Gauze (Kling or Elastic) 2" or 3"	Wound pressure bandage
2	RL	Roller Gauze (Kling or Elastic) 3" or 4"	Wound pressure bandage
1	EA	Ace bandage, 4 inches wide	Wound pressure bandage
Various	BX	Band-Aids, assorted & large size	Cuts
12	EA	Butterfly bandages	Cuts
1	BT	Betadine, iodine, (or other disinfecting solution)	Wound cleaning
4	EA	Gel burn dressings	Burn care
2	EA	ABD pads, 5" x 9"	Wound / Burn
1	EA	Tourniquet	Bleeding control
3	RL	Adhesive Tape ½", 1" & 2" -Waterproof	Wound Bandage
10	EA	Swabs, Cotton Tip 6" wooden (Q-tips)	Wound Cleaning

MEDICATION ITEMS			
QTY	UOI	ITEM	APPLICATION
50	TABS	Tylenol 325 mg Tabs	Mild Pain
50	TABS	Aspirin, 325 mg Tabs (not aspirin substitute)	Mild Pain, DCS, Swelling
2	EA	Ammonia Inhalants	Dizziness
1	BT	Hydrogen Peroxide .03%	Minor wound cleaning
2	TU	Triple Antibiotic Ointment	Wound Dressing Antiseptic
1	EA	Hot Pack	Scorpion fish, ray, etc. Stings/ punctures

EQUIPMENT ITEMS			
QTY	UOI	ITEM	APPLICATION
1	EA	Bandage Scissors	Wound Dressing
1	EA	Forceps (i.e. Kelly, etc.)	Wound Dressing
1	EA	Tweezers (or 22 ga needle)	Foreign body / Splinter removal
1	EA	Flashlight (or Otoscope)	Examination
6	PR	Examination latex gloves	Victim handling

ALTERNATE ITEMS TO CONSIDER			
QTY	UOI	ITEM	APPLICATION
1	EA	Ice Pack	Sprains, injury
1	EA	Stethoscope	Examination
1	EA	BP Cuff	Examination
1	BT	Sunscreen	U/V Protection
6	PR	Examination latex gloves*	Victim handling
2	EA	Oral Airways – Adult sizes #4 & #5	Diver resuscitation, airway management

Appendix H

SCUBA Emergency Procedures

Lost Diver Emergency Situation

If a pair of divers become separated, divers should perform a 360-degree visual search from current position. Divers should note max depth and bottom time. Both divers should make a controlled ascent while tapping in 4 tap intervals on tanks with a knife or use other underwater signaling device. The first diver to reach the surface shall alert the dive team leader of the separation. The dive team leader will fix the position of the lost diver's bubbles. If the lost diver has not surfaced within two (2) minutes, the standby diver will buddy up with the primary diver on the surface and attempt to follow the lost divers bubble trail. If there is no bubble trail from the lost diver, the search team will immediately return to the last known location of the lost diver and begin a search. If the initial search is unsuccessful, notify authorities of a possible recovery situation and continue search.

Trapped/Fouled Diver Emergency Situation

The diver shall remain calm, analyze the situation, and carefully try to work free. The diver should obtain help through line pull signals or the buddy diver if the situation cannot be resolved. The buddy diver should attempt to free the entrapped diver as long as it is safe to do so. If a hazard or danger exists or if the buddy diver is unable to free the trapped diver, the buddy diver should signal the trapped diver he is going to surface for help. Once the buddy diver surfaces, the buddy diver shall advise the dive team leader of the situation and take the appropriate actions to free the trapped diver. The dive team leader may launch the standby diver to provide required assistance. For example, standby diver may deliver a new apparatus and assist cutting the trapped diver free.

Loss of Air

If a diver experiences a loss of air, the diver shall immediately check that the bottle valve is fully opened. Abort the dive. Switch to the alternate air supply and signal to the dive buddy to surface. If the alternate supply does not restore breathing air, signal the dive buddy that you are out of air and utilize their alternate air supply. Face one another and make a controlled ascent. If no alternate air supply is available, make an emergency ascent to the surface, remembering to continually blow out to avoid over expansion injury to the lungs.

Unconscious Diver

Approach with caution. The buddy diver will assist the unconscious diver to the surface as quickly as possible, within the ascent rate (30 feet per minute). If the regulator is out of mouth, do not insert. If the regulator is in mouth, leave it in. Surface with the victim in an upright position. Upon reaching the surface, immediately notify the dive team leader and standby diver for assistance, call 911. Once on shore, assess the victim's condition and take appropriate first aid measures.