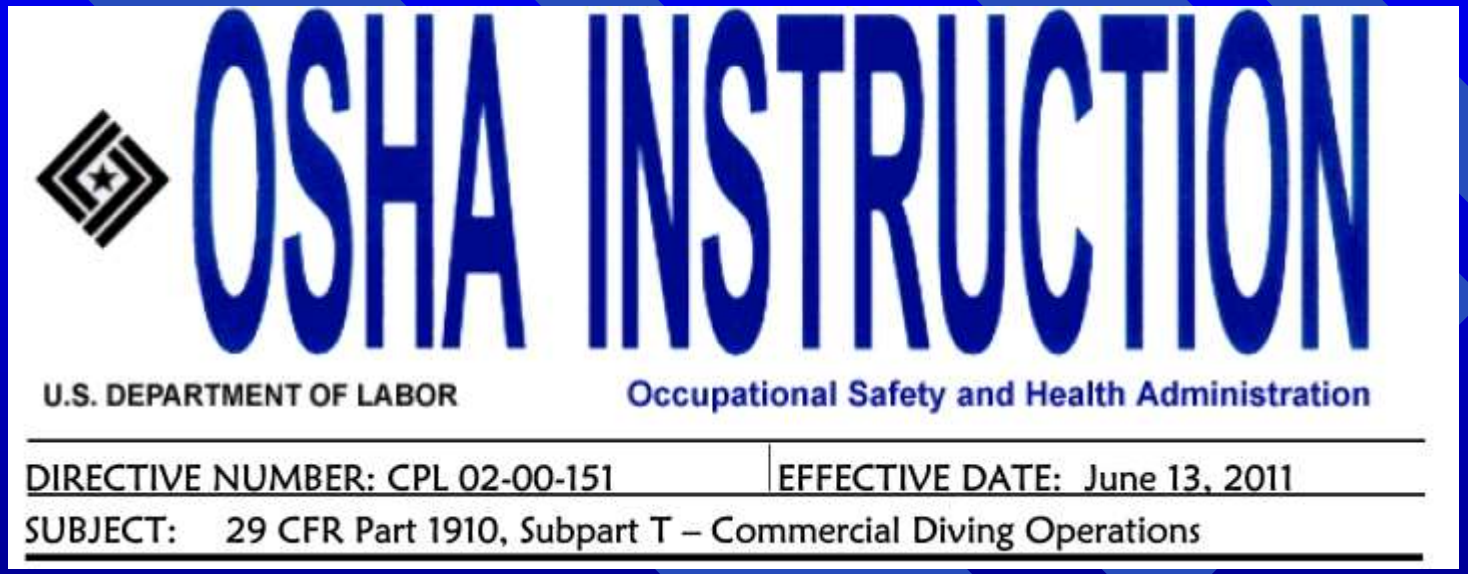
The Facts about Water Tank Diving Evaluations

Jennifer Coon, CSP, CHMM., CET

Safety Director

Tank Industry Consultants

OSHA Regulation



OSHA INSTRUCTION

U.S. DEPARTMENT OF LABOR — Occupational Safety and Health Administration

DIRECTIVE NUMBER: CPL 02-00-151 | EFFECTIVE DATE: June 13, 2011

SUBJECT: 29 CFR Part 1910, Subpart T – Commercial Diving Operations

Contributing Factors
Diver Fatalities - 2008 to 2013

Ranked in Order of Frequency

1. Insufficient Number of Dive Team Members
   - 2008 to 2013 - 54 Diver Fatalities
   - 24 Due to Insufficient Number of Dive Team Members
2. Physical Condition of Diver

Office of Maritime Enforcement
Steve Butler
February 2014

Contributing Factors
Diver Fatalities - 2008 to 2013

Ranked in Order of Frequency

3. Equipment Malfunction
   - Leading Cause of Malfunction – Improper Maintenance
4. Training Deficiencies
   - Failure to Recognize and Avoid Underwater Hazards
   - Poor Response when Hazards Encountered
5. Differential Pressure

Office of Maritime Enforcement
Steve Butler
February 2014

Contributing Factors
Diver Fatalities - 2008 to 2013

Ranked in Order of Frequency

6. Entanglement
7. Entrapment
8. Explosion
9. AGE (arterial gas embolism) / Decompression Sickness

Office of Maritime Enforcement
Steve Butler
February 2014


0:02 / 0:12


:03 / 0:12

Qualifications – What to Ask

- Divers' qualified to perform water tank and coating evaluations
- Divers' properly certified
- Divers' training records
- Copies of Company and Personal Dive Logs
- Divers' retain current CPR/1st Aid/O2 administration training
- Divers' have current Accident Management Training
- Examples of previous site-specific dive plans available

Qualifications – Know Water Tanks?


3

Selecting a Storage Tank Engineer/Inspector

AWWA M42

- Registered Professional Engineer with
  - extensive experience in water storage tank engineering and inspection
  - experienced personnel

Selecting a Storage Tank Engineer/Inspector

- Extensive knowledge of
  - industry standards
  - traditional engineering disciplines
  - specialized training
  - tank construction practices
  - surface cleaning and cleanliness standards

Selecting a Storage Tank Engineer/Inspector

- Effective communications skills to
  - interpret specifications
  - resolve potential issues
- Climbing abilities and knowledge of
  - proper rigging
  - safety practices
  - respect for heights

Dive Fatality

- Braintree, Massachusetts
- December 16, 2016
- Air supply to diver cut off unexpectedly
- Crew unable to pull him out of the water
- Spotter entered water but also became trapped and required rescue

OSHA Requires

Verification of Competency

Qualifications
Diver Properly Certified?

Qualifications
Company and Personal Training Records

Dive Logs

- Should be 2 types “COMPANY” and “PERSONAL”
- Must be current
- List at least last 12 months of dive activity
- Ensure dive experience is real
- Verify that personnel are not subject to unsafe dive practices

Dive Logs

Date:		Tank Name:	
Job No.:			
Tank Location:			

	Dive #1	Dive #2	Dive #3
Diver's Name:			
Previous Dive RG:			
Surface Interval:			
Repetitive Factor (RF) In:			
Max. Depth:			
Left Surface:			
Reach Bottom:			
Leave Bottom:			
Reach Surface:			
Deo: Depth/Time:			

Qualifications
Accident Management Training

Divers Alert Network

Tank Industry Consultants

Qualifications
CPR/1st-Aid/O2

Qualifications
Dive Plans

Site-Specific Dive Plan

- Anticipated High-Risk Activities
- Crew Roles and Responsibilities
- Required Equipment
- Emergency Planning
- Locations of Nearest Hospitals and Monoplace Hyperbaric Chambers
- Safety Data Sheets (SDS)
- Address other safety hazards

High-Risk Activities

Crew Roles and Responsibilities

Team Size

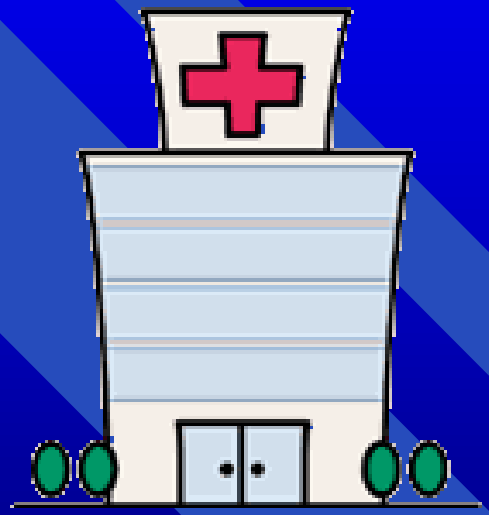
Required Equipment

Equipment Check List

- Two-Way Communication Radios w/ Tether Line
- Buoyancy Compensators (BCD)
- Personal Fall Arrest Equipment
- Full Face Masks
- Dry Suits
- Main Air Tanks, Emergency Air Tanks, BCD Air Tanks
- Dive Tables
- Weights
- Bag-Type Manual Resuscitate w/ Mask and Tubing
- Emergency O2 Tank
- Tarps
- Raft
- Disinfectant
- Safety Goggles
- Chemical Gloves

Emergency Planning

Nearest Hospital and Monoplace Hyperbaric Chamber



Safety Data Sheet (SDS)

Permit-Required Confined Space

Permit-Required Confined Space

- Written program
- Employee training
- Designated crew roles/responsibilities
- Emergency response
- Permits
- Continuous air monitoring

Logout/Tagout


DANGER
DO NOT OPERATE
This lock / tag may only be removed by
Name:
Dept:
Expected Completion:

Disinfection

Disinfection

Exterior Ladders

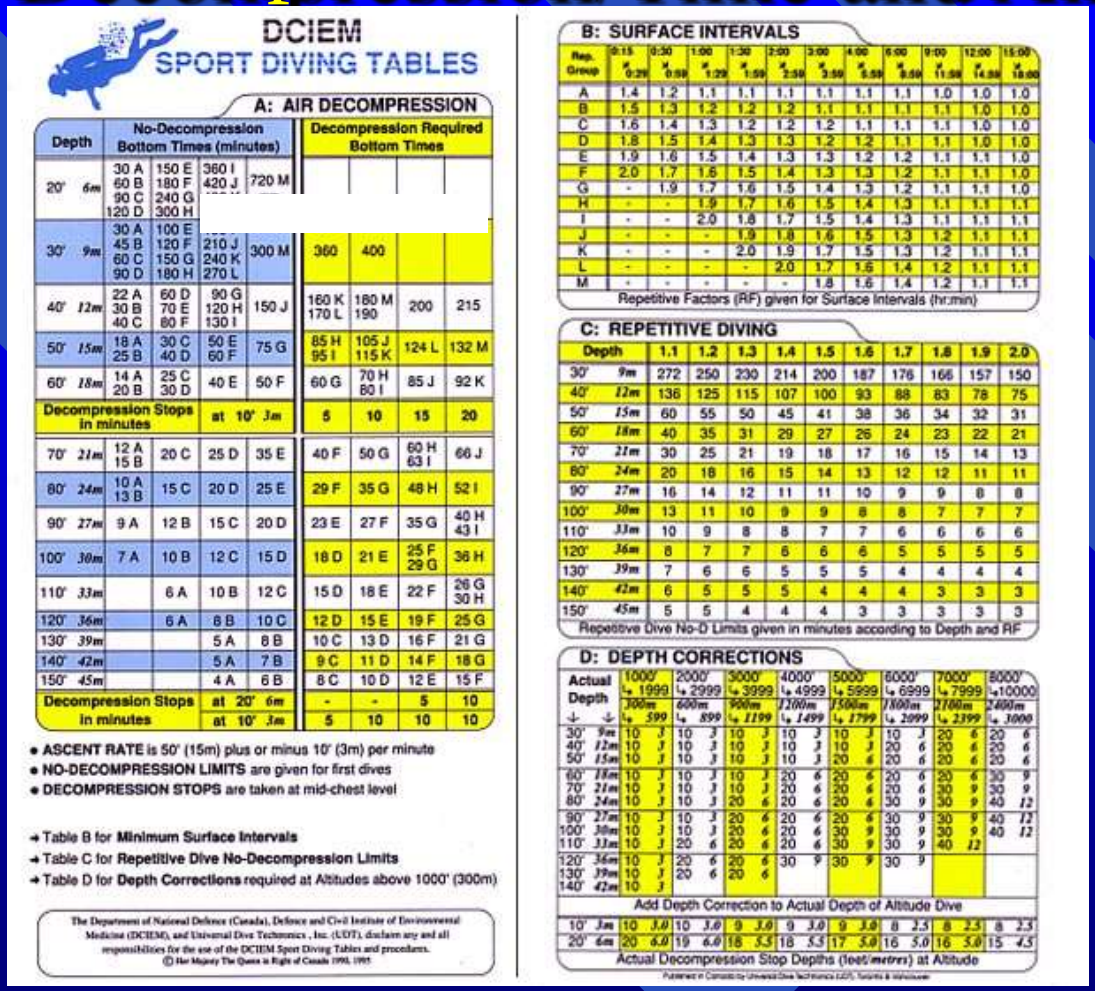
Condition of Interior Ladders

Working at Heights

Physical Hazards

- Illumination
- Heat Stress
- Cold Stress
- Material Hoisting and Lifting Procedure
- Handling Air Cylinders

Decompression/Time and Air



DCIEM SPORT DIVING TABLES

A: AIR DECOMPRESSION

Depth	No-Decompression Bottom Times (minutes)				Decompression Required Bottom Times			
20' 6m	30 A 60 B 90 C 120 D	150 E 180 F 240 G 300 H	360 I 420 J	720 M				
30' 9m	30 A 45 B 60 C 90 D	100 E 120 F 150 G 180 H	210 J 240 K 270 L	300 M	360	400		
40' 12m	22 A 30 B 40 C	60 D 70 E 80 F	90 G 120 H 130 I	150 J	160 K 170 L	180 M 190	200	215
50' 15m	18 A 25 B	30 C 40 D	50 E 60 F	75 G	85 H 95 I	105 J 115 K	124 L	132 M
60' 18m	14 A 20 B	25 C 30 D	40 E	50 F	60 G	70 H 80 I	85 J	92 K
Decompression Stops in minutes			at 10' 3m		5	10	15	20
70' 21m	12 A 15 B	20 C	25 D	35 E	40 F	50 G	60 H 63 I	66 J
80' 24m	10 A 13 B	15 C	20 D	25 E	29 F	35 G	48 H	52 I
90' 27m	9 A	12 B	15 C	20 D	23 E	27 F	35 G	40 H 43 I
100' 30m	7 A	10 B	12 C	15 D	18 D	21 E	25 F 29 G	36 H
110' 33m		6 A	10 B	12 C	15 D	18 E	22 F	26 G 30 H
120' 36m		6 A	8 B	10 C	12 D	15 E	19 F	25 G
130' 39m			5 A	8 B	10 C	13 D	16 F	21 G
140' 42m			5 A	7 B	9 C	11 D	14 F	18 G
150' 45m			4 A	6 B	8 C	10 D	12 E	15 F
Decompression Stops in minutes			at 20' 6m		-	-	5	10
			at 10' 3m		5	10	10	10

- **ASCENT RATE** is 50' (15m) plus or minus 10' (3m) per minute
- **NO-DECOMPRESSION LIMITS** are given for first dives
- **DECOMPRESSION STOPS** are taken at mid-chest level

→ Table B for **Minimum Surface Intervals**
→ Table C for **Repetitive Dive No-Decompression Limits**
→ Table D for **Depth Corrections** required at Altitudes above 1000' (300m)

The Department of National Defence (Canada), Defence and Civil Institute of Environmental Medicine (DCIEM), and Universal Dive Technonics , Inc. (UDT), disclaim any and all responsibilities for the use of the DCIEM Sport Diving Tables and procedures.
© Her Majesty The Queen in Right of Canada 1990, 1995

B: SURFACE INTERVALS

Rep. Group	0:15 ↓ 0:29	0:30 ↓ 0:59	1:00 ↓ 1:29	1:30 ↓ 1:59	2:00 ↓ 2:59	3:00 ↓ 3:59	4:00 ↓ 5:59	6:00 ↓ 8:59	9:00 ↓ 11:59	12:00 ↓ 14:59	15:00 ↓ 18:00
A	1.4	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0
B	1.5	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.0	1.0
C	1.6	1.4	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0
D	1.8	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0
E	1.9	1.6	1.5	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0
F	2.0	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.1	1.0
G	-	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0
H	-	-	1.9	1.7	1.6	1.5	1.4	1.3	1.1	1.1	1.1
I	-	-	2.0	1.8	1.7	1.5	1.4	1.3	1.1	1.1	1.1
J	-	-	-	1.9	1.8	1.6	1.5	1.3	1.2	1.1	1.1
K	-	-	-	2.0	1.9	1.7	1.5	1.3	1.2	1.1	1.1
L	-	-	-	-	2.0	1.7	1.6	1.4	1.2	1.1	1.1
M	-	-	-	-	-	1.8	1.6	1.4	1.2	1.1	1.1

Repetitive Factors (RF) given for Surface Intervals (hr:min)

C: REPETITIVE DIVING

Depth	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
30' 9m	272	250	230	214	200	187	176	166	157	150
40' 12m	136	125	115	107	100	93	88	83	78	75
50' 15m	60	55	50	45	41	38	36	34	32	31
60' 18m	40	35	31	29	27	26	24	23	22	21
70' 21m	30	25	21	19	18	17	16	15	14	13
80' 24m	20	18	16	15	14	13	12	12	11	11
90' 27m	16	14	12	11	11	10	9	9	8	8
100' 30m	13	11	10	9	9	8	8	7	7	7
110' 33m	10	9	8	8	7	7	6	6	6	6
120' 36m	8	7	7	6	6	6	5	5	5	5
130' 39m	7	6	6	5	5	5	4	4	4	4
140' 42m	6	5	5	5	4	4	4	3	3	3
150' 45m	5	5	4	4	4	3	3	3	3	3

Repetitive Dive No-D Limits given in minutes according to Depth and RF

D: DEPTH CORRECTIONS

Actual Depth	1000' ↳ 1999'	2000' ↳ 2999'	3000' ↳ 3999'	4000' ↳ 4999'	5000' ↳ 5999'	6000' ↳ 6999'	7000' ↳ 7999'	8000' ↳ 10000'
	300m ↳ 599m	600m ↳ 899m	900m ↳ 1199m	1200m ↳ 1499m	1500m ↳ 1799m	1800m ↳ 2099m	2100m ↳ 2399m	2400m ↳ 3000m
30' 9m	10 3	10 3	10 3	10 3	10 3	10 3	20 6	20 6
40' 12m	10 3	10 3	10 3	10 3	10 3	20 6	20 6	20 6
50' 15m	10 3	10 3	10 3	10 3	20 6	20 6	20 6	20 6
60' 18m	10 3	10 3	10 3	20 6	20 6	20 6	30 9	30 9
70' 21m	10 3	10 3	10 3	20 6	20 6	20 6	30 9	30 9
80' 24m	10 3	10 3	20 6	20 6	20 6	30 9	30 9	40 12
90' 27m	10 3	10 3	20 6	20 6	20 6	30 9	30 9	40 12
100' 30m	10 3	10 3	20 6	20 6	30 9	30 9	30 9	40 12
110' 33m	10 3	20 6	20 6	20 6	30 9	30 9	40 12	
120' 36m	10 3	20 6	20 6	30 9	30 9	30 9		
130' 39m	10 3	20 6	20 6					
140' 42m	10 3							

Add Depth Correction to Actual Depth of Altitude Dive

10' 3m	10 3.0	10 3.0	9 3.0	9 3.0	9 3.0	8 2.5	8 2.5	8 2.5
20' 6m	20 6.0	19 6.0	18 5.5	18 5.5	17 5.0	16 5.0	16 5.0	15 4.5

Actual Decompression Stop Depths (feet/*metres*) at Altitude

Over 100 Ft of Water Depth

Decompression Chamber On-Site

Facilitating a Safer Dive

- Provide Keys to All of the Roof Manholes
- Keep Water Levels High
- Isolate the Tank Early
- Let Inspectors Know if the Tank Has an Interior Ladder

Dive Safety Checklist OSHA

- Up-to-Date Company & Diver Dive Logs
- CPR/First-Aid & Oxygen Administration Training
- 4-Member Dive Team
- Comply with OSHA Hazard Communication Requirements
- Lockout & Tag All Valves
- Previous Dive Plans
- Commercial Diver Certification
- Sufficient Equipment to Suit-Up 3 Divers
- Comply with OSHA Confined Space
- Compliance with New OSHA Subpart D – Walking Surfaces (effective January 17, 2017)

Additional Recommendations

- Extensive Experience in Water Tank Engineering & Inspection
- Diver is Employee of Registered Professional Engineer
- Tank Isolated System while Diver in Tank
- Potential for 5-Member Dive Team

Dive Evaluation Sample RFQ Available

Snodgrass@TankIndustry.com

www.TankIndustry.com

Questions?