MARINO

CONSTRUCTION GROUP

ITB No. 26-002

Re-bid Navy Mole Pier Seawall Repair

The City of Key West
1300 White Street, Key West, Florida 33040

CGC021647 | 305-359-5269 | 3100 Overseas HWY
Key West, FL 33040 | www.marino-construction.com

NOTE TO BIDDER: Use preferably black ink or typewritten for completing this Bid Form.

BID FORM

To: The City of Key West

Address: 1300 White Street, Key West, Florida 33040

Project Title: **Re-Bid Navy Mole Pier Seawall Project**
ITB #26-002

Bidder's contact person for additional information on this bid:

Company Name: Marino Construction Group, Inc.

Contact Name & Telephone #: Matah Persaud 305-359-5269

Email Address: mpersaud@marino-construction.com

BIDDER'S DECLARATION AND UNDERSTANDING

The undersigned, hereinafter called the Bidder, declares that the only persons or parties interested in this bid are those named herein, that this bid is, in all respects, fair and without fraud, that it is made without collusion with any official of the City, and that the bid is made without any connection or collusion with any person submitting another bid on this contract.

The Bidder further declares that they have carefully examined the Contract Documents for the construction of the project, that they have personally inspected the site, and satisfied themselves as to the quantities involved, including materials and equipment, and conditions of work involved, including the fact that the description of the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the said quantities with the detailed requirements of the Contract Documents, and that this bid is made according to the provisions and under the terms of the Contract Documents, which documents are hereby made a part of this bid.

CONTRACT EXECUTION AND BONDS

The Bidder agrees that if their bid is accepted, they will, within ten (10) days, not including Sundays and legal holidays, after the Notice of Award, sign the contract in the form annexed hereto, and will at that time, deliver to the City examples of the Performance Bond and Payment Bond required herein, and evidence of holding required licenses and certificates, and will, to the extent of their bid, furnish all machinery, tools, apparatus, and other means of construction and do the work and furnish all the materials necessary to complete all work as specified or indicated in the Contract Documents.

CERTIFICATES OF INSURANCE

Bidder agrees to furnish the City, before commencing the work under this contract, the Certificates of Insurance (COI) as specified in these documents.

START OF CONSTRUCTION AND CONTRACT COMPLETION TIME

The Bidder further agrees to begin work within ten (10) calendar days after receiving the Notice to Proceed and to complete the project, in all respects, within one hundred and eighty 180 calendar days after the date of the Notice to Proceed.

LIQUIDATED DAMAGES

In the event the Bidder is awarded the contract and shall fail to complete the work within the time limit or extended time limit agreed upon, as more particularly set forth in the Contract Documents, liquidated damages shall be paid to the City at the rates identified in the Instructions to Bidders: *#17- Time of Completion* per day for all work awarded until the work has been satisfactorily completed as provided by the Contract Documents.

ADDENDA

The Bidder hereby acknowledges that they have received Addenda No's.#1__, #2__, #3__, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, (Bidder shall insert No. of each Addendum received) and agrees that all addenda issued are hereby made part of the Contract Documents, and the Bidder further agrees that their bid(s) includes all impacts resulting from said addenda.

SALES AND USE TAXES

The Bidder agrees that all federal, state, and local sales and use taxes are included in the stated bid prices for the work.

LUMP SUM ITEMS

The Bidder further proposes to accept as full payment for the work proposed herein the amounts computed under the provisions of the Contract Documents and based on the following lump sum amounts. The Bidder agrees that the lump sum represents a true measure of the labor and materials required to perform the work, including all allowances for overhead and profit for each type and unit of work called for in these Contract Documents.

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ADDENDUM NO. 1
Re-Bid Navy Mole Pier Seawall Repair
ITB 26-002

This addendum is issued as supplemental information to the Invitation to Bid package for clarification of certain matters of both a general and a technical nature. The referenced Invitation to Bid package is hereby amended in accordance with the following items:

1. **Clarification: (ITB 26-002** Page 2. And 14. Update)

   Page 2.

   Access request for Pre-Bid Meeting

   - **Point of Clarification:** On the morning of the pre-bid meeting, attendees that submitted the proper request by January 26, 2026 at 4 P.M. shall go to the Visitor Control Center between 7:00AM-9:00AM to complete background check and obtain a base access pass to Truman Annex/Mole Pier (Please remember to bring your printed paper copy of the emailed invitation). Visitor Control Center Wait Times Vary. The Pre-Bid Meeting will begin at the Navy Mole Pier inside of the Truman Waterfront Park at 10:00AM. Visitor Control Center is located at A641 Saratoga Ave, Key West, FL 33040. No firearms are allowed.

   Pre-Bid Meeting: **10 A.M. LOCAL TIME at the Navy Mole Pier in the Truman Waterfront Park. BASE ACCESS PASS MUST BE OBTAINED FROM THE BOCA CHICA VISITOR CONTROL CENTER ON 28JAN, PRIOR TO THE SITE VISIT.**

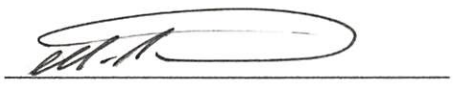
   Page 14.

   PART 1

BIDDING REQUIREMENTS

Please provide your name, email address, company information, including address and phone number, to Keith Bring keith.bring@cityofkeywest-fl.gov and LT Skye McNutt skye.r.mcnutt.mil@us.navy.mil An invitation to obtain your access pass will be emailed. Please print a copy of this email invitation and bring it with you to the Visitor Control Center outside of NAS Key West, Boca Chica Annex, to be received for security screening.

2. **Changes to Submission Requirements:** [No Changes]
3. **Updates to Project Timeline:** [No Changes]
4. **Responses to Questions:** [No Changes]
5. **Additional Resources:** [No Changes]



Signature

Marino Construction Group

Name of Business

ADDENDUM NO. 2
Re-Bid Navy Mole Pier Seawall Repair
ITB 26-002

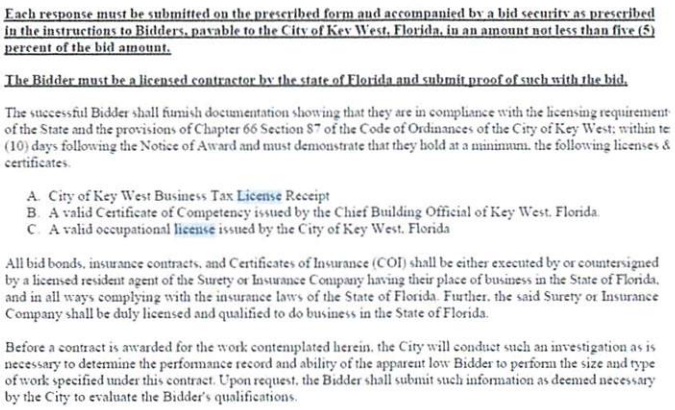
This addendum is issued as supplemental information to the Invitation to Bid package for clarification of certain matters of both a general and a technical nature. The referenced Invitation to Bid package is hereby amended in accordance with the following items:

1. **Clarification:** [No Changes]
2. **Changes to Submission Requirements:** [No Changes]
3. **Updates to Project Timeline:** [No Changes]
4. **Responses to Questions:** [No Changes]

    - **Question:** The bid documents require the bidder to have a State of Florida Contractors license. Will this be required since this is on Federal Navy property.

      Answer:

      Page #16 of ITB-26-002 states: Please refer to ITB 26-002 regarding requirements.



Each response must be submitted on the prescribed form and accompanied by a bid security as prescribed in the instructions to Bidders, payable to the City of Key West, Florida, in an amount not less than five (5) percent of the bid amount.

The Bidder must be a licensed contractor by the state of Florida and submit proof of such with the bid.

The successful Bidder shall furnish documentation showing that they are in compliance with the licensing requirement of the State and the provisions of Chapter 66 Section 87 of the Code of Ordinances of the City of Key West; within ten (10) days following the Notice of Award and must demonstrate that they hold at a minimum, the following licenses & certificates.

A. City of Key West Business Tax License Receipt
B. A valid Certificate of Competency issued by the Chief Building Official of Key West, Florida.
C. A valid occupational license issued by the City of Key West, Florida

All bid bonds, insurance contracts, and Certificates of Insurance (COI) shall be either executed by or countersigned by a licensed resident agent of the Surety or Insurance Company having their place of business in the State of Florida, and in all ways complying with the insurance laws of the State of Florida. Further, the said Surety or Insurance Company shall be duly licensed and qualified to do business in the State of Florida.

Before a contract is awarded for the work contemplated herein, the City will conduct such an investigation as is necessary to determine the performance record and ability of the apparent low Bidder to perform the size and type of work specified under this contract. Upon request, the Bidder shall submit such information as deemed necessary by the City to evaluate the Bidder's qualifications.

Page #22 of ITB 26-002 states:

CITY OF KEY WEST LICENSE REQUIRED

Bidders are required to have a Certified or Registered General Contractors City of Key West license. License fees do not exceed $410.00. License shall be obtained within ten (10) days of Notice of Award.

- **Question:** If the bidder does need a Florida license; does this also apply to subcontractors.

  Answer: All sub-contractors required to pull a permit are required to be licensed in the state of Florida.

5. **Additional Resources:** [No Changes]

Signature

Marino Construction Group
Name of Business

ADDENDUM NO. 3
Re-Bid Navy Mole Pier Seawall Repair
ITB 26-002

This addendum is issued as supplemental information to the Invitation to Bid package for clarification of certain matters of both a general and a technical nature. The referenced Invitation to Bid package is hereby amended in accordance with the following items:

1. **Clarification:** [Changes]

   Update: The United States Navy has decided to remove/omit all electrical scope from this ITB 26-002.

2. **Changes to Submission Requirements:** [Changes]

   Update: All electrical scope noted in the original bid documents pursuant ITB 26-002 Re-Bid Navy Mole Pier Seawall Repair has been removed/omitted from the bidding requirements. Please do not submitted any cost via ADD/Alternate line item "Electrical" on pg. #18.

3. **Updates to Project Timeline:** [No Changes]

4. **Responses to Questions:** [No Changes]

1. The scope of work in the bid documents state we are to supply 4-50-amp dock pedestals. The electrical drawings show the pedestals as 30-amp 120vac. Can you confirm the correct pedestal configuration? Marina pedestals can be supplied with 50-amp 240vac and 30-amp 120vac receptacles. Do you want us to supply that configuration for versatility?

   Answer: N/A

2. The electrical drawings show that we are to feed the new 200amp panel from the existing panel. The existing panel and service disconnect are only rated for 100amps. Adding a 200amp panel to the existing 100amp panel will overload

the existing panel. There is a spare conduit in the existing 100amp disconnect that appears to stub up in the existing transformer. Can we utilize this spare conduit to feed the new 200amp panel?

Answer: N/A

3. The existing 75kva transformer is 3-phase 120/208vac. The 50amp receptacles specified in the bid documents do not specify the voltage. Typically, 50amp marine receptacles are 220vac and 30amp marine receptacles are 120vac. If 50amp receptacles are to be supplied the voltage will be 120/208vac. If the 50amp receptacles are what are wanted, will the 208vac voltage be a problem for the boats that will be utilizing the pedestals?

Answer: N/A

5. The drawings call for a single phase 120/240vac single phase panel. The existing transformer is 120/208vac 3 phase. The AMI meter that is to be installed is not available in 120/208vac single phase. Are we to install a 3-phase 120/208vac panel and meter?

Answer: N/A

5. During the site visit we noticed that the dock was osculating quite a bit due to the rough seas. Using the specified flexible seal tight conduit may cause the wire to chafe inside the conduit due to the extreme motion of the dock. Can we use type G-cable to feed the pedestals instead of the specified seal tight conduit?

Answer: N/A

6. **Additional Resources:** [No Changes]



Signature

Marina Construction Group

Name of Business

PROPOSAL FORM

RE-BID NAVY MOLE PIER SEAWALL REPAIR ITB 26-002

	Description of Work/Materials (Please list addl. items as necessary)	Amount
	Permits 1. Navy Excavation Permit-Contractor will be require to obtain a GPR Survey of all utilities. 2. USACE (Permit Acquired No Cost) 3. FDEP (Exempt NO PERMIT REQUIRED-No cost)	$ 4,000.00
	P&P bonds	$8,195.17
	Mobilization/Demobilization	$29,832.00
	General conditions	$153,094.00
	Demolition/clear/fill	$17,947.00
	Fabrication/Installation of steel patch panels	$ 421,257.49
	Polyurethane grout	$105,439.74
	#57 stone fill	$ 56,805.61
	Subtotal:	$796,571.01
	TOTAL:	$ $796,571.01
	ADD/ALT	
	Electrical	$N/A
	Non-Shrink Polyurethane Grout Including Install-Unit Price: (Per ~~SQFT~~)	$ 90.00 per gallon injected
	Soil Infill Including Install-Unit Price: (Per/SQFT)	$ N/A
	57 Stone Including Install-Unit Price (Per Ton)	$ 110.00 per ton installed
	Soil Infill Including Install-Unit Price (Per/YD)	$ 75.00 per yard installed
	Underwater Welding - Unit Price (Per/ SQFT)	$ 13,750.00 per day(8hr minimum)
	3/8" Steel Plate Including Install-Unit Price (Per/SQFT)	$ 19.75 per SQFT (material only)

RE-BID NAVY MOLE PIER SEAWALL REPAIR LUMP SUM BASE BID:

(Includes all demolition, disposal, fixtures, equipment, materials, & labor)

$ 796,571.01

In Words:

Seven hundred ninety-six thousand five hundred seventy-one Dollars & one Cents

Payment for materials & equipment authorized by the Owner in a written Change Order but not listed in the Schedule of Values will be provided at suppliers' invoice plus 15 %.

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SCHEDULE OF VALUES

AIA DOCUMENT G703 Page OF

APPLICATION NO:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G	H	I	J	J-1	J-2
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE 10% Of ADJUSTED VALUE	RETAINAGE RELEASED	BALANCE Of RETAINAGE
Div. 1	**General Requirements**										
01-001	Mobilization	$30,000.00	$0.00	$0.00	$0.00	$0.00	0.00%	$30,000.00	$0.00	$0.00	$0.00
01-001	General Requirements	$148,020.00	$0.00	$0.00	$0.00	$0.00	0.00%	$148,020.00	$0.00	$0.00	$0.00
	Total General Requirements	**$178,020.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$178,020.00**	**$0.00**	**$0.00**	**$0.00**
Div. 13	**Special Construction**										
13	Demo/Clear Fill	$17,947.00	$0.00	$0.00	$0.00	$0.00	0.00%	$17,947.00	$0.00	$0.00	$0.00
13	Fab/Install of Steel Panels	$329,023.00	$0.00	$0.00	$0.00	$0.00	0.00%	$329,023.00	$0.00	$0.00	$0.00
13	Polyurethane Grout	$82,256.00	$0.00	$0.00	$0.00	$0.00	0.00%	$82,256.00	$0.00	$0.00	$0.00
13	#57 Stone	$44,368.00						$44,368.00			
13	GPR	$4,000.00						$4,000.00			
	Total Specialties	**$477,594.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$477,594.00**	**$0.00**	**$0.00**	**$0.00**
	GL/OH/FEE										
17-002	Gen Liability	$36,058.77	$0.00	$0.00	$0.00	$0.00	0.00%	$36,058.77	$0.00	$0.00	$0.00
17-003	Overhead/Fee	$104,898.24	$0.00	$0.00	$0.00	$0.00	0.00%	$104,898.24	$0.00	$0.00	$0.00
	Total GL/OH/FEE	**$140,957.01**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$140,957.01**	**$0.00**	**$0.00**	**$0.00**
	CHANGE ORDERS										
	TOTAL CHANGE ORDERS										
	GRAND TOTALS	**$796,571.01**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$796,571.01**	**$0.00**	**$0.00**	**$0.00**

Users may obtain validation of this document by requesting of the license a completed AIA Document D401 - Certification of Document's Authenticity

List items to be performed by Bidder's own forces and the estimated total cost of these items. (Use additional sheets if necessary.)

General Labor $5,000			
Site Management $120,000			

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SUBCONTRACTORS

The Bidder further proposes that the following subcontracting firms or businesses will be awarded subcontracts for the following portions of the work if the Bidder is awarded the contract:

Florida Seawall Solutions

Name

24526 NW 178th Place, High Springs, FL, 32643

Street, City, State, Zip

Name

_____, _____, _____, _____

Street, City, State, Zip

Name

_____, _____, _____, _____

Street, City, State, Zip

Name

_____, _____, _____, _____

Street, City, State, Zip

SURETY

Travelers Casualty and Surety Company of America whose address is

One Tower Square, Hartford, CT, 06183

Street, City, State, Zip

BIDDER

The name of the Bidder submitting this bid is

Marino Construction Group, Inc doing business at

3100 Overseas Highway, Key West, FL, 33040

Street, City, State, Zip

which is the address to which all communications concerned with this Bid and with the Contract shall be sent.

The names of the principal officers of the corporation submitting this bid, or of the partnership, or of all persons interested in this bid as principals are as follows:

Michael Marino | Matah Persaud

If Sole Proprietor or Partnership

IN WITNESS hereto the undersigned has set their (its) hand this _____day of _____2025.

_____ Signature
of Bidder

CEO
Title

If Corporation

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed, and its seal affixed by its duly authorized officers this 18th day of February 2026.

(SEAL)

Marino Construction Group, Inc.
Name of Corporation

Matah Persaud
By
Title CEO
Attest _____

Sworn and subscribed before this 18th day of February, 2026

NOTARY PUBLIC, State of FLORIDA, at Large

My Commission Expires: 1-29-2029

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

EXPERIENCE OF BIDDER

The Bidder states that they are an experienced Contractor and have completed similar projects within the last five (5) years.

(List similar projects, with types, names of owners, construction costs, Engineers, and references with phone numbers. Use additional sheets if necessary).

See Attached

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MARINO

CONSTRUCTION GROUP

Project Name	Owner & Designers	Project Type	Contract Amount	Completion Time
Garrison Bight Marina 711 Eisenhower Drive. Key West, FL 33040	Suntex Marinas LLC Eric Metz 213-814-8829 Weiler Engineering Corporation Max Morgan 305.289.4161	Marina Renovation	$8M	9 Months In-Progress
Stock Island Marina Village 6000 Peninsular Ave. Key West, FL 33040	FOD Capital, LLC Stephen Geth 954-609-7848 Weiler Engineering Corporation Josh Jennings 305.289.4161	Utility Expansion, Dockage and Complex	$15.1M	18 Months Completed 2020
Perry Hotel Naples 12155 Tamiami Trl N Naples, FL 34110	FOD Capital, LLC Stephen Geth 954-609-7848 Weiler Engineering Corporation Josh Jennings 305.289.4161	New Docks with Utilities	$300K	3 Months Completed 2025
Old Port Harbour HOA 1145 Marine Way North Palm Beach, FL 33408	Focus Management LLC. 651-309-9455	Poly Injections	$180K	3 Months Competed 2025

FLORIDA BID BOND

BOND NO. N/A

AMOUNT: $Five Percent of Bid Proposal Submitted

KNOW ALL MEN BY THESE PRESENTS, that

Marino Construction Group, Inc.

Hereinafter called the Principal, and Travelers Casualty and Surety Company of America

a corporation duly organized under the laws of the State of Connecticut

having its principal place of business at One Tower Square, Hartford, CT 06183

in the State of Connecticut,

and authorized to do business in the State of Florida, as Surety, are held and firmly bound unto

City of Key West

hereinafter called the Obligee, in the sum of Five Percent of Bid Proposal Submitted Dollars ($----------5%----------) for the payment for which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these present.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS the Principal is herewith submitting his or its bid for

ITB # 26-002 /Re-Bid Navy Mole Pier Seawall Repair said bid, by reference thereto, being hereby made a part hereof.

WHEREAS, the Principal contemplates submitting or has submitted a bid to the City for the furnishing of all labor, materials (except those to be specifically furnished by the City), equipment,

machinery, tools, apparatus, means of transportation for, and the performance of the work covered in the bid and the Contract Documents, entitled:

ITB 26-002 / Re-Bid Navy Mole Pier Seawall Repair

WHEREAS, it was a condition precedent to the submission of said bid that a cashier's check, certified check, or bid bond in the amount of five (5) percent of the base bid be submitted with said bid as a guarantee that the Bidder would, if awarded the contract, enter into a written contract with the City for the performance of said contract, within ten (10) working days after written notice having been given of the award of the contract.

NOW, THEREFORE, the conditions of this obligation are such that if the Principal within ten (10) consecutive calendar days after written notice of such acceptance, enters into a written contract with the Obligee and furnishes the Performance and Payment Bonds, each in an amount equal to one hundred (100) percent of the base bid, satisfactory to the City, then this obligation shall be void; otherwise the sum herein stated shall be due and payable to the Obligee and the Surety herein agrees to pay said sum immediately upon demand of the Obligee in good and lawful money of the United States of America, as liquidated damages for failure thereof of said Principal.

Signed and sealed this 18 day of February, 2026.

Principal Marino Construction Group, Inc.

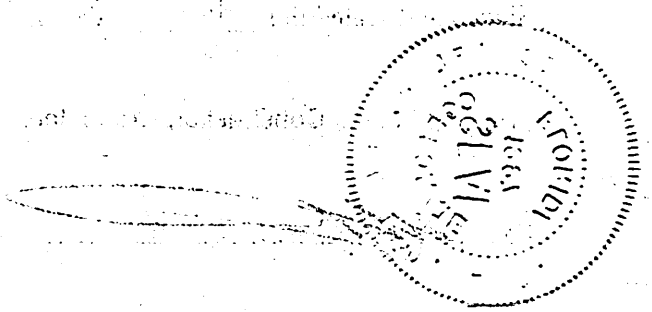
By _____

STATE OF Florida)
: SS
COUNTY OF Monroe)

Travelers Casualty and Surety Company of America

Surety

By _____
William L. Parker, Attorney in Fact & FL Res Agent





TRAVELERS

Travelers Casualty and Surety Company of America
Travelers Casualty and Surety Company
St. Paul Fire and Marine Insurance Company

: That Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company are corporations duly organized under the laws of the State of Connecticut (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint **William L. Parker** of **MIAMI** , **Florida** , their true and lawful Attorney-in-Fact to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

, the Companies have caused this instrument to be signed, and their corporate seals to be hereto affixed, this day of ,

State of Connecticut

City of Hartford ss.

By: _____
Robert L. Raney, Senior Vice President

On this the day of , , before me personally appeared , who acknowledged himself to be the Senior Vice President of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

, I hereunto set my hand and official seal.

My Commission expires the day of ,

Marie C. Tetreault, Notary Public

This Power of Attorney is granted under and by the authority of the following resolutions adopted by the Boards of Directors of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, which resolutions are now in full force and effect, reading as follows:

, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President, any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary may appoint Attorneys-in-Fact and Agents to act for and on behalf of the Company and may give such appointee such authority as his or her certificate of authority may prescribe to sign with the Company's name and seal with the Company's seal bonds, recognizances, contracts of indemnity, and other writings obligatory in the nature of a bond, recognizance, or conditional undertaking, and any of said officers or the Board of Directors at any time may remove any such appointee and revoke the power given him or her; and it is

, that the Chairman, the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President may delegate all or any part of the foregoing authority to one or more officers or employees of this Company, provided that each such delegation is in writing and a copy thereof is filed in the office of the Secretary; and it is

, that any bond, recognizance, contract of indemnity, or writing obligatory in the nature of a bond, recognizance, or conditional undertaking shall be valid and binding upon the Company when (a) signed by the President, any Vice Chairman, any Executive Vice President, any Senior Vice President or any Vice President, any Second Vice President, the Treasurer, any Assistant Treasurer, the Corporate Secretary or any Assistant Secretary and duly attested and sealed with the Company's seal by a Secretary or Assistant Secretary; or (b) duly executed (under seal, if required) by one or more Attorneys-in-Fact and Agents pursuant to the power prescribed in his or her certificate or their certificates of authority or by one or more Company officers pursuant to a written delegation of authority; and it is

, that the signature of each of the following officers: President, any Executive Vice President, any Senior Vice President, any Vice President, any Assistant Vice President, any Secretary, any Assistant Secretary, and the seal of the Company may be affixed by facsimile to any Power of Attorney or to any certificate relating thereto appointing Resident Vice Presidents, Resident Assistant Secretaries or Attorneys-in-Fact for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, and any such Power of Attorney or certificate bearing such facsimile signature or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by such facsimile signature and facsimile seal shall be valid and binding on the Company in the future with respect to any bond or understanding to which it is attached.

I, , the undersigned, Assistant Secretary of Travelers Casualty and Surety Company of America, Travelers Casualty and Surety Company, and St. Paul Fire and Marine Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which remains in full force and effect.

Dated this **18** day of **February** , **2026** .

Kevin E. Hughes, Assistant Secretary

To verify the authenticity of this Power of Attorney, please call us at 1-800-421-3880.
Please refer to the above-named Attorney-in-Fact and the details of the bond to which the power is attached.

ANTI – KICKBACK AFFIDAVIT

STATE OF Florida)
: SS
COUNTY OF Monroe)

I, the undersigned hereby duly sworn, depose and say that no portion of the sum herein bid will be paid to any employees of the City of Key West as a commission, kickback, reward or gift, directly or indirectly by me or any member of my firm or by an officer of the corporation.

By: _____ Matah Persaud

Sworn and subscribed before me this 18th day of February, 2026.

NOTARY PUBLIC, State of FLORIDA at Large

My Commission Expires: 1-29-2029

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

NON-COLLUSION AFFIDAVIT

STATE OF Florida)
: SS
COUNTY OF Monroe)

I, the undersigned hereby declares that the only persons or parties interested in this bid are those named herein, that this bid is, in all respects, fair and without fraud, that it is made without collusion with any official of the City, and that the bid is made without any connection or collusion with any person submitting another bid on this contract.

By: _____
Matah Persaud

Sworn and subscribed before me this

18th day of February, 2026.

_____
NOTARY PUBLIC, State of Florida at Large

My Commission Expires: 1-29-2029

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

SWORN STATEMENT UNDER SECTION 287.133(3)(A) FLORIDA STATUTES, ON PUBLIC ENTITY CRIMES

THIS FORM MUST BE SIGNED IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICER AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted with bid or proposal for ITB No. 26-002 Re-Bid Navy Mole Pier Seawall Repair

2. This sworn statement is submitted by Marino Construction Group, Inc.
(Name of entity submitting sworn statement)
whose business address is 3100 Overseas Highway, Key West, FL, 33040

and (if applicable) its Federal Employer Identification Number (FEIN) is 65-0823279

(If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement

3. My name is Matah Persaud
(Please print name of individual signing)
and my relationship to the entity named above is CEO

4. I understand that a "public entity crime" as defined in Paragraph 287.133(1)(g), Florida Statutes, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or with the United States, including but not limited to, any bid or contract for goods or services to be provided to any public or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, material misrepresentation.

5. I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication guilt, in any federal or state trial court of record relating to charges brought by indictment information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

6. I understand that an "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means:

a. A predecessor or successor of a person convicted of a public entity crime; or

b. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

7. I understand that a "person" as defined in Paragraph 287.133(1)(8), Florida Statutes, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.

8. Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies).

X Neither the entity submitting this sworn statement, nor any officers, directors, executives, partners, shareholders, employees, members, or agents who are active in management of the entity, nor any affiliate of the entity have been charged with and convicted of a public entity crime subsequent to July 1, 1989, AND (Please indicate which additional statement applies.)

___There has been a proceeding concerning the conviction before a hearing of the State of Florida, Division of Administrative Hearings. The final order entered by the hearing officer did not place the person or affiliate on the convicted vendor list. (Please attach a copy of the final order.)

____The person or affiliate was placed on the convicted vendor list. There has been a subsequent proceeding before a hearing officer of the State of

Florida, Division of Administrative Hearings. The final order entered by the hearing officer determined that it was in the public interest to remove the person or affiliate from the convicted vendor list. (Please attach a copy of the final order.)

X The person or affiliate has not been put on the convicted vendor list. (Please describe any action taken by or pending with the Department of General Services.)

(Signature)

2/18/2026

(Date)

STATE OF Florida

COUNTY OF Monroe

PERSONALLY, APPEARED BEFORE ME, the undersigned authority,

Matah Persaud who, after first being sworn by me, affixed his/her

(Name of individual signing)

Signature in the space provided above on this 18th day of Febmary, 2026.

My commission expires: 1-29-2029

NOTARY PUBLIC

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

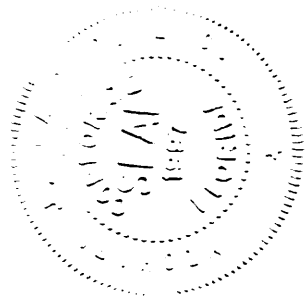
INDEMNIFICATION

To the fullest extent permitted by law, the Bidder expressly agrees to indemnify and hold harmless the City of Key West, their officers, directors, agents, and employees (herein called the "indemnitees") from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees and court costs, such legal expenses to include costs incurred in establishing the indemnification and other rights agreed to in this paragraph, to persons or property, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the Bidder, its Subcontractors or persons employed or utilized by them in the performance of the contract. Claims by indemnitees for indemnification shall be limited to the amount of Bidder's insurance or $1 million per occurrence, whichever is greater. The parties acknowledge that the amount of the indemnity required hereunder bears a reasonable commercial relationship to the contract and it is part of the project specifications or the bid documents, if any.

The indemnification obligations under the contract shall not be restricted in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Bidder under workers' compensation acts, disability benefits acts, or other employee benefits acts, and shall extend to and include any actions brought by or in the name of any employee of the Bidder or of any third party to whom Bidder may subcontract a part or all of the Work. This indemnification shall continue beyond the date of completion of the work.

BIDDER : Marino Construction Group, Inc.

SEAL:



3100 Overseas Highway, Key West, FL, 33040
Address

Signature

Matah Persaud
Print Name

CEO
Title

DATE: 2/18/2026

INDEMNIFICATION

To the fullest extent permitted by law, the Bidder expressly agrees to indemnify and hold harmless the City of Key West, their officers, directors, agents, and employees (herein called the "Indemnitees") from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees and court costs, such legal expenses to include costs incurred in establishing the indemnification and other rights agreed to in this paragraph, to persons or property, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the Bidder, its Subcontractors or persons employed or utilized by them in the performance of the contract. Claims by Indemnitees for indemnification shall be limited to the amount of Bidder's insurance or $1 million per occurrence, whichever is greater. The parties acknowledge that the amount of the indemnity required hereunder bears a reasonable commercial relationship to the contract and is part of the project specifications or the bid documents, if any.

The indemnification obligation under the contract shall not be restricted in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Bidder under workers' compensation acts, disability benefits acts, or other employee benefits acts, and shall extend to and include any actions brought by or in the name of any employee of the Bidder or of any third party to whom Bidder may subcontract a part or all of the Work. This indemnification shall continue beyond the date of completion of the Work.

SIGNED BY: Marine Construction Group, Inc. SEAL:

Bldg Overseas Flights by Key West Int. Airport

Address

Signature

Mark Perreault

Print name

CEO

Title

DATE: 2/14/2024

LOCAL VENDOR CERTIFICATION PURSUANT TO CKW ORDINANCE 09-22 SECTION 2-798

The undersigned, as a duly authorized representative of the vendor listed herein, certifies to the best of his/her knowledge and belief, that the vendor meets the definition of a "Local Business." For purposes of this section, "local business" shall mean a business which:

a. Principal address as registered with the FL Department of State located within 30 miles of the boundaries of the city, listed with the chief licensing official as having a business tax receipt with its principal address within 30 miles of the boundaries of the city for at least one year immediately prior to the issuance of the solicitation.

b. Maintains a workforce of at least 50 percent of its employees from the city or within 30 miles of its boundaries.

c. Having paid all current license taxes and any other fees due the city at least 24 hours prior to the publication of the call for bids or request for Bids.

- Not a local vendor pursuant to Ordinance 09-22 Section 2-798
- Qualifies as a local vendor pursuant to Ordinance 09-22 Section 2-798

If you qualify, please complete the following in support of the self-certification & submit copies of your County and City business licenses. Failure to provide the information requested will result in denial of certification as a local business.

Business Name Marino Construction Group, Inc. Phone: 305-359-5269

Current Local Address: 3100 Overseas Highway,Key West, FL, 33040 Fax: _____
(P.O Box numbers may not be used to establish status)

Length of time at this address: 2+ years

_____ Date: 2/18/2026
Signature of Authorized Representative

STATE OF Florida COUNTY OF Monroe

The foregoing instrument was acknowledged before me this 18th day of February, 2026.

By Matah Persaud, of Marino Construction Group, Inc.
(Name of officer or agent, title of officer or agent) (Name of corporation acknowledging)

or has produced identification _____ as identification
(Type of identification)

_____
Signature of Notary

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

_____
Print, Type or Stamp Name of Notary

Project Administrator
Title or Rank

If you are a local vendor:
Return Completed form with
Supporting documents to:
City of Key West Purchasing

EQUAL BENEFITS FOR DOMESTIC PARTNERS AFFIDAVIT

STATE OF Florida)
: SS
COUNTY OF Monroe)

I, the undersigned hereby duly sworn, depose and say that the firm of Marino Construction Group, Inc. provides benefits to domestic partners of its employees on the same basis as it provides benefits to employees' spouses per City of Key West Ordinance Sec. 2-799.

By: _____

Sworn and subscribed before me this

18th Day of February, 2026.

_____

NOTARY PUBLIC, State of FLORIDA at Large

My Commission Expires: 1-29-2029

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

CONE OF SILENCE AFFIDAVIT

STATE OF Florida)
: SS
COUNTY OF Monroe)

I, the undersigned hereby duly sworn depose and say that all owner(s), partners, officers, directors, employees and agents representing the firm of Marino Construction Group, Inc. have read and understand the limitations and procedures regarding communications concerning City of Key West issued competitive solicitations pursuant to City of Key West Ordinance Section 2-773 Cone of Silence.

Sworn and subscribed before me this

18th Day of February, 2026.

NOTARY PUBLIC, State of Florida at Large

My Commission Expires: 1-29-2029

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

VENDOR CERTIFICATION REGARDING SCRUTINIZED COMPANIES LISTS

Respondent Vendor Name: Marino Construction Group, Inc.

Vendor FEIN: 65-0823279

Vendor's Authorized Representative Name and Title: Matah Persaud, CEO

Address: 3100 Overseas Highway, Key West, FL, 33040

City: Key West State: Florida

Zip: 33040

Phone Number: 305-359-5269

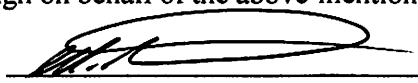
Email Address: mpersaud@marino-construction.com

Section 287.135(2)(a), Florida Statutes, prohibits a company from bidding on, submitting a proposal for, or entering into or renewing a contract for goods or services of any amount if, at the time of contracting or renewal, the company is on the Scrutinized Companies that Boycott Israel List, created pursuant to section 215.4725, Florida Statutes, or is engaged in a boycott of Israel. Section 287.135(2)(b), Florida Statutes, further prohibits a company from bidding on, submitting a proposal for, or entering into or renewing a contract for goods or services over one million dollars ($1,000,000) if, at the time of contracting or renewal, the company is on either the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, both created pursuant to section 215.473, Florida Statutes, or the company is engaged in business operations in Cuba or Syria.

As the person authorized to sign on behalf of Respondent, I hereby certify that the company identified above in the section entitled "Respondent Vendor Name" is not listed on either the Scrutinized Companies that Boycott Israel List, Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List I understand that pursuant to section 287.135, Florida Statutes, the submission of a false certification may subject such company to civil penalties, attorney's fees, and/or costs and termination of the contract at the option of the awarding governmental entity.

Certified By: Matah Persaud (Print Name) CEO (Print Title),

who is authorized to sign on behalf of the above-mentioned company.

Authorized Signature: 

AFFIDAVIT ATTESTING TO NONCOERCIVE CONDUCT FOR LABOR OR SERVICES

Entity/Vendor Name: Marino Construction Group, Inc.
Vendor FEIN: 65-0823279
Vendor's Authorized Representative: Matah Persaud CEO
(Name and Title)
Address: 3100 Overseas Highway
City: Key West State: Florida Zip: 33040
Phone Number: 305-359-5269
Email Address: mpersaud@marino-construction.com

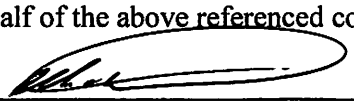
As a nongovernmental entity executing, renewing, or extending a contract with a government entity, Vendor is required to provide an affidavit under penalty of perjury attesting that Vendor does not use coercion for labor or services in accordance with Section 787.06, Florida Statutes.

As defined in Section 787.06(2)(a), coercion means:

1. Using or threating to use physical force against any person;
2. Restraining, isolating, or confining or threating to restrain, isolate, or confine any person without lawful authority and against her or his will;
3. Using lending or other credit methods to establish a debt by any person when labor or services are pledged as a security for the debt, if the value of the labor or services as reasonably assessed is not applied toward the liquidation of the debt, the length and nature of the labor or service are not respectively limited and defined;
4. Destroying, concealing, removing, confiscating, withholding, or possessing any actual or purported passport, visa, or other immigration document, or any other actual or purported government identification document, of any person;
5. Causing or threating to cause financial harm to any person;
6. Enticing or luring any person by fraud or deceit; or
7. Providing a controlled substance as outlined in Schedule I or Schedule II of Section 893.03 to any person for the purpose of exploitation of that person.

As a person authorized to sign on behalf of Vendor, I certify under penalties of perjury that Vendor does not use coercion for labor or services in accordance with Section 787.06. Additionally, Vendor has reviewed Section 787.06, Florida Statutes, and agrees to abide by same.

Certified By: Marino Construction Group, Inc., who is authorized to sign on behalf of the above referenced company.

Authorized Signature: 

Print Name: Matah Persaud

Title: CEO

THE CITY OF KEY WEST E-VERIFY AFFIDAVIT

Beginning January 1, 2021, Florida law requires all contractors doing business with The City of Key West to register with and use the E-Verify System in order to verify the work authorization status of all newly hired employees. The City of Key West requires all vendors who are awarded contracts with the City to verify employee eligibility using the E-Verify System. As before, vendors are also required to maintain all I-9 Forms of their employees for the duration of the contract term. To enroll in the E-Verify System, vendors should visit the E-Verify Website located at www.e-verify.gov.

In accordance with Florida Statute § 448.095, **it is the responsibility of the Awarded Vendor to ensure compliance with all applicable E-Verify requirements.**

By executing this affidavit, the undersigned contractor verifies it compliance with Florida Statute § 448.095, stating affirmatively that the individual, firm, or corporation which is engaged in the performance of services on behalf of the City of Key West, has registered with, is authorized to use, and uses the U.S. Department of Homeland Security's E-Verify system.

Furthermore, the undersigned contractor agrees that it will continue to use E-Verify throughout the contract period, and should it employ or contract with any subcontractor(s) in connection with the performance of services pursuant to this Agreement with The City of Key West, contractor will secure from such subcontractor(s) similar verification of compliance with Florida Statute § 448.095, by requiring the subcontractor(s) to provide an affidavit attesting that the subcontractor does not employ, or subcontract with, an unauthorized alien. Contractor further agrees to maintain records of such compliance during the duration of the Agreement and provide a copy of each such verification to The City of Key West within five (5) business days of receipt.

Failure to comply with this provision is a material breach of the Agreement and shall result in immediate termination of the Agreement without penalty to the City of Key West. Contractor shall be liable for all costs incurred by the City of Key West to secure replacement Agreement, including but not limited to, any increased costs for the same services, and costs due to delay, and rebidding costs, if applicable.

2/18/2026
Date

(Signature of Authorized Representative)

State of Florida,
County of Monroe,

Personally Appeared Before Me, the undersigned authority, Matah Persaud who, ☑ being personally know or ☐ having produced his/her signature in the space provided above on this 18th day of February 20 26.

Signature, Notary Public

January 29, 2029
Commission Expires

Stamp/Seal:

Notary Public State of Florida
Chelsea Pita
My Commission HH 633188
Expires 1/29/2029

Florida Trench Safety Act

Bidder's Name: Florida Seawall Solutions

Bidder acknowledges that included in the various items of the proposal in the total bid price are costs for complying with the Florida Tench Safety Act (90-96, Laws of Florida) effective October 1, 1990. The Bidder further identifies the costs to be summarized below:

	Trench Safety Measure Description	Unit of Measure	Unit Quantity	Unit Cost
A.	open hole	feet/depth	TBD	500.00 per foot
B.				
C.				
D.				

*Total: 500.00 per foot

*This total amount is incidental to the contract bid price and is provided only as Bidder's acknowledgement of the Florida Trench Safety Act. Failure to complete the above may result in the bid being declared non-responsive.

Authorized Representative Signature

Authorized Representative

Authorized Representative Title

Florida Seawall Solutions

Company Name

24526 NW 178th Pl

Mailing Address

High Springs FL 32643

City, State, Zip

239-671-4686

Telephone number

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

Florida dbpr

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE GENERAL CONTRACTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES

MARINO, MICHAEL JAMES

MARINO CONSTRUCTION GROUP INC
7025 SHRIMP RD
2E
KEY WEST FL 33040

LICENSE NUMBER: CGC021647

EXPIRATION DATE: AUGUST 31, 2026

Always verify licenses online at MyFloridaLicense.com

ISSUED: 08/20/2024

Do not alter this document in any form.

This is your license. It is unlawful for anyone other than the licensee to use this document.

Form **W-9**
(Rev. March 2024)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Go to *www.irs.gov/FormW9* for instructions and the latest information.

Give form to the requester. Do not send to the IRS.

Before you begin. For guidance related to the purpose of Form W-9, see *Purpose of Form*, below.

Print or type. See *Specific Instructions* on page 3.

1 Name of entity/individual. An entry is required. (For a sole proprietor or disregarded entity, enter the owner's name on line 1, and enter the business/disregarded entity's name on line 2.)
MARINO CONSTRUCTION GROUP, INC.

2 Business name/disregarded entity name, if different from above.

3a Check the appropriate box for federal tax classification of the entity/individual whose name is entered on line 1. Check only one of the following seven boxes.

☐ Individual/sole proprietor ☐ C corporation ☑ S corporation ☐ Partnership ☐ Trust/estate

☐ LLC. Enter the tax classification (C = C corporation, S = S corporation, P = Partnership) . . . . .

Note: Check the "LLC" box above and, in the entry space, enter the appropriate code (C, S, or P) for the tax classification of the LLC, unless it is a disregarded entity. A disregarded entity should instead check the appropriate box for the tax classification of its owner.

☐ Other (see instructions)

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any)

Exemption from Foreign Account Tax Compliance Act (FATCA) reporting code (if any)

(Applies to accounts maintained outside the United States.)

3b If on line 3a you checked "Partnership" or "Trust/estate," or checked "LLC" and entered "P" as its tax classification, and you are providing this form to a partnership, trust, or estate in which you have an ownership interest, check this box if you have any foreign partners, owners, or beneficiaries. See instructions . . . . . ☐

5 Address (number, street, and apt. or suite no.). See instructions.
3100 OVERSEAS HIGHWAY

Requester's name and address (optional)

6 City, state, and ZIP code
KEY WEST FL 33040

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. See also *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number
[ ][ ][ ] - [ ][ ] - [ ][ ][ ][ ]

or

Employer identification number
65 - 0823279

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification Instructions. *You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and, generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.*

Sign Here | **Signature of U.S. person** | **Date** 02/18/2026

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9*.

What's New

Line 3a has been modified to clarify how a disregarded entity completes this line. An LLC that is a disregarded entity should check the appropriate box for the tax classification of its owner. Otherwise, it should check the "LLC" box and enter its appropriate tax classification.

New line 3b has been added to this form. A flow-through entity is required to complete this line to indicate that it has direct or indirect foreign partners, owners, or beneficiaries when it provides the Form W-9 to another flow-through entity in which it has an ownership interest. This change is intended to provide a flow-through entity with information regarding the status of its indirect foreign partners, owners, or beneficiaries, so that it can satisfy any applicable reporting requirements. For example, a partnership that has any indirect foreign partners may be required to complete Schedules K-2 and K-3. See the Partnership Instructions for Schedules K-2 and K-3 (Form 1065).

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS is giving you this form because they

CamScanner

Client#: 1930344 MARINCON4

ACORD™ CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 7/11/2025

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer any rights to the certificate holder in lieu of such endorsement(s).

PRODUCER USI Insurance Services, LLC 4600 Touchton Rd Building 100, Suite 275 Jacksonville, FL 32246	CONTACT NAME: Amanda Starcher PHONE (A/C, No, Ext): 352-390-2768 FAX (A/C, No): 352-732-0132 E-MAIL ADDRESS: Amanda.Starcher@usi.com
INSURED Marino Construction Group, Inc. P.O. Box 1708 Key West, FL 33041	INSURER(S) AFFORDING COVERAGE — NAIC # INSURER A: Security National Insurance Company — 19879 INSURER B: Insurance Company of the West — 27847 INSURER C: Ohio Casualty Insurance Company — 24074 INSURER D: Progressive Express Insurance Company — 10193 INSURER E: INSURER F:

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY			SES1814945	07/12/2025	07/12/2026	EACH OCCURRENCE	$1,000,000
	CLAIMS-MADE X OCCUR						DAMAGE TO RENTED PREMISES (Ea occurrence)	$100,000
	X BI/PD Ded:5,000						MED EXP (Any one person)	$10,000
							PERSONAL & ADV INJURY	$1,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE	$2,000,000
	POLICY X PRO-JECT LOC						PRODUCTS - COMP/OP AGG	$2,000,000
	OTHER:							$
D	AUTOMOBILE LIABILITY			997807642	05/22/2026	05/22/2026	COMBINED SINGLE LIMIT (Ea accident)	$1,000,000
	ANY AUTO						BODILY INJURY (Per person)	$
	OWNED AUTOS ONLY X SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	X HIRED AUTOS ONLY X NON-OWNED AUTOS ONLY						PROPERTY DAMAGE (Per accident)	$
								$
A	X UMBRELLA LIAB X OCCUR			EXS1809701	07/12/2025	07/12/2026	EACH OCCURRENCE	$5,000,000
	EXCESS LIAB CLAIMS-MADE						AGGREGATE	$5,000,000
	DED X RETENTION $10000							$
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N			WFL507889701	07/12/2026	07/12/2026	X PER STATUTE OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? N (Mandatory in NH)	N/A					E.L. EACH ACCIDENT	$1,000,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$1,000,000
							E.L. DISEASE - POLICY LIMIT	$1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

The General Liability policy includes endorsements that provide Additional Insured status on a Primary and Noncontributory basis for both ongoing and completed operations to any person or entity when required by written contract or agreement. The Automobile Liability policy includes endorsements that provide Additional
Insured status on Primary and Noncontributory basis to any person or entity when required by written
(See Attached Descriptions)

CERTIFICATE HOLDER

For Information Purposes Only

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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2025 / 2026
MONROE COUNTY BUSINESS TAX RECEIPT
EXPIRES SEPTEMBER 30, 2026

RECEIPT# 30140-105410

Business Name: MARINO CONSTRUCTION GROUP INC

Owner Name: MICHAEL J MARINO PRES
Mailing Address:
3100 OVERSEAS HWY
KEY WEST, FL 33040

Business Location: MO CTY
KEY WEST, FL 33040

Business Phone: 305-359-5269
Business Type: CONTRACTOR (GENERAL)

Employees 20

STATE LICENSE: CGC021647

Tax Amount	Transfer Fee	Sub-Total	Penalty	Prior Years	Collection Cost	Total Paid
50.00	0.00	50.00	0.00	0.00	0.00	50.00

Paid WRB-24-00101385 09/15/2025 50.00

THIS BECOMES A TAX RECEIPT WHEN VALIDATED

Sam C. Steele, CFC, Tax Collector
PO Box 1129, Key West, FL 33041

THIS IS ONLY A TAX. YOU MUST MEET ALL COUNTY AND/OR MUNICIPALITY PLANNING, ZONING AND LICENSING REQUIREMENTS.

MONROE COUNTY BUSINESS TAX RECEIPT
P.O. Box 1129, Key West, FL 33041-1129
EXPIRES SEPTEMBER 30, 2026

RECEIPT# 30140-105410

Business Name: MARINO CONSTRUCTION GROUP INC

Owner Name: MICHAEL J MARINO PRES
Mailing Address:
3100 OVERSEAS HWY
KEY WEST, FL 33040

Business Location: MO CTY
KEY WEST, FL 33040

Business Phone: 305-359-5269
Business Type: CONTRACTOR (GENERAL)

Employees 20

STATE LICENSE: CGC021647

Tax Amount	Transfer Fee	Sub-Total	Penalty	Prior Years	Collection Cost	Total Paid
50.00	0.00	50.00	0.00	0.00	0.00	50.00

Paid WRB-24-00101385 09/15/2025 50.00

State of Florida
Department of State

I certify from the records of this office that MARINO CONSTRUCTION GROUP, INC. is a corporation organized under the laws of the State of Florida, filed on October 27, 1997.

The document number of this corporation is P97000092251.

I further certify that said corporation has paid all fees due this office through December 31, 2025, that its most recent annual report/uniform business report was filed on March 31, 2025, and that its status is active.

I further certify that said corporation has not filed Articles of Dissolution.

Given under my hand and the Great Seal of the State of Florida at Tallahassee, the Capital, this the Twenty-first day of August, 2025

Secretary of State

Tracking Number: 3095591733CU

To authenticate this certificate,visit the following site,enter this number, and then follow the instructions displayed.

https://services.sunbiz.org/Filings/CertificateOfStatus/CertificateAuthentication

Detail by Entity Name

Florida Profit Corporation
MARINO CONSTRUCTION GROUP, INC.

Filing Information

Document Number	P97000092251
FEI/EIN Number	65-0823279
Date Filed	10/27/1997
State	FL
Status	ACTIVE
Last Event	AMENDMENT
Event Date Filed	05/20/2019
Event Effective Date	NONE

Principal Address

3100 Overseas Hwy
Key West, FL 33040

Changed: 03/31/2025

Mailing Address

PO BOX 1706
KEY WEST, FL 33041

Changed: 11/11/2010

Registered Agent Name & Address

MARINO, MICHAEL J
824 Shavers Lane
KEY WEST, FL 33040

Address Changed: 01/13/2015

Officer/Director Detail

Name & Address

Title DPST

MARINO, MICHAEL J
824 Shavers Lane
KEY WEST, FL 33040

Title SV

MARINO, ANGELA KAY
824 Shavers Lane
KEY WEST, FL 33040

Title CEO

Persaud, Matah S
PO Box 1706
Key West, FL 33041

Annual Reports

Report Year	Filed Date
2023	02/03/2023
2024	03/06/2024
2025	03/31/2025

Document Images

03/31/2025 -- ANNUAL REPORT	View image in PDF format
03/06/2024 -- ANNUAL REPORT	View image in PDF format
02/03/2023 -- ANNUAL REPORT	View image in PDF format
01/31/2022 -- ANNUAL REPORT	View image in PDF format
03/01/2021 -- AMENDED ANNUAL REPORT	View image in PDF format
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01/29/2020 -- ANNUAL REPORT	View image in PDF format
05/20/2019 -- Amendment	View image in PDF format
02/14/2019 -- ANNUAL REPORT	View image in PDF format
05/09/2018 -- ANNUAL REPORT	View image in PDF format
01/09/2017 -- ANNUAL REPORT	View image in PDF format
01/25/2016 -- ANNUAL REPORT	View image in PDF format
01/13/2015 -- ANNUAL REPORT	View image in PDF format
01/15/2014 -- ANNUAL REPORT	View image in PDF format
01/24/2013 -- ANNUAL REPORT	View image in PDF format
01/10/2012 -- ANNUAL REPORT	View image in PDF format
01/10/2011 -- ANNUAL REPORT	View image in PDF format
11/11/2010 -- REINSTATEMENT	View image in PDF format
01/08/2009 -- ANNUAL REPORT	View image in PDF format
04/07/2008 -- Name Change	View image in PDF format
02/14/2008 -- ANNUAL REPORT	View image in PDF format
02/15/2007 -- ANNUAL REPORT	View image in PDF format
03/13/2006 -- ANNUAL REPORT	View image in PDF format
01/29/2005 -- ANNUAL REPORT	View image in PDF format
03/25/2004 -- ANNUAL REPORT	View image in PDF format
01/16/2003 -- ANNUAL REPORT	View image in PDF format
05/07/2002 -- ANNUAL REPORT	View image in PDF format
05/01/2001 -- ANNUAL REPORT	View image in PDF format

08/22/2000 -- ANNUAL REPORT	View image in PDF format
02/19/1999 -- ANNUAL REPORT	View image in PDF format
11/25/1998 -- REINSTATEMENT	View image in PDF format
10/27/1997 -- Domestic Profit Articles	View image in PDF format

BIDDER'S CHECKLIST

(Note: The purpose of this checklist is to serve as a reminder of major items to be addressed in submitting a bid and is not intended to be all inclusive. It does not alleviate the Bidder from the responsibility of becoming familiar with all aspects of the Contract Documents and proper completion and submission of his bid.)

1.	All Contract Documents are thoroughly read and understood.	[✓]
2.	All blank spaces in bid filled in, using black ink or typewritten.	[✓]
3.	Total and unit prices added correctly and attached Schedule of Values	[✓]
4.	Addenda acknowledged.	[✓]
5.	Subcontractors are named as indicated in the bid.	[✓]
6.	Experience record included.	[✓]
7.	Bid signed by authorized officer and notarized.	[✓]
8.	Bid Bond completed and executed, including power-of-attorney dated the same date as Bid Bond.	[✓]
9.	Bidder familiar with federal, state, and local laws, ordinances, rules and regulations affecting performance of the work.	[✓]
10.	Bidder, if successful, able to obtain and/or demonstrate possession of required licenses and certificates within ten (10) calendar days after receiving a Notice of Award.	[✓]
11.	Bid submitted intact with 1 original, and 2 flash drives as stated in the Invitation to Bid.	[✓]
12.	Bid Documents submitted in sealed envelope and addressed and labelled *in conformance with the instructions in the Invitation to Bid.*	[✓]
13.	Bid Certifications and Affidavits signed and notarized, where applicable.	[✓]

SECTION 2 | HAZARD IDENTIFICATION AND RISK ASSESSMENT

VESSEL/PROJECT:	Disney Dream	**JOB NO:**	N/A
WORK DESCRIPTION:	DN 350 Discharge Blank	**Prepared By:**	Matt Barker
PROJECT LOCATION:	Port Everglades		

SECTION 2.1 - RISK EVALUATION

SGS Risk Assessment Matrix

Severity (S)	Likelihood (L)				
	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Likely (5)
Negligible (A)	A1	A2	A3	A4	A5
Minor (B)	B1	B2	B3	B4	B5
Moderate (C)	C1	C2	C3	C4	C5
Major (D)	D1	D2	D3	D4	D5
Catastrophic (E)	E1	E2	E3	E4	E5

Action for Risk Levels

Risk Level	Risk Acceptability	Risk Ratings	Recommended Actions
Low	Acceptable	A1, B1, C1, D1, A2, B2, A3, A4	• Risk may be acceptable. • Review the task to see if the risk can be reduced. • Monitor and ensure controls stay in place.
Medium	Tolerable	E1, C2, D2, E2, B3, C3, D3, B4, C4, A5, B5	• Where possible, redefine task in view of the anticipated hazard, or review to reduce risk. • Effort should be made to reduce risk further as reasonably practicable. • Additional monitoring and controls should be considered.
High	Not Acceptable	E3, D4, E4, C5, D5, E5	• Task must not proceed. • Redefine or add further control measures to reduce risk. • Reassess control measures before commencing task to ensure they are adequate.

SECTION 2.2 - ACTIVITY HAZARD ANALYSIS AND RISK MANAGEMENT

Activity	Hazard	Effect	Severity	Likelihood	Rating 1	Risk Control Measures	Severity	Likelihood	Rating 2
Example task	What can happen?	What can it do?	C	3	C3	What can we do about it?	B	2	B2
Setup dive station / manual handling	Tripping over equipment / Improper lifting / Improper setup	Injury / Damage to equipment	B	3	B3	Area secured / Good house keeping / Correct lifting techniques for manual lifting / Correct setup procedure / SGS JSA	B	2	B2
Setup Power supply to dive station	Improper connection / Generator run out of fuel	Injury to diver in water / Injury to topside crew /Damage equipment	C	3	C3	Only use proper connection with trained personnel / Check fuel regularly / Test electrical rotation to ensure proper connection has been made / SGS JSA	C	1	C1
Diver entering the water	Jumping on submerged items	Injury to diver	C	2	C2	First dive in goes down the ladder to inspect area under entry point.	B	1	B1

Activity	Hazard	Effect	Severity	Likelihood	Rating 1	Risk Control Measures	Severity	Likelihood	Rating 2
Diving Operation	Passing approaching vessel near divers / Prop wash / Umbilical in running gear	Severe injury / Divers pushed around by prop wash / Underwater tools fall to bottom	**D**	**3**	**D3**	Notify port authority of diving operations / Stand by on VFH channel for local port / Hoist alpha flag / Have bridge of vessel stay on watch / Monitor AIS if possible / SGS JSA	**B**	**2**	**B2**
Diving Operation	Intake and Discharge /Suction and differential pressure / burn from discharge	Injury / Entrapment	**C**	**2**	**C2**	Lockout tagout procedure / Good communication with vessel if working near suction or discharge	**C**	**1**	**C1**
Diving Operation	Propeller, thruster, steering gear, stabilizer moving while divers in the water	Injury to diver / Damage to equipment	**D**	**3**	**D3**	Lockout tagout procedure / Good communication with vessel / Signs in place on vessel / Nothing to be de-isolated without Supervisors approval.	**D**	**1**	**D1**
Diving Operation	Cathodic protection / Transducers	Injury to diver / electrical shock	**C**	**3**	**C3**	Lockout tagout procedure	**C**	**1**	**C1**
Diving Operation	Potential of sewage discharge or garbage overboard while divers in the water	Injury to diver / Health hazard	**C**	**3**	**C3**	Lockout tagout procedure / Good communication with vessel	**C**	**1**	**C1**
Diving Operation	Increased seas causing vessel to break lines / Seas to rough for diver to exit water safely / Lighting hitting dive station	Injury to diver / Electrical shock / Damage to vessel and equipment	**D**	**2**	**D2**	Vessel and dive supervisor monitor weather forecast / Good communication between both parties / postpone operation if forecast is unfavorable or above SGS weather limits / SGS JSA	**D**	**1**	**D1**
Diving Operation	Loss of main breathing air to divers while in the water	Injury to diver / Unable to launch stand by diver	**D**	**3**	**D3**	Test and maintain breathing air / Always have an independent back for main air / Diver bailout bottle filled and tested / trained and qualified personnel / SGS JSA	**D**	**1**	**D1**

Activity	Hazard	Effect	Severity	Likelihood	Rating 1	Risk Control Measures	Severity	Likelihood	Rating 2
Diving Operation	Contaminated air mixed with breathing gas to divers	Injury to diver / Unable to launch stand by diver	**D**	**3**	**D3**	Compressor clear of any exhaust / Filters cleaned and checked / Always have an independent back for main / Diver bailout bottle filled and tested / SGS JSA	**D**	**1**	**D1**
Diving Operation	Loss of communication to divers	Injury to diver / minimal control during an emergency	**C**	**3**	**C3**	Pre dive communications test / Use of pull signals of flashing of light of communication goes out / Maintain equipment / SGS JSA	**C**	**1**	**C1**
Diving Operation	Loss of communication to vessel	Delayed response in event of an emergency / minimal control of dive station	**C**	**3**	**C3**	Radio check with vessel every 2 hours / Spare battery or charge for handheld radio / Pre dive meeting with vessel	**C**	**1**	**C1**
Diving Operation	Moving vehicles or cranes within the vicinity of dive station	Injury to diver / Injury to topside crew / Damage to equipment	**D**	**3**	**D3**	Working area cordoned off / Use of high visibility clothing and hard hats / Good communication with all parties / SGS JSA	**D**	**1**	**D1**
Blank Installation / Curvature	Water ingress into vessel, patch leaking, failed seal on patch	Injury to diver / Damage to equipment	**D**	**3**	**D3**	Never put a flat patch on a curved area, never exceed 2" - 50mm of neoprene on the gasket of the patch, template for curvature if needed, if there is a leak find and fix it before moving removing valve internally. Have benski sealant on diver by to stop minor leak.	**D**	**1**	**D1**
Blank Installation	Diver Entrapment from unexpected water flow	Injury to Diver	**C**	**3**	**C3**	Ensure Discharge is Locked out before diving begins. Confirm no backflow or suction from crossover piping. Good communication between vessel crew and dive team.	**C**	**1**	**C1**

Activity	Hazard	Effect	Severity	Likelihood	Rating 1	Risk Control Measures	Severity	Likelihood	Rating 2
Blank Installation	Increased suction due to patch failing, water ingress into vessel	Injury to diver / Water Ingress into vessel	**D**	**2**	**D2**	Blank plate inspected prior to use for any defects. Neoprene on blank plate inspected before use. Replace any neoprene that is defective. T-bar for patch, make sure hardware is in good working order. Have secondary patch in site in case of structural defects. Have benski sealant on diver by to stop minor leak.	**D**	**1**	**D1**
Blank Installation	Blank placed over wrong over board	Water Ingress / Damage to vessel equipment	**C**	**2**	**C2**	Verify correct overboard by number / drawing / or knocking internally, good communication between vessel. Valve not removed internally until diver confirm blank is secured.	**C**	**1**	**C1**
Blank Installation	Misalignment causing improper seal	Water Ingress / Delayed job	**C**	**2**	**C2**	Mark alignment points underwater. Ensure correct size blank is being used for overboard. Never attempt to use the wrong size / type of blank. Have benski sealant on diver by to stop minor leak.	**C**	**1**	**C1**
Rigging on surface and underwater	Blank falling in diver while lowering into the water	Injury to diver	**C**	**2**	**C2**	Proper rigging techniques from topside crew /Diver not below blank while being lowered into the water.	**C**	**1**	**C1**
Blank Removal	Hardware failing during removal	Delayed job / Blank unable to be removed	**C**	**2**	**C2**	Use proper tools and hardware while installing and removing patch. Do not over tighten and strip hardware.	**D**	**1**	**D1**

	Florida Seawall Solutions 24526 NW 178th Place High Springs, FL 32643 813-377-2463	Project Address: Navy Mole Pier seawall repairs Care of GC: Marino Construction Group Contact: Adrian Pettit 703 Eisenhower Dr Key West, FL 33040 (305) 262-6181 l Apettit@marino-construction.com	Created By: Rodney Reyes (239) 671-4686 Rodney@floridaseawallsolutions.com

Florida Seawall Solutions and its subcontractors agree to adhere to the following dive safety conditions outlined below.

Further information and literature on the specific SOP to comply can be made available upon request.

Safety/Dive Plan Each Bidder must submit a proposed Dive/Safety Plan to the City. This plan must align with applicable OSHA regulations for commercial diving, U.S. Coast Guard standards, and Florida-specific diving practices. The plan should include, but is not limited to, the following elements:

1. Dive Team Composition and Qualifications
• Names and qualifications (certifications, experience) of all dive team members. Copies of diving certifications (e.g., ADCI, NAUL, PADI, or commercial diving certifications).
• Medical clearance documentation for all divers (in compliance with OSHA 29 CFR 1910 Subpart 1).
2. Dive Operations Procedures
• Detailed description of planned dive operations and techniques.
• Step-by-step task outline for the underwater inspection. • Site-specific dive plan, including expected depth, bottom conditions, visibility, and potential hazards.
3. Safety and Emergency Protocols
Emergency response plan, including:
• Nearest hyperbaric chamber and contact information.
• Emergency medical transport plan.
• Rescue diver procedures.
• On-site first aid and emergency oxygen supply details.
• Surface support personnel and roles.
4. Equipment Specifications
List and specifications of all dive equipment to be used, including:
• Diving suits and helmets.
• Communication systems.
• Air supply systems and redundancy.
• Underwater lighting and video equipment.
• Maintenance and inspection records of the equipment.
5. Compliance and Regulations
Statement of compliance with:
• OSHA 29 CFR 1910 Subpart I (Commercial Diving Operations).
• U.S. Coast Guard requirements (if operating from a vessel).
• Florida-specific environmental or safety regulations.
• Project-specific Job Hazard Analysis (JHA) or risk assessment.
6. Environmental and Wildlife Considerations • Plan to mitigate environmental impact (e.g., avoiding coral, manatee protection zones). • Coordination with FWC or NOAA if protected areas or species may be affected
7. Communication and Reporting Protocols
• Pre-dive briefing and post-dive debriefing procedures.
• Method and schedule for reporting dive progress and safety checks.
• Coordination with City of Key West representatives and/or harbor officials.

C. Underwater Welder Qualifications

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Gary Goins
Date of birth	July 4, 1993
ABS cert. No:	LA 6681381-01
Identification No.	DL G520-299-93-244-0
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above. WO: LA

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.	Noted		May 1, 2025
2						
3						
4						
5						
6						

ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS

Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Gary Goins
Date of birth	July 4, 1993
ABS cert. No:	LA 6681381-02
Identification No.	DL G520-299-93-244-0
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	ABS-UW-111-BW-DH36-20-3G-WPS
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	AH/DH 36, ASTM A572-50/A709-50	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	20 mm	10 mm – 30 mm
Type of welded joint	Groove Weld in Butt Joint, Stinger Beads	Groove and Fillet Welds in Plate and Pipe (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3G), Downward	PA (flat), PG (vertical, downward)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test		Not Required
Bend test	Performed and Accepted	
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.			May 1, 2025
2						
3						
4						
5						
6						

ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS

Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Tyler Doak
Date of birth	April 13, 1992
ABS cert. No:	LA 6681381-03
Identification No.	DL D200-810-92-133-0
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.	NOCIR		May 1, 2025
2						
3						
4						
5						
6						

ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS
Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Tyler Doak
Date of birth	April 13, 1992
ABS cert. No:	LA 6681381-04
Identification No.	DL D200-810-92-133-0
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	ABS-UW-111-BW-DH36-20-3G-WPS
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	AH/DH 36, ASTM A572-50/A709-50	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	20 mm	Groove 10 mm - 30 mm, Fillet Unlimited
Type of welded joint	Groove Weld in Butt Joint, Stinger Beads	Groove and Fillet Welds in Plate and Pipe (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3G), Downward	PA (flat), PG (vertical, downward)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test		Not Required
Bend test	Performed and Accepted	
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.			May 1, 2025
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SUBSEA GLOBAL SOLUTIONS
Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Tai Ogunsanya
Date of birth	October 1, 1985
ABS cert. No:	LA 6681381-05
Identification No.	PP 561929505
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.	Nedar		May 1, 2025
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ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS
Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Zach Robles
Date of birth	October 29, 1999
ABS cert. No:	LA 6681381-06
Identification No.	DL 40443887
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.			May 1, 2025
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ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS
Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Bobby Ferguson
Date of birth	March 9, 1989
ABS cert. No:	LA 6681381-07
Identification No.	DL 47280346
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.			May 1, 2025
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ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS

Uwe Aschemeier
SR Welding Engineer

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Matthew Houllier
Date of birth	February 12, 1985
ABS cert. No:	LA 6681381-08
Identification No.	DL 851712
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downward, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.		May 1, 2025	Uwe Aschemeier SR Welding Engineer
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ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS

WELDER'S QUALIFICATION CERTIFICATE

Welder's name:	Cody Attin
Date of birth	August 8, 1988
ABS cert. No:	LA 6681381-09
Identification No.	DL 867545
Employer's name and address	Subsea Global Solutions, 12062 NW, 27th Ave., Miami, FL 33167, USA
WPS/pWPS No.	MDC-WPS-02A, MDC-WPS-03A
Date of initial approval	October 29, 2024



This is to certify that the welder has passed the qualification test [/and re-validation record audit] according to the rules of ABS and is qualified to undertake welding operation specified in Range of Qualification of this certificate.

Items	*Weld Test Details*	*Range of Qualification*
Welding process	SMAW (111, WET)	SMAW (111, WET)
Base metal	ASTM A36	Ordinary and Higher Strength Hull Structural Steel
Filler metal, type, and thickness	Hydroweld FS, Ø3.2 mm	Hydroweld FS, Ø3.2 mm
Filler metal classification	UWE70XX-YZ / UWE49XX-YZ	UWE70XX-YZ / UWE49XX-YZ
Plate thickness	12 mm	Unlimited
Type of welded joint	Fillet Welds in T-Joints, Stinger Beads	Fillet Welds in Plates and Pipes (Dia. > 600 mm), Stringer Bead only
Welding position	PG (3F), Downhill Progression, PD (4F)	PA (flat), PB (horizontal), PG (vertical), PD (overhead)
Water depth	6.5 m	3 m to 16.5 m
Other details	None	None

TEST RECORD

Type of test	*Performed and Accepted*	*Not Required*
Visual examination	Performed and Accepted	
Radiographic examination		Not Required
Surface examination		Not Required
Macro examination	Performed and Accepted	
Fracture test	Performed and Accepted	
Bend test		Not Required
Additional tests		Not Required

Initial validity period of welding certificate 3 years.

Comments:

We certify that the above statements are correct and that the test pieces were prepared, welded, and tested in accordance with the specified codes or standards. **ANSI/AWS D3.6M:2017 - CLASS A**

Organization:	Subsea Global Solution	Surveyor to ABS Los Angeles	
Name:	Uwe Aschemeier	Name of Surveyor:	Mostafa Akhavannouri
Date:	November 1, 2024	Date:	November 1, 2024

This certificate remains valid only whilst the welder remains in the employment of the manufacturer above.

No.	Endorsement (6 monthly)	Signature and position of employers representative verifying employment and welding performance		Signature of surveyor verifying acceptable welding performance (if applicable)	Office stamp and date	
1	May 1, 2025	Uwe Aschemeier	Sr. Welding Eng.	Noun		May 1, 2025
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ABS LOS ANGELES

SUBSEA GLOBAL SOLUTIONS
Uwe Aschemeier
SR Welding Engineer

WELDER PERFORMANCE QUALIFICATION

Ref. No:
WES2403

According to **AWS D3.6M: 2017, Underwater Welding Class A** (e.g. AWS D1.1, ASME IX)

Photo (if required)



Welder's / Operator's / Tack Welder´s name:	**Caleb William Drake**
Date of birth:	**August 25, 1992**
Stamp No. / Id. No.:	**-**
Project:	**Welder Performance Qualification**
Manufacturer/Employer:	**SUBSEA GLOBAL SOLUTIONS**
These tests performance are performed at:	**Gang-Neung Campus, Korea Polytechnics**
Date of test welding:	**July 15/16, 2024**
WPS No.:	**MIA99562-2**

Base metal(s)	Specification	Type or Grade	AWS Group No.	Size (NPS)	Schedule	Thickness	Diameter
Base Material(s)	**NV A36 (Equiv. ASTM A36)**	**NV A36 (Equiv. ASTM A36)**	**P1**	**-**	**-**	**-**	**-**
Welded to Base Material(s)	**NV A36 (Equiv. ASTM A36)**	**NV A36 (Equiv. ASTM A36)**	**P1**	**-**	**-**	**-**	**-**

Variables	Actual Values		Range Qualified	
Type of Weld Joint	**Fillet**	**Plate**	**Fillet**	**Plate, and Pipe in case diameter is over than 600 mm (24 in.)**
Base Metal Group(s)	**P1**	**P1**	**P1**	**P1**

Test Piece	Groove	Fillet	Groove	Fillet
Test piece Thickness	**-**	**12 mm**	**Not Qualified**	**All thickness (Un-limited)**
Pipe Diameter(O.D.)	**-**	**-**	**-**	**-**

Welding Process(es)		
Type[1]	**SMAW, Wet, Fillet, Muti.-pass**	**SMAW, Wet, Fillet, Single & Muti.-pass**
Backing	**No**	**Qualified**
Filler Metal		
Classification	**AWS 5.35 / A535M: 2015**	**AWS 5.35 / A535M: 2015**
F-Number	**-**	**-**
Position		
Groove	**-**	**-**

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.

1 Manual, Semiautomatic, Mechanized, Automatic.

Fillet	**PG (3F)**	**F, Vdown**
Weld direction	**Vertical down**	**Fillet, Vertical down for plate, and for pipe in case diameter is over 600 mm (24 in.)**
GMAW Transfer Mode	**-**	**-**
Single or multiple electrodes	**Single**	**Single**
Gas / Flux Type	**-**	**-**
Others	**Test Depth: 5 meters** **Visibility: over 1 meter**	**Qualified Depth: up to 15 meters** **Min. Visibility: 300 mm**

Test Results

Type of test	Acceptance criteria	Results	Remarks
Visual Examination x 1 **Maroetch x 2** **Break Test x 1**	**AWS D3.6M, Cl. 9.7.2.1.** **AWS D3.6M, Cl. 9.7.2.2.** **AWS D3.6M, Cl. 9.7.2.4.**	**Accepted** **Accepted** **Accepted**	

Laboratory

Test Conducted by	
Laboratory (name):	**Gang-Neung Campus, Korea Polytechnics**
Test No.:	**-**
File Number:	**-**

Other information (Pre- and/or post weld heat treatment, etc.):

This is to confirm:

We, the undersigned, confirm that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of the named standard.

Place: **Gang-Neung, Korea** Date: **July 15/16, 2024.**

Witnessed by

Bo-Hyun YOON

Place: **Gang-Neung, Korea** Date: **July 15/16, 2024.**

Employer's representative

SUBSEA GLOBAL SOLUTIONS

Uwe Aschemeier
SR Welding Engineer

Uwe Aschemeier

Place: **Gang-Neung, Korea** Date: **July 15/16, 2024.**

for **DNV**

Bo-Hyun YOON
Surveyor

D. Top Side Welder Qualifications

Work Order:	5984964-A
First Visit Date:	10-Aug-2023
Last Visit Date:	14-Aug-2023
Vendor PO Number:	Kevin Peter
Survey Location:	Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

Welder Qualification Report - Remote Survey

Customer Name SGS SAINT JOHN DIVING ULC

WCN of Customer 452900

Location Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

This is to certify that the undersigned Surveyors to this Bureau did at the request of SGS SAINT JOHN DIVING ULC , provide Remote Survey attendance from 10-Aug-2023 to 14-Aug-2023, carry out the following survey and report as follows:

Welder Qualifications

Welder Name	*Welder ID Number*	*Welding Process*	*Type of welded joint*	*Welding Procedure Specification*	*Pass/Fail*
SEE NARRATIVE	SEE NARRATIVE	SMAW MANUAL	PIPE TO PIPE "V" JOINT 75 DEGREES	SGS-LR-SMAW-6G REV. 0.	Pass

Statement of Work - Classification Service - Welders Qualification Survey

- The welder or welding operator's qualification test record was completed by the manufacturer.
- Testing carried out as required by approved procedure/specifications and as reported herein.
- Testing machines are maintained in a satisfactory condition and records of their recheck or calibration dates confirmed.
- The welder or operator followed the approved procedure/specification including positions.
- The welding consumables and the welding process were in accordance with approved ABS procedures or specifications.

Report Findings

Statement/Observation

Finding No	*Asset*	*Survey Task*	*Date Created*
1.0	-	Welders Qualification Survey SGS-LR-SMAW-6G REV. 0.	14-Aug-2023

Found
Welders Qualification Survey

Survey Location : Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

This is to Certify that the undersigned surveyor(s) to this Bureau did, at the request of the customer, carry out the following survey and report as follows:

The following were verified as deemed necessary and presented as contained in this report:

The welding consumables and the welding process were in accordance with approved ABS procedures or specifications.

The welder or operator followed the approved procedure/specification in Position 6 G

Testing carried out as required by approved procedure/specifications and as reported herein.

NOTE: This Report evidences that the survey reported herein was carried out in compliance with one or more of the Rules, guides, standards or other criteria of the American Bureau of Shipping and is issued solely for the use of the Bureau, its committees, its clients or other authorized entities. This Report is a representation only that the vessel, structure, item of material equipment, machinery or any other item covered by this Report has been examined for compliance with, or has met one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping. The validity, applicability and interpretation of this Report is governed by the Rules and standards of American Bureau of Shipping who shall remain the sole judge thereof. Nothing contained in this Report or in any notation made in contemplation of this Report shall be deemed to relieve any designer, builder, owner, manufacturer, seller, supplier, repairer, operator or other entity of any warranty express or implied.

Work Order:	5984964-A
First Visit Date:	10-Aug-2023
Last Visit Date:	14-Aug-2023
Vendor PO Number:	Kevin Peter
Survey Location:	Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

The welder or welding operator's qualification test record was completed by the Boilermakers Local 647 UNION.

Testing machines are maintained in a satisfactory condition and records of their recheck or calibration dates confirmed.

Thirteen (13) SMAW welder qualifications were witnessed as follows:

Welder qualification tests were carried out at the Boilermakers Local 647 UNION, for the SUBSEA GLOBAL SOLUTIONS Welding specification (WPS) SGS-LR-SMAW-6G Rev.0.

Qualification tests were held in accordance with 2023 Marine Vessel Rules,

And AWS D1.1 Structural Welding Code – Steel.

A. Welding Process Description:

1. Process: SMAW (111)

2. Position: 6G

3. Base Metal: ASTM A106 Grade B&C / ASTM A5191026HR

4. Thickness Welded: 15 mm Pipe Diameter 70 mm (OD)

5. Filler materials: Spec: Lincoln Electric AWS A5.1:2012, ASME SFA-5.1, Product Fleetweld 5p+, Excalibur 7018 MR

B. Examination:

1. Welding, testing, and examination witnessed and considered satisfactory

2. The welding procedure was previously approved by ABS.

3. Tests performed: Visual examination, side bends.

C. Approvals:

The following welders are qualified to weld SMAW, WPS SGS-LR-SMAW-6G Rev.0.

WELDER NAME	WELDER ID #
Jacob Mcintyre	M6132
James Fluey	F5014
Chris Stein	S3538
Mark Kerkaert	K5012
Brent Vogel	V2105
Jada Coover	C9247
Beau Hehn	H6753
John Sprung	S6839
Tyler Lichty	L3122
Josh Phillips	P5267
Jeremy Stemick	S9820
Nick Green	G7991
Jason Mohler	M1716

Work Order:	5984964-A
First Visit Date:	10-Aug-2023
Last Visit Date:	14-Aug-2023
Vendor PO Number:	Kevin Peter
Survey Location:	Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

Remote Survey Statement(s):
One or more surveys has been performed remotely based on information submitted by the manufacturer and accomplished through the use of information and communication technology.

Attending Surveyor(s):

Maxwell, William C.
Signed-off Date: 14-Aug-2023

William C. Maxwell
14 AUG 2023

HOUSTON

Reviewing Surveyor(s)

Work Order Reviewer: Achorn, Bradley M.
Work Order Credit Date: 14-Aug-2023

Work Order:	4669349-A
First Visit Date:	01-Mar-2021
Last Visit Date:	02-Mar-2021
Vendor PO Number:	2009-030821
Survey Location:	Sturgeon Bay

Welder Qualification Report

Customer Name SUBSEA GLOBAL SOLUTIONS LLC.

WCN of Customer 273798

Location Sturgeon Bay

This is to certify that the undersigned Surveyors to this Bureau did at the request of SUBSEA GLOBAL SOLUTIONS LLC. , from 01-Mar-2021 to 02-Mar-2021, carry out the following survey and report as follows:

Welder Qualifications

Welder Name	*Welder ID Number*	*Welding Process*	*Plate thickness and Welding Positions*	*Pass/Fail*
SEE NARRATIVE	SEE NARRATIVE	SMAW	16 °mm and 6G	Pass

Statement of Work - Classification Service - Welders Qualification Survey

- The welder or welding operator's qualification test record was completed by the manufacturer.
- Testing carried out as required by approved procedure/specifications and as reported herein.
- Testing machines are maintained in a satisfactory condition and records of their recheck or calibration dates confirmed.
- The welder or operator followed the approved procedure/specification including positions.
- The welding consumables and the welding process were in accordance with approved ABS procedures or specifications.

Report Findings

Statement/Observation

Finding No	*Asset*	*Survey Task*	*Date Created*
80.0	-	Welders Qualification Survey	02-Mar-2021

Found
Welders Qualification Survey

Survey Location : Boilermakers Local 647 Training Center, 9459, US HWY 210, Ramsey, MN

This is to Certify that the undersigned surveyor(s) to this Bureau did, at the request of the customer, carry out the following survey and report as follows:

The following were verified as deemed necessary and presented as contained in this report:

The welding consumables and the welding process were in accordance with approved ABS procedures or specifications.

The welder or operator followed the approved procedure/specification including positions.

Testing carried out as required by approved procedure/specifications and as reported herein.

NOTE: This Report evidences that the survey reported herein was carried out in compliance with one or more of the Rules, guides, standards or other criteria of the American Bureau of Shipping and is issued solely for the use of the Bureau, its committees, its clients or other authorized entities. This Report is a representation only that the vessel, structure, item of material equipment, machinery or any other item covered by this Report has been examined for compliance with, or has met one or more of the Rules, guides, standards or other criteria of American Bureau of Shipping. The validity, applicability and interpretation of this Report is governed by the Rules and standards of American Bureau of Shipping who shall remain the sole judge thereof. Nothing contained in this Report or in any notation made in contemplation of this Report shall be deemed to relieve any designer, builder, owner, manufacturer, seller, supplier, repairer, operator or other entity of any warranty express or implied.

Work Order:	4669349-A
First Visit Date:	01-Mar-2021
Last Visit Date:	02-Mar-2021
Vendor PO Number:	2009-030821
Survey Location:	Sturgeon Bay

The welder or welding operator's qualification test record was completed by the Boilermakers Local 647 UNION.

Testing machines are maintained in a satisfactory condition and records of their recheck or calibration dates confirmed.

Twenty-two (22) SMAW welder qualifications were witnessed as follows:

Welder qualification tests were carried out at the Boilermakers Local 647 UNION, for the SUBSEA GLOBAL Solutions Welding specification (WPS) SGS-LR-SMAW-6G Rev.0. Qualification tests were held in accordance with 2021 ABS Rules for Building and Classing Steel Vessels , AWS

D1.1 Structural Welding Code - Steel, and the ABS Naval Vessel Rules.

A. Welding Process Description:

1. Process: SMAW (111)
2. Position: 6G
3. Base Metal: ASTM A106 Grade B&C / ASTM A5191026HR
4. Thickness Welded: 0.625” (5/8”), Pipe Diameter 2.75” (OD)
5. Filler materials: Spec: Lincoln Electric AWS A5.1:2012, ASME SFA-5.1, Product Fleetweld 5p+, Excalibur 7018 MR

B. Examination:

1. Welding, testing, and examination witnessed and considered satisfactory
2. The welding procedure was previously approved by ABS.
3. Tests performed: Visual examination, face bend, root bend

C. Approvals:

The following welders are qualified to weld SMAW, WPS SGS-LR-SMAW-6G Rev.0, 6G

#	Name	Date of Birth	Place of Birth	Welder ID #
1	Kevin Pellersels	10/4/1975	Grand Rapids MN	P-1374
2	Max Sperry	7/8/1996	St Paul MN	S-2973
3	Lee Radaich	2/26/1987	Hibbing MN	R-8701
4	Max Bowers	3/29/1990	Coon Rapids MN	B-1916
5	Royce Schiller-Olson	11/24/1982	Minneapolis MN	S-7519
6	Erik Maisch	0/23/1991	Cannon Falls, MN	M-9587
7	Blake Helm	4/1/1989	Wenatchee WA	H-6067
8	Jacob Beckler	4/7/1992	Hazen ND	B-3145
9	Lee Roth	9/7/1979	Hettinger ND	R-3051
10	Jesse Bearinger	3/21/1980	Greely CO	B-7973
11	Adam Clarys	8/23/1990	Dickinson ND	C-7563

Work Order:	4669349-A
First Visit Date:	01-Mar-2021
Last Visit Date:	02-Mar-2021
Vendor PO Number:	2009-030821
Survey Location:	Sturgeon Bay

12 Conner Wunderlich	8/1/1991	Minot ND	W-1697
13 William Estep	6/5/1988	Centralia WA	E-7983
14 Rylan Brawley	7/15/1993	Minot ND	B-1762
15 Pete Pfeifer	8/22/1991	Hazen ND	P-4990
16 Jayden Hanson	6/15/1990	Bismarck ND	H-9822
17 Matt Ziemann	9/29/1995	Grand Forks ND	Z-6021
18 Mitch Haabala	7/9/1991	St. Cloud MN	H-6876
19 Garret Scholin	2/5/1973	Thief River Falls MN	S-3166
20 Bryon Bistodeau	8/26/1975	Buffalo MN	B-0723
21 Jesse Ridlon	6/28/1976	Virginia MN	R-7033
22 Warren Ortenblad	3/14/1989	Minneapolis MN	O-6290

Attending Surveyor(s):

Rangan, Sam
Gombos, David W. (David Gombos)
Signed-off Date: 14-Apr-2021

Reviewing Surveyor(s)

Work Order Reviewer: Mantey, Benjamin D
Work Order Credit Date: 16-Apr-2021

E. Top Side Welding Procedure Specification

Miami Diver

Procedure Qualification Record

MD-ABS-1G-SMAW-OR-COMPLE

PQR No. MD-ABS-1G-SMAW-OR-COMPI Revision Initial Date 5/10/2010 By Uwe W. Aschemeier

Authorized By Kevin S. Peters Date 5/10/2010 Type Manual ☒ Machine ☐

Welding Process(es) SMAW SMAW Reference WPS No. MD-ABS-1G-SMAW-WPS-O Semi-Auto ☐ Auto ☐

JOINT

Type Butt

Backing Yes ☐ No ☒ Single Weld ☒ Double Weld ☐

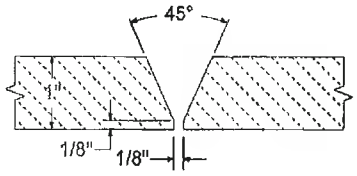
Backing Material None

Root Opening 3 mm Root Face Dimension 3 mm

Groove Angle 45 Radius (J-U) N.A.

Back Gouging Yes ☐ No ☒

Method N.A.



BASE METALS

Material Spec. ABS to ABS

Type or Grade Grade DH 36 to Grade DH 36

Thickness: Groove (mm) 25 Fillet (mm) N.A.

Diameter (Pipe, cm) N.A.

FILLER METALS

AWS Specification E6010 E7018

AWS Classification A5.1 A5.1

SHIELDING

Flux Gas N.A.

Cellulose/Low Hydro Composition N.A.

Electrode-Flux (Class) Flow Rate N.A.

N.A. Gas Cup Size N.A.

PREHEAT

Preheat Temp., Min. 175 F

Interpass Temp., Min. 175 F Max. 400 F

POSTWELD HEAT TREATMENT

Required ☐

Temp. N.A.

Time N.A.

POSITION

Position of Groove Flat Fillet N/A

Vertical Progression: Up ☐ Down ☐

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):

Short-Circuiting ☐ Globular ☐ Spray ☐

Current: AC ☐ DCEP ☒ DCEN ☐ Pulsed ☐

Other N.A.

Tungsten Electrode (GTAW):

Size N.A. Type N.A.

TECHNIQUE

Stringer or Weave Bead Both

Multi-pass or Single Pass (per side) Multiple

Number of Electrodes 1

Electrode Spacing: Longitudinal N.A.

Lateral N.A. Angle N.A.

Contact Tube to Work Distance N.A.

Peening NONE

Interpass Cleaning CHIPPING AND GRINDING

WELDING PROCEDURE

Layer/Pass	Process	Filler Metal Class	Diameter	Cur. Type	Amps or WFS	Volts	Travel Speed	Other Notes
ROOT	SMAW	E6010	1/8	DCEP	80-95	28-30	11-14	CM/MIN
FILLER	SMAW	E7018	3/32	DCEP	90-105	24-26	9-11	CM/MIN
FILLER	SMAW	E7018	1/8	DCEP	125-145	24-26	10-13	CM/MIN
COVER	SMAW	E7018	1/8	DCEP	125-145	24-26	10-13	CM/MIN
					AMPS			
					AMPS			

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09 FEB 2011

Miami Diver

Procedure Qualification Record

MD-ABS-2G-SMAW-OR-COMPLE

PQR No. MD-ABS-2G-SMAW-OR-COMPIRevision Initial Date 5/10/2010 By Uwe W. Aschemeier

Authorized By Kevin S. Peters Date 5/10/2010 Type Manual ☒ Machine ☐

Welding Process(es) SMAW SMAW Reference WPS No. MD-ABS-2G-SMAW-WPS-O Semi-Auto ☐ Auto ☐

JOINT

Type Butt

Backing Yes ☐ No ☒ Single Weld ☒ Double Weld ☐

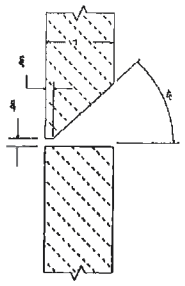
Backing Material None

Root Opening 3 mm Root Face Dimension 3 mm

Groove Angle 45 Radius (J-U) N.A.

Back Gouging Yes ☐ No ☒

Method N.A.



BASE METALS

Material Spec. ABS to ABS

Type or Grade Grade DH 36 to Grade DH 36

Thickness: Groove (mm) 25 Fillet (mm) N.A.

Diameter (Pipe, cm) N.A.

FILLER METALS

AWS Specification	E6010	E7018
AWS Classification	A5.1	A5.1

SHIELDING

Flux	Gas	N.A.
Cellulose/Low Hydro	Composition	N.A.
Electrode-Flux (Class)	Flow Rate	N.A.
N.A.	Gas Cup Size	N.A.

PREHEAT

Preheat Temp., Min. 175 F

Interpass Temp., Min. 175 F Max. 400 F

POSTWELD HEAT TREATMENT

Required ☐

Temp. N.A.

Time N.A.

POSITION

Position of Groove Horizontal Fillet N/A

Vertical Progression: Up ☐ Down ☐

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):

Short-Circuiting ☐ Globular ☐ Spray ☐

Current: AC ☐ DCEP ☒ DCEN ☐ Pulsed ☐

Other N.A.

Tungsten Electrode (GTAW):

Size N.A. Type N.A.

TECHNIQUE

Stringer or Weave Bead Both

Multi-pass or Single Pass (per side) Multiple

Number of Electrodes 1

Electrode Spacing: Longitudinal N.A.

Lateral N.A. Angle N.A.

Contact Tube to Work Distance N.A.

Peening NONE

Interpass Cleaning CHIPPING AND GRINDING

WELDING PROCEDURE

Layer/Pass	Process	Filler Metal Class	Diameter	Cur. Type	Amps or WFS	Volts	Travel Speed	Other Notes
ROOT	SMAW	E6010	1/8	DCEP	80-95	28-30	11-14	CM/MIN
FILLER	SMAW	E7018	3/32	DCEP	90-105	24-26	9-11	CM/MIN
FILLER	SMAW	E7018	1/8	DCEP	125-145	24-26	14-17	CM/MIN
COVER	SMAW	E7018	1/8	DCEP	125-145	24-26	14-17	CM/MIN
					AMPS			

AMERICAN BUREAU OF SHIPPING ABS FT. LAUDERDALE

Oct 12 2010

Miami Diver

Procedure Qualification Record

MD-ABS-3G-SMAW-OR-COMPLE

PQR No. MD-ABS-3G-SMAW-OR-COMPI Revision Initial Date 5/10/2010 By Uwe W. Aschemeier

Authorized By Kevin S. Peters Date 5/10/2010 Type Manual ☒ Machine ☐

Welding Process(es) SMAW SMAW Reference WPS No. MD-ABS-3G-SMAW-WPS-O Semi-Auto ☐ Auto ☐

JOINT

Type Butt

Backing Yes ☐ No ☒ Single Weld ☒ Double Weld ☐

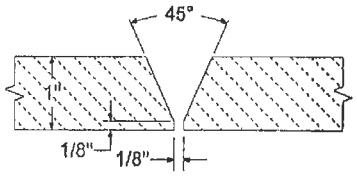
Backing Material None

Root Opening 3 mm Root Face Dimension 3 mm

Groove Angle 45 Radius (J-U) N.A.

Back Gouging Yes ☐ No ☒

Method N.A.



BASE METALS

Material Spec. ABS to ABS

Type or Grade Grade DH 36 to Grade DH 36

Thickness: Groove (mm) 25 Fillet (mm) N.A.

Diameter (Pipe, cm) N.A.

FILLER METALS

AWS Specification	E6010	E7018
AWS Classification	A5.1	A5.1

SHIELDING

Flux Gas N.A.

Cellulose/Low Hydro Composition N.A.

Electrode-Flux (Class) Flow Rate N.A.

N.A. Gas Cup Size N.A.

PREHEAT

Preheat Temp., Min. 175 F

Interpass Temp., Min. 175 F Max. 400 F

POSTWELD HEAT TREATMENT

Required ☐

Temp. N.A.

Time N.A.

POSITION

Position of Groove Vertical Fillet N/A

Vertical Progression: Up ☒ Down ☐

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):

Short-Circuiting ☐ Globular ☐ Spray ☐

Current: AC ☐ DCEP ☒ DCEN ☐ Pulsed ☐

Other N.A.

Tungsten Electrode (GTAW):

Size N.A. Type N.A.

TECHNIQUE

Stringer or Weave Bead Both

Multi-pass or Single Pass (per side) Multiple

Number of Electrodes 1

Electrode Spacing: Longitudinal N.A.

Lateral N.A. Angle N.A.

Contact Tube to Work Distance N.A.

Peening NONE

Interpass Cleaning CHIPPING AND GRINDING

WELDING PROCEDURE

Layer/Pass	Process	Filler Metal Class	Diameter	Cur. Type	Amps or WFS	Volts	Travel Speed	Other Notes
ROOT	SMAW	E6010	1/8	DCEP	80-95	26-29	8-12	CM/MIN
FILLER	SMAW	E7018	3/32	DCEP	90-105	22-25	1.5-4	CM/MIN
FILLER	SMAW	E7018	1/8	DCEP	120-140	22-25	4.5-7	CM/MIN
COVER	SMAW	E7018	1/8	DCEP	120-140	22-25	9-12	CM/MIN
					AMPS			

AMERICAN BUREAU OF SHIPPING ABS FT. LAUDERDALE 09 FEB 2011

Miami Diver

Procedure Qualification Record

MD-ABS-4G-SMAW-OR-COMPLE

PQR No. MD-ABS-4G-SMAW-OR-COMPI Revision Initial Date 5/10/2010 By Uwe W. Aschemeier

Authorized By Kevin S. Peters Date 5/10/2010 Type Manual ☒ Machine ☐

Welding Process(es) SMAW SMAW Reference WPS No. MD-ABS-4G-SMAW-WPS-O Semi-Auto ☐ Auto ☐

JOINT

Type Butt

Backing Yes ☐ No ☒ Single Weld ☒ Double Weld ☐

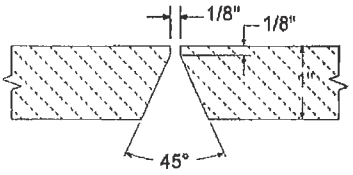
Backing Material None

Root Opening 3 mm Root Face Dimension 3 mm

Groove Angle 45 Radius (J-U) N.A.

Back Gouging Yes ☐ No ☒

Method N.A.



BASE METALS

Material Spec. ABS to ABS

Type or Grade Grade DH 36 to Grade DH 36

Thickness: Groove (mm) 25 Fillet (mm) N.A.

Diameter (Pipe, cm) N.A.

FILLER METALS

AWS Specification E6010 E7018

AWS Classification A5.1 A5.1

SHIELDING

Flux Gas N.A.

Cellulose/Low Hydro Composition N.A.

Electrode-Flux (Class) Flow Rate N.A.

N.A. Gas Cup Size N.A.

PREHEAT

Preheat Temp., Min. 175 F

Interpass Temp., Min. 175 F Max. 400 F

POSTWELD HEAT TREATMENT

Required ☐

Temp. N.A.

Time N.A.

POSITION

Position of Groove Overhead Fillet N/A

Vertical Progression: Up ☐ Down ☐

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):

Short-Circuiting ☐ Globular ☐ Spray ☐

Current: AC ☐ DCEP ☒ DCEN ☐ Pulsed ☐

Other N.A.

Tungsten Electrode (GTAW):

Size N.A. Type N.A.

TECHNIQUE

Stringer or Weave Bead Both

Multi-pass or Single Pass (per side) Multiple

Number of Electrodes 1

Electrode Spacing: Longitudinal N.A.

Lateral N.A. Angle N.A.

Contact Tube to Work Distance N.A.

Peening NONE

Interpass Cleaning CHIPPING AND GRINDING

WELDING PROCEDURE

Layer/Pass	Process	Filler Metal Class	Diameter	Cur. Type	Amps or WFS	Volts	Travel Speed	Other Notes
ROOT	SMAW	E6010	1/8	DCEP	90-105	28-30	9-12	CM/MIN
FILLER	SMAW	E7018	1/32	DCEP	85-100	22-25	9-12	CM/MIN
FILLER	SMAW	E7018	1/8	DCEP	125-145	24-26	10-14	CM/MIN
COVER	SMAW	E7018	1/8	DCEP	125-145	24-26	10-14	CM/MIN
					AMPS			

AMERICAN BUREAU OF SHIPPING ABS FT. LAUDERDALE 09 FEB 2011

. nder ater la ppro ed WPS

SUBSEA GLOBAL SOLUTIONS

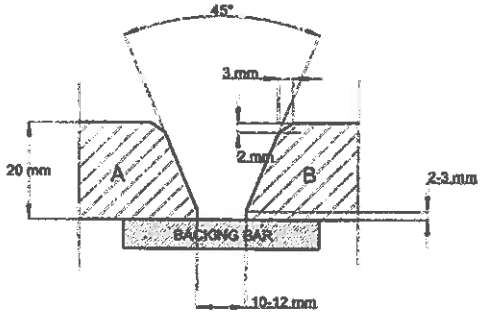
WET WELDING

WELDING PROCEDURE SPECIFICATION (WPS)

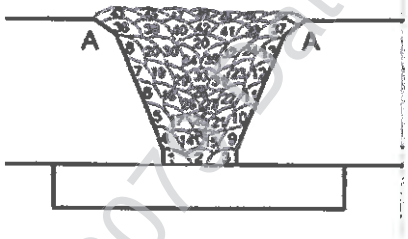
WPS Ref. No.:	ABS-UW-111-BW-DH36-20-1G-WPS	*REV.*	0	*Welding Witnessed by:*	James O'Hare (ABS)
PQR No.	ABS-UW-111-BW-DH36-20-1G-PQR			*Testing witnessed by:.*	ABS Hamburg
Date:	May 29, 2014			*Welding Specification and Class:*	AWS D3.6M:2010 - Class 'A'
Manufacturer:	Subsea Global Solutions			*Welding Process:*	SMAW wet (111)
Location:	2994 N. Miami Ave., Miami, FL 33127, USA			*Welding Position:*	1G (PA)
Welder	Wesley Guntharp			*Joint Type:*	Single-V-Groove-Weld

JOINT DETAILS

Weld Preparation (Dimensional Sketch)



Run Sequence and Completed Weld Dimensions



THE NUMBER OF PASSES SHOWN DOES NOT REFLECT THE ACTUAL NUMBER OF PASSES WELDED, BUT RATHER SHOWS THE BEAD PLACEMENT

BASE MATERIALS

Material ID	*Grade/Type*	*Thickness*	*Pipe/Plate*	*C.E. %*	*Proof/YS / UTS N/mm²*	
A:	AH/DH 36	20 mm	Plate	0.32	400	495
B:	AH/DH 36	20 mm	Plate	0.32	400	495

CONSUMABLES

Manufacture:	*HYDROWELD*	*Specification:*	N.A.	*Transport:*	Dry
Type and Diameter:	*FS, 3.2 mm*	*Flux type*	Rutile	*Storage:*	Wet
Classification:	*N.A.*	*Filler wire*	Ferritic	*Storage Time:*	< 12 Hours

POWER SOURCES

Constant voltage / Current:	Constant Current
Engine / electric:	Either
DC Generated / rectified:	Either

JOINT PREPARATION

Preparation:	Grinding/Thermic Cutting/Machining
Cleaning:	Grinding/Wire Brush/Chipping
Peening:	None

ENVIRONMENT

Water Depth:		*Pressure differential:*	None	*Water Temp.:*	0 - 30° C
Backside (Wet/Dry):	Wet	*Fresh water / Brine:*	Either	*U/W Visibility:*	> 0.5 metres

WELDING PARAMETERS

Pass No.	*Electrode Size (mm)*	*Amps*	*Arc Volts*	*Electrode Polarity*	*Travel Speed mm/min*	*Heat Input kJ/mm Max.*	*Heat Input kJ/mm Av.*	*Stringer / Weave*
Temp	3.2	140-170	28-31	DCEN	200-240	N.A.	1.25	Stringer
Root	3.2	140-170	28-31	DCEN	180-220	N.A.	1.4	Stringer
Fill	3.2	140-230	25-32	DCEN	150-250	N.A.	1.6	Stringer
Cover	3.2	130-160	24-30	DCEN	150-250	N.A.	1.15	Stringer

REVIEWED
Details of this review are as indicated in the ABS letter

Manufacture: SUBSEA GLOBAL SOLUTIONS

Name: Uwe W. Aschemeier, Sr. Welding Engineer

Signature:

Stamp: SUBSEA GLOBAL SOLUTIONS

Date: November 2, 2015

Witness: AMERICAN BUREAU OF SHIPPING (ABS)

Name:

Signature: ABS FOUNDED 1862

Stamp:

Date:

See ABS Houston Letter Ref. 14480 dated 07 DEC-2015

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SUBSEA GLOBAL SOLUTIONS

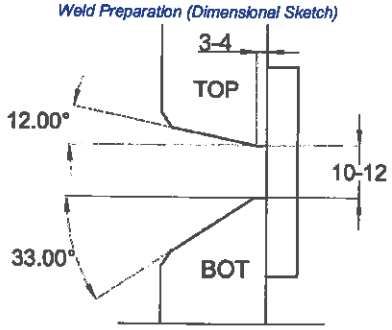
WET WELDING

WELDING PROCEDURE SPECIFICATION (WPS)

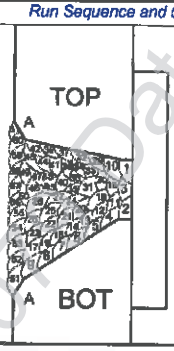
WPS Ref. No.:	ABS-UW-111-BW-DH36-20-2G-WPS	*REV.*	0	*Welding Witnessed by:*	James O'Hare (ABS)
PQR No.	ABS-UW-111-BW-DH36-20-2G-PQR			*Testing witnessed by:*	ABS Hamburg
Date:	May 29, 2014			*Welding Specification and Class:*	AWS D3.6M:2010 - Class 'A'
Manufacturer:	Subsea Global Solutions			*Welding Process:*	SMAW wet (111)
Location:	2994 N. Miami Ave., Miami, FL 33127, USA			*Welding Position:*	2G (PC)
Welder	Jarrad Schmerl			*Joint Type:*	Single-V-Groove-Weld

JOINT DETAILS

Weld Preparation (Dimensional Sketch)



Run Sequence and Completed Weld Dimensions



THE NUMBER OF PASSES SHOWN DOES NOT REFLECT THE ACTUAL NUMBER OF PASSES WELDED, BUT RATHER SHOWS THE BEAD PLACEMENT

BASE MATERIALS

Material ID	*Grade/Type*	*Thickness*	*Pipe/Plate*	*C.E. %*	*Proof/YS / UTS N/mm²*	
A:	AH/DH 36	20 mm	Plate	0.32	400	495
B:	AH/DH 36	20 mm	Plate	0.32	400	495

CONSUMABLES

Manufacture:	*HYDROWELD*	*Specification:*	N.A.	*Transport:*	Dry
Type and Diameter:	FS, 3.2 mm	*Flux type*	Rutile	*Storage:*	Wet
Classification:	N.A.	*Filler wire*	Ferritic	*Storage Time:*	< 12 Hours

POWER SOURCES

Constant voltage / Current:	Constant Current
Engine / electric:	Either
DC Generated / rectified:	Either

JOINT PREPARATION

Preparation:	Grinding/Thermic Cutting/Machining
Cleaning:	Grinding/Wire Brush/Chipping
Peening:	None

ENVIRONMENT

Water Depth:	2-14.5 m	*Pressure differential:*	None	*Water Temp.:*	0 - 30° C
Backside (Wet/Dry):	Wet	*Fresh water / Brine:*	Either	*U/W Visibility:*	> 0.5 metres

REVIEWED

Details of this review are as indicated in the ABS letter

ABS FOUNDED 1862

WELDING PARAMETERS

Pass No.	*Electrode Size (mm)*	*Amps*	*Arc Volts*	*Electrode Polarity*	*Travel Speed mm/min*	*Progression*	*Heat Input kJ/mm Av.*	*Stringer / Weave*
Temp	3.2	120-140	25-30	DCEN	220-330	N.A.	0.7	Stringer
Root	3.2	130-170	25-30	DCEN	100-180	N.A.	1.8	Stringer
Fill	3.2	120-150	22-30	DCEN	150-300		1.05	Stringer
Cover	3.2	120-140	22-30	DCEN	150-250		1.0	Stringer

Manufacture: SUBSEA GLOBAL SOLUTIONS

Name: Uwe W. Aschemeier, Sr. Welding Engineer

Signature:

Stamp: SUBSEA GLOBAL SOLUTIONS

Date: November 2, 2015

Witness: AMERICAN BUREAU OF SHIPPING (ABS)

Name:

Stamp:

Signature:

Date:

See ABS Houston Letter Ref. No. 4807 Dated 01-DEC-2015

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SUBSEA GLOBAL SOLUTIONS

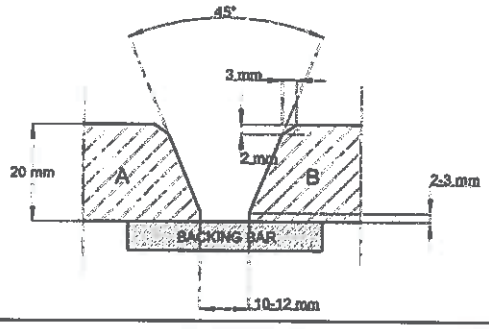
WET WELDING

WELDING PROCEDURE SPECIFICATION (WPS)

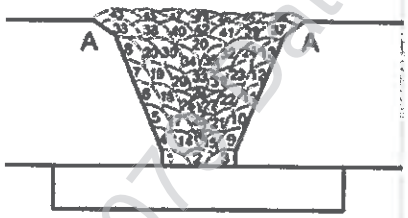
WPS Ref. No.:	ABS-UW-111-BW-DH36-20-3G-WPS	*REV.*	0	*Welding Witnessed by:*	James O'Hare (ABS)
PQR No.	ABS-UW-111-BW-DH36-20-3G-PQR			*Testing witnessed by:*	ABS Hamburg
Date:	May 29, 2014			*Welding Specification and Class:*	AWS D3.6M:2010 - Class 'A'
Manufacturer:	Subsea Global Solutions			*Welding Process:*	SMAW wet (111)
Location:	2994 N. Miami Ave., Miami, FL 33127, USA			*Welding Position:*	3G (PG)
Welder	Cornelis Marinus Snoek			*Joint Type:*	Single-V-Groove-Weld

JOINT DETAILS

Weld Preparation (Dimensional Sketch)



Run Sequence and Completed Weld Dimensions



THE NUMBER OF PASSES SHOWN DOES NOT REFLECT THE ACTUAL NUMBER OF PASSES WELDED, BUT RATHER SHOWS THE BEAD PLACEMENT

BASE MATERIALS

Material ID	*Grade/Type*	*Thickness*	*Pipe/Plate*	*C.E. %*	*Proof/YS / UTS N/mm²*	
A:	AH/DH 36	20 mm	Plate	0.32	400	495
B:	AH/DH 36	20 mm	Plate	0.32	400	495

CONSUMABLES

Manufacture:	*HYDROWELD*	*Specification:*	N.A.	*Transport:*	Dry
Type and Diameter:	FS, 3.2 mm	*Flux type*	Rutile	*Storage:*	Wet
Classification:	N.A.	*Filler wire*	Ferritic	*Storage Time:*	< 12 Hours

POWER SOURCES

Constant voltage / Current:	Constant Current
Engine / electric:	Either
DC Generated / rectified:	Either

JOINT PREPARATION

Preparation:	Grinding/Thermic Cutting/Machining
Cleaning:	Grinding/Wire Brush/Chipping
Peening:	None

ENVIRONMENT

Water Depth:	2-14.5 m	*Pressure differential:*	None	*Water Temp.:*	0 - 30° C
Backside (Wet/Dry):	Wet	*Fresh water / Brine:*	Either	*U/W Visibility:*	> 0.5 metres

WELDING PARAMETERS

Pass No.	*Electrode Size (mm)*	*Amps*	*Arc Volts*	*Electrode Polarity*	*Travel Speed mm/min*	*[illegible]*	*Heat Input kJ/mm Av.*	*Stringer / Weave*
Temp	3.2	135-170	20-25	DCEN	140-200	N.A.	1.2	Stringer
Root	3.2	140-170	25-30	DCEN	100-200	N.A.	1.55	Stringer
Fill	3.2	140-160	23-30	DCEN	100-250	N.A.	1.65	Stringer
Cover	3.2	130-160	20-28	DCEN	150-250	N.A.	1.05	Stringer

REVIEWED
Details of this review are as indicated in the ABS letter

ABS

Manufacture: SUBSEA GLOBAL SOLUTIONS

Name: Uwe W. Aschemeier, Sr. Welding Engineer

Signature:

Date: November 2, 2015

Stamp: SUBSEA GLOBAL SOLUTIONS

Witness: AMERICAN BUREAU OF SHIPPING (ABS)

Name:

Signature:

Date:

Stamp:

See ABS Houston Letter Ref. 14807 Dated 03-DEC-2015

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. n pection cceptance riteria

Table 6.1
Visual Inspection Acceptance Criteria (see 6.9)

Discontinuity Category and Inspection Criteria	Statically Loaded Nontubular Connections	Cyclically Loaded Nontubular Connections	Tubular Connections (All Loads)
(1) Crack Prohibition Any crack shall be unacceptable, regardless of size or location.	X	X	X
(2) Weld/Base-Metal Fusion Thorough fusion shall exist between adjacent layers of weld metal and between weld metal and base metal.	X	X	X
(3) Crater Cross Section All craters shall be filled to provide the specified weld size, except for the ends of intermittent fillet welds outside of their effective length.	X	X	X
(4) Weld Profiles Weld profiles shall be in conformance with 5.24.	X	X	X
(5) Time of Inspection Visual inspection of welds in all steels may begin immediately after the completed welds have cooled to ambient temperature. Acceptance criteria for ASTM A 514, A 517, and A 709 Grade 100 and 100 W steels shall be based on visual inspection performed not less than 48 hours after completion of the weld.	X	X	X
(6) Undersized Welds The size of a fillet weld in any continuous weld may be less than the specified nominal size (L) without correction by the following amounts (U): L, specified nominal weld size, in. [mm] / U, allowable decrease from L, in. [mm] ≤ 3/16 [5] / ≤ 1/16 [2] 1/4 [6] / ≤ 3/32 [2.5] ≥ 5/16 [8] / ≤ 1/8 [3] In all cases, the undersize portion of the weld shall not exceed 10% of the weld length. On web-to-flange welds on girders, underrun shall be prohibited at the ends for a length equal to twice the width of the flange.	X	X	X
(7) Undercut (A) For material less than 1 in. [25 mm] thick, undercut shall not exceed 1/32 in. [1 mm], with the following exception: undercut shall not exceed 1/16 in. [2 mm] for any accumulated length up to 2 in. [50 mm] in any 12 in. [300 mm]. For material equal to or greater than 1 in. thick, undercut shall not exceed 1/16 in. [2 mm] for any length of weld.	X		
(B) In primary members, undercut shall be no more than 0.01 in. [0.25 mm] deep when the weld is transverse to tensile stress under any design loading condition. Undercut shall be no more than 1/32 in. [1 mm] deep for all other cases.		X	X
(8) Porosity (A) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no visible piping porosity. For all other groove welds and for fillet welds, the sum of the visible piping porosity 1/32 in. [1 mm] or greater in diameter shall not exceed 3/8 in. [10 mm] in any linear inch of weld and shall not exceed 3/4 in. [20 mm] in any 12 in. [300 mm] length of weld.	X		
(B) The frequency of piping porosity in fillet welds shall not exceed one in each 4 in. [100 mm] of weld length and the maximum diameter shall not exceed 3/32 in. [2.5 mm]. Exception: for fillet welds connecting stiffeners to web, the sum of the diameters of piping porosity shall not exceed 3/8 in. [10 mm] in any linear inch of weld and shall not exceed 3/4 in. [20 mm] in any 12 in. [300 mm] length of weld.		X	X
(C) CJP groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the frequency of piping porosity shall not exceed one in 4 in. [100 mm] of length and the maximum diameter shall not exceed 3/32 in. [2.5 mm].		X	X

Note: An "X" indicates applicability for the connection type; a shaded area indicates non-applicability.

Table 6.3
UT Acceptance-Rejection Criteria (Cyclically Loaded Nontubular Connections) (see 6.13.2)

Discontinuity Severity Class	Weld Size[a] in in. [mm] and Search Unit Angle										
	5/16 through 3/4 [8–20]	> 3/4 through 1-1/2 [20–38]	> 1-1/2 through 2-1/2 [38–65]			> 2-1/2 through 4 [65–100]			> 4 through 8 [100–200]		
	70°	70°	70°	60°	45°	70°	60°	45°	70°	60°	45°
Class A	+10 & lower	+8 & lower	+4 & lower	+7 & lower	+9 & lower	+1 & lower	+4 & lower	+6 & lower	–2 & lower	+1 & lower	+3 & lower
Class B	+11	+9	+5 +6	+8 +9	+10 +11	+2 +3	+5 +6	+7 +8	–1 0	+2 +3	+4 +5
Class C	+12	+10	+7 +8	+10 +11	+12 +13	+4 +5	+7 +8	+9 +10	+1 +2	+4 +5	+6 +7
Class D	+13 & up	+11 & up	+9 & up	+12 & up	+14 & up	+6 & up	+9 & up	+11 & up	+3 & up	+6 & up	+8 & up

[a] Weld size in butt joints shall be the nominal thickness of the thinner of the two parts being joined.

Notes:
1. Class B and C discontinuities shall be separated by at least 2L, L being the length of the longer discontinuity, except that when two or more such discontinuities are not separated by at least 2L, but the combined length of discontinuities and their separation distance is equal to or less than the maximum allowable length under the provisions of Class B or C, the discontinuity shall be considered a single acceptable discontinuity.
2. Class B and C discontinuities shall not begin at a distance less than 2L from weld ends carrying primary tensile stress, L being the discontinuity length.
3. Discontinuities detected at "scanning level" in the root face area of CJP double groove weld joints shall be evaluated using an indicating rating 4 dB more sensitive than described in 6.26.6.5 when such welds are designated as "tension welds" on the drawing (subtract 4 dB from the indication rating "d"). This shall not apply if the weld joint is backgouged to sound metal to remove the root face and MT used to verify that the root face has been removed.
4. For indications that remain on the display as the search unit is moved, refer to 6.13.2.1.

Class A (large discontinuities)
Any indication in this category shall be rejected (regardless of length).

Class B (medium discontinuities)
Any indication in this category having a length greater than 3/4 in. [20 mm] shall be rejected.

Class C (small discontinuities)
Any indication in this category having a length greater than 2 in. [50 mm] in the middle half or 3/4 in. [20 mm] length in the top or bottom quarter of weld thickness shall be rejected.

Class D (minor discontinuities)
Any indication in this category shall be accepted regardless of length or location in the weld.

Scanning Levels	
Sound path[b] in in. [mm]	Above Zero Reference, dB
through 2-1/2 [65 mm]	20
> 2-1/2 through 5 [65–125 mm]	25
> 5 through 10 [125–250 mm]	35
> 10 through 15 [250–380 mm]	45

[b] This column refers to sound path distance; NOT material thickness.

. E Procedure

UNDERWATER MAGNETIC PARTICLE INSPECTION

SUBSEA GLOBAL SOLUTIONS

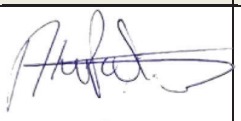
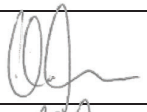
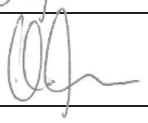
Document No	**SGS-MT UW1-Rev 4**	Rev	4
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COMPANY PROPRIETARY INFORMATION

Prior to use, ensure this document is the most recent revision by checking the Master Document List. To request a change, submit a Document Change Request to the Document Control Representative.

Approvals

The signatures below certify that this procedure has been reviewed and accepted, and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.

	Name	Signature	Position	Date
Prepared by	Kevin Peters Subsea Global Solutions		Director, Technical Sales & Repair & Environmental Services	Oct. 1, 2020
Reviewed by	Dipl. Ing. Uwe Aschemeier SFI, EWE, IWE Subsea Global Solutions		Sr. Welding Engineer CSWIP MPI L3, 671260	Oct. 2, 2020
Approved by	Dipl. Ing. Uwe Aschemeier SFI, EWE, IWE Subsea Global Solutions		Sr. Welding Engineer CSWIP MPI L3, 671260	Oct. 2, 2020
Approved by	Ramesh Babu Govindaraj M.Sc, C.Eng, IWE DNV		Principal Specialist Material, Welding and Additive Manufacturing	

Amendment Record

This procedure reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or omissions is given below:

Page No.	Context	Revision	Date
ALL	The document was revised to follow SGS ISO outline, pictures were added and grammatical changes.	2	Oct. 20, 2013
ALL	The document was revised to reflect changes within the company structure and to update regulations and techniques.	3	Jan. 30, 2018
ALL	The document was revised to reflect changes within the company structure and to update regulations and techniques. After Class review, comments from DNV GL were incorporated into the document.	4	Oct. 2, 2020

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1. Introduction & Purpose

The purpose of this procedure is to establish and define the rules and requirements for underwater magnetic particle examination with a yoke to detect flaws open to the surface in ferromagnetic welds and materials using the magnetic particle techniques.

2. References

Reference	Title & Description
AWS D3.6	Underwater Welding Code
ASME Section V	Article 7 - Magnetic Particle Examination
ASTM E709	Standard Guide for Magnetic Particle Testing
ISO 5817	Welding – Fusion-welded joints in steel, nickel, titanium and their alloys, Quality levels for imperfections
ISO 23278	Non-destructive testing of welds -- Magnetic particle testing of welds -- Acceptance levels
ABS	Guide for Non-destructive inspection of Hull Welds
DNV-CG-0051	CLASS GUIDELINE Non-destructive testing
DNV-RU-SHIP-Pt2Ch4	RULES FOR CLASSIFICATION, Part 2 Materials and welding, Chapter 4 Fabrication and testing Part 2 Chapter 4 Section 7 Table 4 is ISO23278 Level 2X (ISO 5817 Class C)
Lloyds Register	Rules and Regulations for the Qualification of Naval Ships

3. Terms & Definitions

Term	Definition
NON-DESTRUCTIVE TESTING (NDT)	A process that involves the inspection, testing, or evaluation of material, components and assemblies for materials' discontinuities, properties and machine problems without further impairing or destroying the part's serviceability.
MAGNETIC PARTICLE INSPECTION (MT)	Magnetic particle Inspection (MT) is a non-destructive testing process for detecting surface and slightly subsurface discontinuities in ferromagnetic materials.
RELEVANT	Relevant indications are discontinuities or flaws, which in turn are un-designed imperfections. When it is considered that a relevant indication will affect the fitness for purpose of a test specimen, it is classified as a defect, but not all defects are cracks.
SPURIOUS INDICATIONS	Indications which are not held on the surface by a flux leakage are called spurious. Lint, scale, dirt, hairs, drainage lines, etc, are examples.
NON-RELEVANT INDICATIONS	Non-relevant indications are true magnetic particle patterns actually formed and held in place by leakage fields. However, they are caused by design

	features and the structure of the specimen and only exceptionally will they affect the fitness for purpose of the specimen (Scores and scratches, Abrupt changes of section, Internal splines and drillings, etc.).
INSPECTION	Conformity evaluation by observation and judgement accompanied by appropriate measurement, testing or gauging
TEST	Determination of one or more characteristics according to a procedure

4. Application & Scope

This procedure is applicable to magnetic particle examination with a yoke performed underwater in the wet to detect flaws open to the surface in ferromagnetic welds and materials.

5. Requirements

The **Sr. Project Manager** is responsible to:

- Document the underwater magnetic particle procedure.

The **Sr. Welding Engineer and MPI Level III** is responsible to:

- Maintain the underwater magnetic particle procedure.
- Ensure that this procedure is implemented.
- To train and certify personnel in underwater magnetic particle inspection with a yoke and to keep their certification updated.
- To review and sign magnetic particle examination reports.
- Review and approve this procedure.

The **examination personnel** are responsible to:

- Perform under water magnetic particle examination with a yoke in accordance with this procedure.

6. Personnel

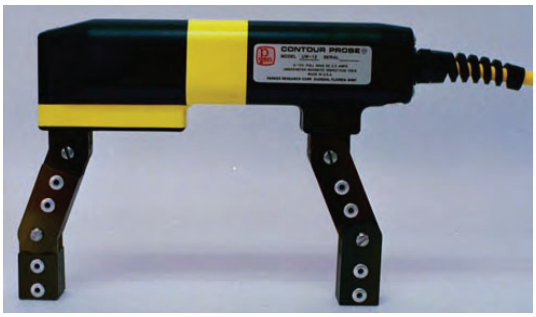
Only personnel qualified in accordance with reference 5.0 may perform inspections to this procedure. In addition, only Level II or III personnel shall accomplish interpretation of Magnetic Particle examination results for acceptance.

7. Equipment and Materials

7.1 Yokes

Portable underwater magnetic particle yokes from reputable manufactures like Parker Research or others with adjustable legs, may be used to accomplish inspections in accordance with this procedure.

The yokes power supply can be either 12V DC Battery or 110 V AC.



Underwater Magnetic Particle Yoke UW-12/UW-115 (Parker Research Corporation)

Portable Magnetic Particle Units - shall be a capable of producing the necessary magnetic flux in the part, maximum of 2000 amps of magnetizing current.

7.2 Examination Medium

7.2.1 Detection Media

For underwater magnetic particle examination, particles Mi-Glow® Underwater 1 manufactured by CIRCLE SYSTEMS, INC. will be preferably used.

Daylight fluorescent magnetic particles from other manufactures may also be used.

Mi-Glow® Underwater 1 particles pre-mixed with a powdered Wetting Agent for use in underwater inspection. The particles can be used with visible light, black light and blue light. The particles are large for better enhancement of large weld discontinuities. The particles are designed to be used for a variety of underwater inspections, including offshore structural welds, pipeline inspection and ship husbandry.



MI-GLOW UW 1

7.2.2 Light Source

Daylight fluorescent under visible light sources (recommend ≥ 200 foot-candle), fluoresces in black light and blue light. The diver hat light will produce approx. 1000 lux at a distance of 600 mm (approx. 2000 lux at 300 mm) from the light source.

7.2.3 Temperature Limits

The detection media described in 7.2.1 may be used at temperatures between 32° and 120°F (0°-49°C)

7.2.4 Shelf Life and Storage

The shelf life of the particles is as a maximum four (4) years. The container needs to be stored closed, in a clean, dry environment away from excessive heat or cold.

7.2.5 Preparation

The particles need to be mixed at a concentration of 2 oz. av. per one gallon (15 grams/litre) of water. The preparation may vary due to different practice and specific application. To help keep the particles in suspension, the storage reservoir should be shaken prior to application, or should have mechanical or air agitation.

The applicator bottle needs to be filled with approx. 20% particles. The diver will add water to the applicator bottle on site.

Adequate particle concentration for the specific application needs to be checked by use of a magnetic field indicator or by observation of the particles applied to a magnetization device (i.e., electromagnet yoke leg).

When the particles are used in a salt water environment, as a minimum, a fresh batch solution should be made daily to prevent corrosion of the particles.

7.3 Magnetic Flux Indicator Strips

When it is necessary to verify the adequacy or direction of the magnetic field, as required by referencing code(s), the Magnetic Flux Indicator Strips Type II (Burmah Castrol Strips Type II) will preferably be used. If Type II Burmah Castrol Strips are not available, Type I Strips may also be used. The proper use of the foil type magnetic flux indicators is used to prove:

- Adequate magnetic field strength and direction.
- Proper illumination.
- Appropriate magnetic particle properties.

If one indicator shows indications clearly and the other none at all, the direction of the induced magnetic field is at right angles to the indicator which shows indications. If both indicators show indications, the direction of the induced magnetic field lies somewhere between the directions of the two indicators:

- Attach one indicator to the work piece so that its long axis is in the same direction as that of any expected defects.
- Attach a second indicator at right angles to the first.
- Magnetize the work piece in the normal way and apply magnetic particles.
- A minimum of 3 seconds magnetization is needed to allow for particle migration before the indicators are inspected with the magnetizing current on.

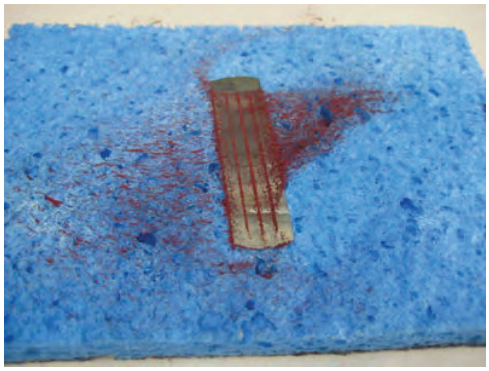
- 3 indications need to be seen clearly.

If applicable, the verification of the adequacy or direction of the magnetic field may be performed during the welding of the confirmation plate.

The magnetic field strength and direction test may be performed on site or in a water bucket before the diver enters the water.



Magnetic Flux Indicator Strips



Magnetic Flux Indicator Strip in Use

8. Surface Conditions

8.1 Preparation

Satisfactory results are usually obtained when the surfaces are in the as welded, as-rolled, as-cast, or as-forged conditions. However, surface preparation by grinding or other positive means may be necessary where surface irregularities could mask indications due to discontinuities.

Prior to magnetic particle examination, the surface to be examined and all adjacent areas within at least 25 mm (1”) shall be free of marine growth, scale, welding flux and splatter, or other extraneous matter that could interfere with the examination.

Cleaning may be accomplished using scrapers, grinders, or other cleaning methods.

If coatings are left on the part in the area being examined, it must be demonstrated that indications can be detected through the existing maximum coating thickness. The demonstration can be performed with Magnetic Flux Indicator Strips as described in Section 7.3 of this document. If indications cannot be detected through the maximum coating thickness, the coating shall be removed.

9. Calibration

9.1 Yokes

Calibration of electromagnetic yokes involves a lifting test. The yokes being used for underwater examinations produce an AC magnetic field from a GFI protected 115V AC power source or from a 12V DC power source. The yokes need to be capable of lifting 45N/4.5 Kg (10 lb) with a yoke pole leg spacing of 50 mm – 100 mm (2" to 4"). The lifting power of a yoke shall be checked at least every twelve (12) months or after any repair. At Subsea Global Solutions the lifting power of the yoke will also be verified prior to the start of an inspection.



Diver Performing Lift Test prior to Inspection

If the yoke fails to lift the required weight, it will be marked, taken out of service and send to the manufacturer for repair.

9.2 Lifting Weights

Each weight shall be weighted with a scale from a reputable manufacturer and hard stamped with the applicable nominal weight prior to first use. After a weight is being identified as described before, the lifting weights will be stored and are only used for the verifying the lifting power of the yoke. A weight needs only be verified again if it is damaged in a manner that could have caused potential loss of material.

The performed calibration will be recorded on the "Equipment Calibration Record Sheet", which can be found in Annex 1.

10. Examination

Examination shall be performed by the continuous method, wet magnetic particles to be applied by spraying or flowing over the areas to be examined during the application of the magnetizing field current.

The examination shall be performed in two (2) directions approximately 90° apart.

The examination shall be conducted with a minimum of 25% pole overlap to ensure 100% coverage at the required sensitivity.

The diver brings the yoke in contact with the area to be inspected with approx. 2” to 4” (50 mm – 100 mm) pole spacing. The flux was previously mixed in a small applicator bottle in a concentration as described in 7.2.5.

The diver instructs the top side to “make it hot”.

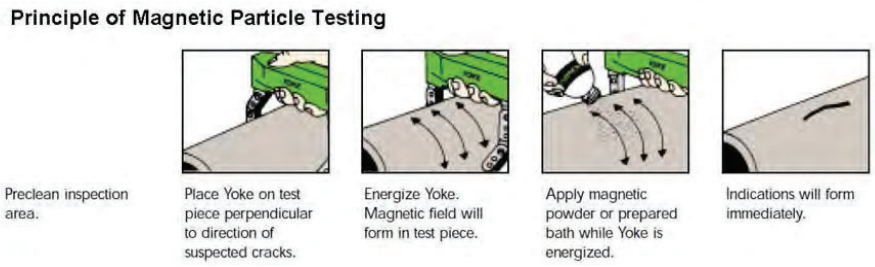
The flux applicator bottle is held 2” to 4” (50 mm – 100 mm) from the centre of the poles and squeezed to apply the flux to the test area with the magnetizing power applied.

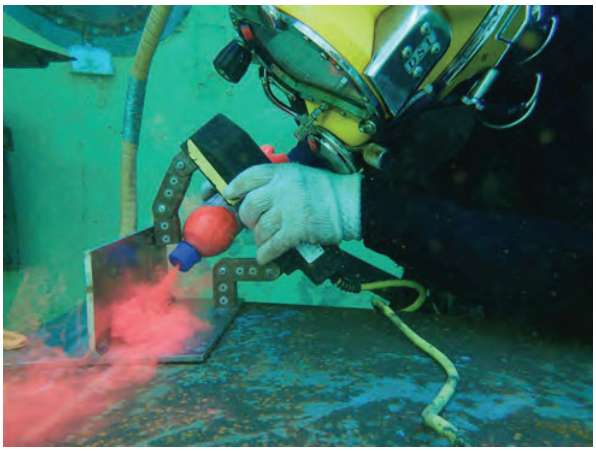
NOTE: If a water current is present – Always apply the flux upstream

Repeat the process over the entire test area.

Interpretation of indications shall be performed with the magnetizing power still applied.

When inspecting welds, the weld and the adjacent ½" (12 mm) of the base metal shall be examined, where possible.





Diver applying Magnetic Particles to Test Object

11. Evaluation

Illumination shall be adequate (see 7.2.2). During the examination and during evaluation of indications, auxiliary lighting, such as the diver's hat light and/or flashlights, shall be used as necessary to ensure adequate sensitivity.

All indications shall be evaluated in terms of the acceptable standards of the referencing code section.

Discontinuities on the surface are indicated by retention of the examination medium. However, localized surface irregularities due to machining marks, pittings or other surface conditions may produce false indications.

Relevant indications are those that result from mechanical discontinuities. Linear indications are those in which the length is more than 3 times the width. Rounded indications are indications which are circular or elliptical with the length less than or equal to 3 times the width.

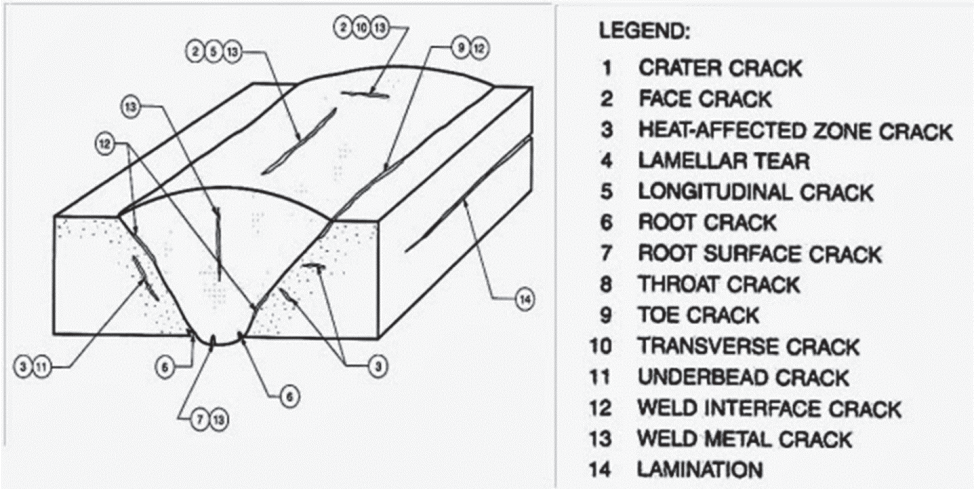
An indication which is believed to be non-relevant shall be regarded as a defect and shall be re-examined by the same or other NDE method to verify whether or not actual defects are present. Surface conditions may precede the re-examination. After an indication has been verified to be non-relevant, it is not necessary to re-investigate repetitive non-relevant indications of the same type. Non-relevant indications which would mask indications of defects are unacceptable.

Broad areas of particle accumulation which might mask indications from discontinuities are prohibited, and such areas shall be cleaned and re-examined.

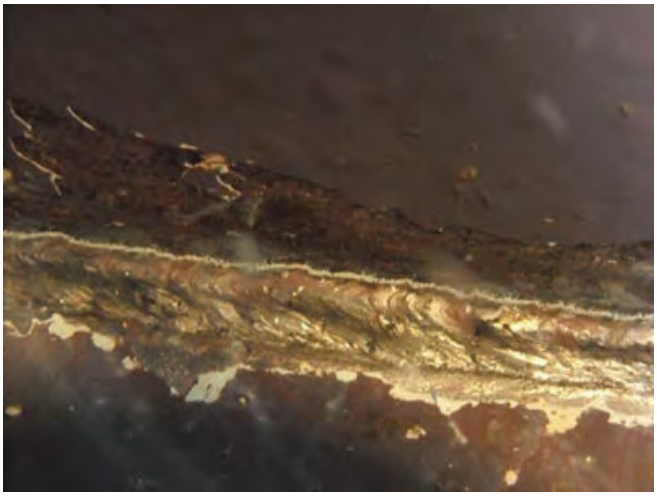
An indication of a discontinuity may be larger than the discontinuity that causes it; however, the size of the indication and not the size of the discontinuity is the basis of acceptance or rejection.

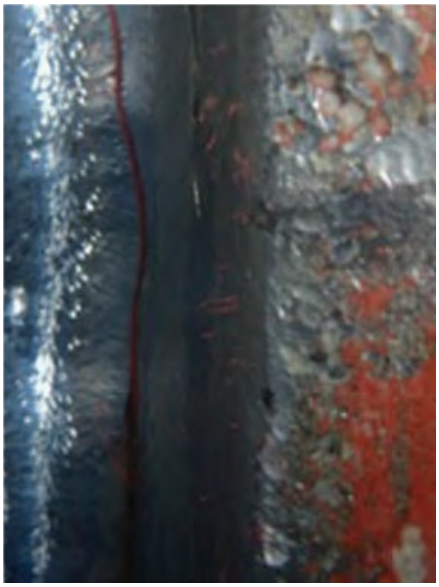
If required, demagnetization shall be accomplished as required by the referencing code, purchase order, or customer specifications.

After interpretation, and if necessary examination materials shall be removed. Cleaning shall be accomplished by wiping the surface with cloth or brushing with a wire brush.

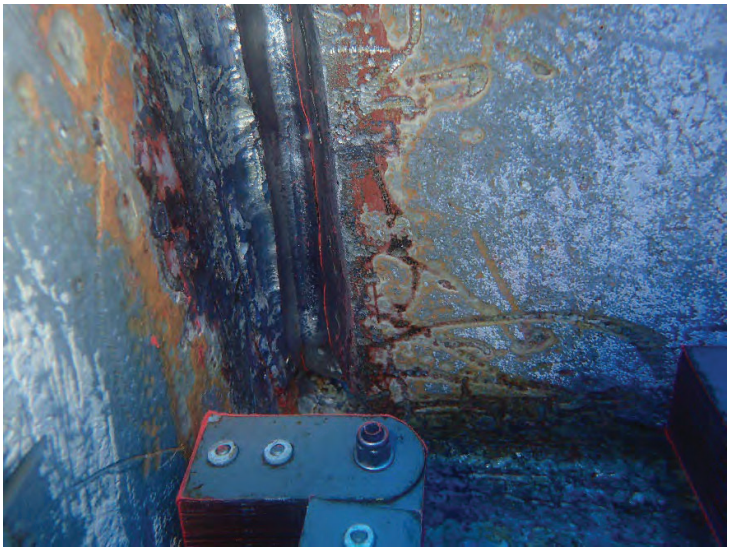


Possible Weld Defects





Examples of MT Indications Underwater



Example of MT Indications Underwater



Example of MT Indications Underwater



Indications in Test Plate

13.0 Acceptance Standards

The acceptability or unacceptability shall be determined by the purchase order, referencing code section, customer specifications, or classification society requirements.

If no acceptance standard is specified, the acceptance criteria of AWS D3.6 Class A or ISO 5614 Class B will apply.

14.0 Documentation and Records

14.1 Inspection Report

An inspection report shall be used to document results of examination. All applicable information shall be included to insure tractability and positive identification. As a minimum the following information shall be included on the report form. See Annex 2 for a sample of a Magnetic Particle Inspection Report.

- Procedure identification and revision
- Magnetic particle equipment and type of current
- Magnetic particles
- Examination personnel and qualification level
- Map or record of indications
- Lighting equipment
- Date and time of examination(s)

14.2 Recording of Indications

14.2.1 Non-rejectable indications

Non-rejectable indications shall be recorded as specified in the purchase order, contract documents, or per customer request.

Non-rejectable indications are typically spurious indications and non-relevant indications as defined in section 3.

14.2.2 Rejectable indications

Rejectable indications shall be recorded. As a minimum, the type of indications (linear or rounded), location, and extent (length or diameter or aligned) shall be recorded.

Rejectable indications are typically relevant indications as defined in section 3.

15.0 Annex

15.1 Equipment Calibration Record Form

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EQUIPMENT CALIBRATION RECORD

Equipment Manufacturer:	Model & Serial Number:	Calibration Record Number & Date:

AC Mode 10# (4.5 Kg) Minimum	DC Mode 40# Minimum
☐ Satisfactory ☐ Unsatisfactory	☐ Satisfactory ☐ Unsatisfactory

* If unsatisfactory tag unit out of service and have it repaired.

Weight Test Performed By: _____

Approved By: _____

Electromagnetic Yoke Lifting Force Check—The magnetizing force of a yoke should be checked by determining its lifting power on a steel plate. See Table below. The lifting force relates to the electromagnetic strength of the yoke.

Minimum Yoke Lifting Force

Type Current	Yoke Pole Leg Spacing	
	2 to 4 in. (50 to 100 mm)	4 to 6 in. (100 to 150 mm)
AC	10 lb (45 N)	
DC	30 lb (135 N)	
		50 lb (225 N)

Rev 2

January 30, 2018

15.2 Underwater Magnetic Particle Inspection Report Form

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UNDERWATER
MAGNETIC PARTICLE INSPECTION REPORT

Customer:		Date and Time:	
Job No.:		Procedure No. and Rev.:	
Standard:		Acceptance:	
Material:		Surface Condition:	
Item/Component(s) inspected:			
Visibility:	Water Current	Watertemp.:	
Particle Manufacturer:	Part Number:	Batch Number:	
Types of Particles: ☐ Wet			
Equip. Manufacturer:	Model & S / N:	Cal. Date:	
Type Magnetization: ☐ Continuous	Type Magnetization Current: ☐ AC		
Test performed by:		Level of Certification:	

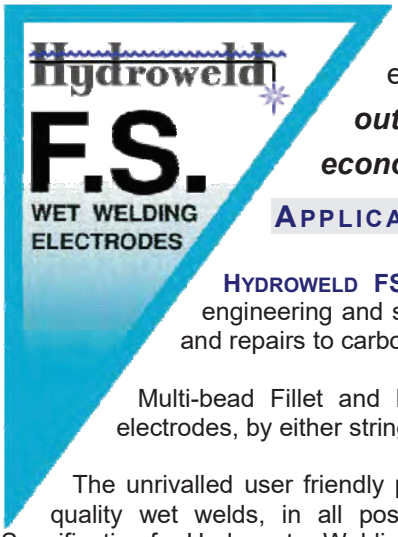
Area Inspected	Size & Location Of Indications	Accept	Reject

Reviewed by:	Level:	Date:

Rev 2 January 30, 2018

. Welding on u a le

HYDROWELD FS USER GUIDE



Hydroweld FS™ is a ***unique*** and ***versatile*** wet welding electrode with ***unrivalled*** user friendly properties and ***outstanding*** wet welding characteristics essential for the ***rapid economical*** production of ***reliable, high quality*** welds underwater.

APPLICATIONS

HYDROWELD FS™ electrodes are extensively used in the offshore oil and gas, civil engineering and shipping industries. They are ideal for underwater maintenance, fabrication and repairs to carbon and carbon manganese steels commonly used underwater.

Multi-bead Fillet and Butt / Groove welds are easily accomplished, using **HYDROWELD FS™** electrodes, by either stringer or weave techniques in fresh water or brine.

The unrivalled user friendly properties of **HYDROWELD FS™** electrodes enable rapid production of high quality wet welds, in all positions, to internationally recognised standards such as the AWS D3.6 Specification for Underwater Welding.

KEY FEATURES

- ❑ General purpose, mild steel, manual metal arc wet welding electrode.
- ❑ Enhanced rutile flux coated.
- ❑ Optimum size for easy manipulation.
- ❑ Each marked **HYDROWELD FS™.**
- ❑ Simple to use in all positions.
- ❑ Easy to strike and re-strike.
- ❑ Smooth and easily maintained, clearly visible arc.
- ❑ High metal transfer efficiency.
- ❑ Excellent root and side-wall fusion.
- ❑ Finely rippled, well shaped beads.
- ❑ Self-releasing slag.
- ❑ Produces high quality welds to internationally recognised standards.

SPECIFICATION

Type:	**HYDROWELD FS**		
Classification:	AWS. E6013*	**Specification:**	ANSI/AWS. A5.1
Size:	3.25 mm x 350 mm	**Weight:**	38.8 kg/1000 electrodes
Size:	4.00 mm x 350 mm	**Weight:**	33.5 kg/1000 electrodes

**As no underwater classification exists to date this equivalent is provided for guidance only.*

Electrical Parameters

3.2 mm Current Range:	120 – 190 A	**4.0 mm Current Range:**	160 - 225
OCV:	60 - 90 V	**Arc Volts:**	20 - 40
Electrode polarity:	Positive [+] or Negative [-]	**Current type:**	DC only

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TYPICAL ALL WELD METAL PROPERTIES

Chemical composition by weight:	
Carbon:	0.1 %
Manganese:	0.5 %
Silicon:	0.43 %
Phosphorus:	0.015 %
Sulphur:	0.008 %

Mechanical properties:	
UTS:	510 N/mm^2
YS:	460 N/mm^2
Elongation:	16 %
Reduction in area:	32 %
Av. Hardness:	175 Hv_{10}
CVN. -20^O C:	45 J
-30^O C:	32 J

WET WELDABLE STEELS

Steel type

The types of steel most suitable for wet welding with **HYDROWELD FS™** electrodes are those in the carbon and carbon manganese group, generally known as *low alloy* or *mild* steels, with a carbon equivalent up to approximately 0.4 %.

Carbon equivalent (*CE*)

Although the *CE* provides a good indication of the wet weldability of a steel, it should only be used as a guide.

The *CE* is calculated from the steel's chemical composition (% by weight taken from ladle or sample analysis) using the formula below.

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

Or if only the carbon and manganese are known, the following short formula may be used.

$$CE = C + \frac{Mn}{6} + 0.05$$

Chemical compositions provided in general steel specifications, may, if used to calculate the *CE*, give a false indication of a steel's wet weldability. They should only be used to determine if a material might fall within the wet weldable range.

Where critical or load bearing welds are required or where the steel's chemical composition is unobtainable, a welding procedure or similar test should be qualified prior to production welding.

WELD DESIGN TIPS

Multi-bead welds

Weld design should always incorporate multi-bead welds as this offers a considerable increase in weld ductility and strength due to the tempering effect of subsequent weld beads. Three beads is recommended as a minimum.

Fillet welds

The root gap for a fillet weld should be kept to a minimum (< 1 mm). Where the gap is in excess of 2.5 mm 'butter up' one face rather than trying to bridge the gap with a single bead.

Butt / Groove welds

A butt weld should have a backing strip and have a root gap of approximately twice the electrode diameter. If a backing strip is not possible one option is to prepare a root face of 3 mm, have no root gap, then, after welding, back gouge and fill. If the back face is inaccessible consider a patch or, on a pipe, a scalloped sleeve, which can be fillet, welded.

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HYDROWELD FS USER GUIDE

Overhead welds
Weld design should minimise the need for overhead welding, for example, patches on vertical faces should be made round or oval.

ELECTRODE HANDLING

HYDROWELD FS™ electrodes require no special handling precautions and can be handled in a manner similar to those used on the surface. Normal precautions against physical damage and chemical contamination should be taken.

EQUIPMENT REQUIRED

Recommended minimum:

- ❑ DC welding generator, inverter or rectifier with minimum upper limits of 350 A and 65 OCV
- ❑ DC circuit breaker (twin pole, single action, 400 A minimum.)
- ❑ Voltmeter / ammeter or clamp meter
- ❑ Welding cables, 50 mm^2 minimum
- ❑ Dinze type connectors throughout
- ❑ Secure earth connector
- ❑ Hydroweld electrode holder
- ❑ **HYDROWELD FS** electrodes
- ❑ Electrode quiver
- ❑ Chipping hammer and wire brush
- ❑ Die/peanut grinder and burrs
- ❑ Insulating rubber gloves/diving dress
- ❑ Hydroweld flip up welding shield c/w EW 8 or 9 glass
- ❑ Hat mounted lighting

Underwater visibility and lighting
The welder diver must be able to see the arc and the results of the weld clearly. Hat mounted lighting is strongly recommended even in good visibility.

Supplementary equipment:
- ❑ Grit blasting or jetting equipment
- ❑ Power tools, e.g. wire brush, chisels and angle grinder
- ❑ Fitting up equipment, e.g. clamps, screw dogs, and wedges
- ❑ Rigging and associated equipment
- ❑ Staging, if required

Welder stability
Never try to weld whilst free swimming. If necessary, a stage should be used.

SETTING UP

Welding generator
Secure and earth the welding generator where it can be operated, under direct instructions from the supervisor, without interfering with the diving operations.

Circuit breaker
Site the circuit breaker in a dry location for operation by a responsible person who remains in direct contact with the welder diver during welding operations.

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HYDROWELD FS USER GUIDE

Cables
Cables should not be corroded nor have cuts or breaks in the insulation or wire. They should be as short as possible, tied together and protected from damage. Any excess should be flaked out rather than left coiled. All connections and joints must be secure and fully insulated particularly those to be submerged.

Pre dive checks
After assembling the equipment and prior to deployment, carry out a full function test, checking the condition and safety of all components and confirming all of the electrical settings.

Underwater set up
Set up any staging required, then deploy the cables, suspending them from rope underwater to support their weight. Secure them at the work site, leaving enough free cable to allow easy manipulation of the welding torch and connection of the earth. An additional work line may be set up and used for transferring electrodes and tools etc.

ELECTRODE DEPLOYMENT

HYDROWELD FS™ electrodes can be transferred to the work site either wet or dry.

Wet transfer
The electrodes should not be threaded through rope or taped together but should be transferred in a suitable wet container or carried by the diver to the work site. Small batches of 10 to 15 electrodes avoid prolonged immersion and/or wastage. Care must be taken not to bend the electrodes, as this will be detrimental to their performance

Dry transfer
The electrodes can be deployed underwater in the dry using a pressurised container or may be carried in the diving bell where they can be stored until ready to use.

Underwater storage
A quiver with an elasticated neck forms a useful store for the electrodes at the work site. It may be attached to the welder diver or to any convenient point within his reach and should be designed in such a way as to allow the electrodes to be removed easily.

Immersion tolerance
HYDROWELD FS electrodes have unequalled immersion tolerance in brine or fresh water and have been used successfully after immersions exceeding 24 hours. For optimum results it is recommended that they be used as soon as possible.

WET WELDING WITH HYDROWELD FS

Pre-weld cleaning
The faces to be welded should be cleaned to bright metal, preferably to Svensk standard Sa 2.5 for a minimum of 75 mm either side of the joint. Cleaning to a lesser specification, up to 1 metre either side of the joint, may also be required.

Striking the electrode
The striking tip is covered with an insulating, water-resistant coating which must be removed just prior to use. With this done, and the power turned on, the electrode is easy to strike and re-strike.

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Welding

HYDROWELD FS™ electrodes work well by either touch welding or with a small pull off. Keep the arc short, but do not bear down on the electrode as it is designed to be manipulated freely. The appropriate electrode angle should be as shown in fig. 1, 2 or 3. Listen to, and watch the arc whilst maintaining a steady even travel speed of between 120 and 180 mm/min. The arc should be bright and even around the tip with a soft even tone, not a roar. When the electrode has been consumed or the weld bead is complete pause with the electrode long enough to build up the weld pool before quickly withdrawing the electrode away from the job.

Changing the electrode

To avoid damage to the electrode holder change the electrode when a stub with at least 25 mm of flux still remains. Always ensure that the new electrode is correctly and securely inserted in the holder. Aways ensure that the power is off before changing the electrode.

Inter-bead cleaning

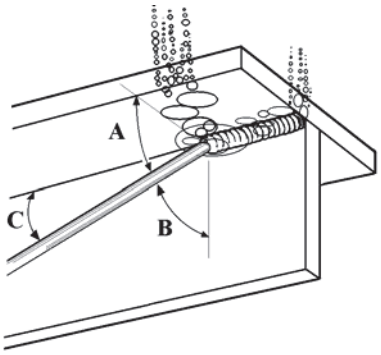
The slag that forms over the weld must be removed before laying another bead on top. This is accomplished with a wire brush and/or chipping hammer. It is vital to remove all trace of slag or it may become trapped under subsequent beads.

Stringer beads and weaving

Stringer and weave beads are easily deposited using **HYDROWELD FS™** electrodes. Stringer beads are the preferred technique since it limits the risk of inclusions in the weld deposit. To minimise the risk of inclusions when weaving, keep the weave to within one and a half times the electrode diameter.

Overhead Welding

Overhead welding requires the most skill. A smoke filled bubble may obscure the arc. The bubble may expel the water so that the weld is completed in a relatively dry atmosphere, requiring a lower current (120 - 130 A) to reduce the possibility of weld sag. Good results are achieved once the welder diver has learnt to get the 'feel and sound' of the arc.

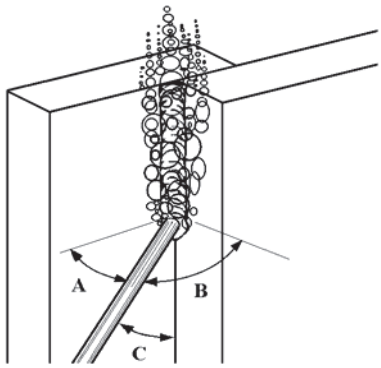


A = 40° B = 50° C = 70° - 85°

Fig. 1

Vertical Welding

HYDROWELD FS™ are designed to weld vertically down, which is the preferred technique for Butt / Groove and fillet welds. Travel speed is critical in this position to avoid slag overtaking the weld pool. Higher currents are required in the root pass to ensure root penetration.



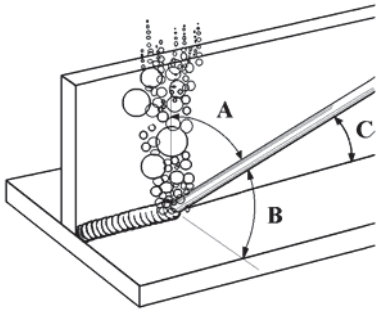
A = 45° B = 45° C = 65° - 75°

Fig. 2

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Down flat and Horizontal Welding

HYDROWELD FS™ electrodes perform well in either the flat or horizontal positions. The angles shown in fig. 3 apply to both, which are the two least demanding positions to weld in terms of skill.



A = 45° B = 45° C = 60° – 70°

Fig. 3

TROUBLE SHOOTING

Several problems can affect wet welding and may impair weld quality or cause delays if not understood and addressed. Some causes and remedies are: -

Magnetism

Magnetic fields, whether permanent, residual or induced, interact with the arc current, producing force fields that can cause arc deflection known as *arc-blow*. If present, its effects are greater at seam ends, corners or intersections with other plates, where the magnetic flux is more concentrated. The main effects of arc-blow may be described as: -

Arc wander - The arc deflects causing weld metal to be deposited to only one side of the joint at a time.

Tram lining - The arc splits, depositing weld metal to both sides of the joint but does not fuse the two sides together.

Blow out - The arc is repulsed, no weld metal is deposited and some parent metal may be removed.

Although arc-blow can not always be entirely eliminated, some methods of reducing its effects are:-

- ❑ Site the earth clamp axially.
- ❑ Weld away from the earth.
- ❑ Keep the arc as short as possible.
- ❑ Move along the joint and weld back towards the affected area.
- ❑ Try other earth locations.
- ❑ Change the electrode polarity.
- ❑ Demagnetise the area.

Power faults

A power fault can occur anywhere in the system causing detrimental changes to the arc, which affect the quality of the weld. This booklet addresses only those electrical faults that occur below the waterline and are unique to underwater welding. Such faults are generally caused by incomplete or damaged insulation encouraging the following effects: -

Current leakage - Loss of current through the water reduces arc power.

Electrolytic corrosion - Rapid corrosion of the equipment may cause high resistance, thus reducing arc power.

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The above faults may manifest themselves to the welder diver as: -

- ❑ Difficulty striking the electrode
- ❑ Sticking electrode
- ❑ Cool, hard to maintain, irregular arc
- ❑ Poor weld appearance and fusion
- ❑ Diver receiving electrical shocks

Having confirmed that the rest of the system is set and functioning correctly, methodically examine all the underwater components for: -

- ❑ Disconnection's
- ❑ Cut, missing or damaged insulation
- ❑ Corrosion
- ❑ Internal conductor damage (seek coppery discharge from pinholes, or excessive local flexibility)

Assess any corrosion damage and replace or repair affected components. Then fully insulate and conduct a function test before resuming work.

ELECTRODE STORAGE

HYDROWELD FS™ electrodes are supplied in durable, clear PVC boxes that are sealed and shrink-wrapped. This packaging provides excellent environmental protection to the electrodes and, if stored as below, will ensure prolonged self-life.

Recommended long-term storage conditions:

Pressure:	Atmospheric
Temperature:	1°C to 25°C. constant
Humidity:	< 60 % RH
Packaging:	Unopened
Stacking:	Maximum 10 boxes high on a flat stable surface
General:	Clean, dry and out of direct sun light.

Normal safeguards against chemical contamination, physical damage and magnetism should be observed.

Part used boxes of **HYDROWELD FS™** electrodes may be returned to store if they have not been immersed. The electrodes should be completely dry, undamaged and resealed in their original boxes before storing as above.

Electrodes that have been immersed can usually tolerate short storage periods provided the electrodes are washed in clean fresh water, thoroughly dried and checked for corrosion and damage before storing. Do not store or dry the electrodes at temperatures above 50°C.

Long term storage of **HYDROWELD FS™** electrodes that have been immersed is not recommended.

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SAFETY

Always:

- ❑ Follow all applicable safety procedures
- ❑ Use fully trained welder divers
- ❑ Earth the welding machine
- ❑ Check the electrical circuit for condition and security
- ❑ Use electrode holders designed for wet welding
- ❑ Wear insulating rubber gloves
- ❑ Use a suitable welding screen
- ❑ Maintain good communications between the diver and surface
- ❑ Turn the current off when not welding
- ❑ Inspect equipment after each dive for damage or signs of electrolysis
- ❑ Ensure good ventilation and avoid breathing the welding fumes

Never:

- ❑ Use electrodes that are not clearly identified as **HYDROWELD FS**
- ❑ Use electrodes if they are corroded bent, damaged or if the flux coating is powdery
- ❑ Let yourself or anyone else come between the electrode and earth
- ❑ Allow welding gasses to build up in confined spaces
- ❑ Use equipment underwater with current carrying parts exposed
- ❑ Swim around with the current on
- ❑ Weld live pipe lines or other pressurised vessels
- ❑ Allow fatigue or the onset of any distracting or debilitating condition to compromise safety

PACKAGING

Size	Pack Type	Weight lb.*	Weight kg*	Electrodes
3.2 mm	Box	7.7 lb.	3.5 kg	90
3.2 mm	Carton	38.5 lb.	17.5	450 (5 Boxes)
4.0 mm	Box	7.3	3.3 kg	60
4.0 mm	Carton	36.5	16.5 kg	300 (5 Boxes)

**Weights indicated are approximate only*

PRODUCT SUPPORT

This booklet is a guide to help **HYDROWELD FS™** users achieve high quality results. It should, however, not restrict experienced users from modifying techniques or parameters to suit their particular applications. Comprehensive technical support is available from Hydroweld covering aspects such as:

- ❑ Advice on applications and design
- ❑ Qualification of wet welding procedure specifications (WPS.)
- ❑ Qualifications of welder divers to appropriate WPS.
- ❑ Provision of qualified welder divers, supervisors and support teams
- ❑ Hire & sale of wet welding, cutting, water-arc gouging, diving systems and associated tools
- ❑ Wet welder training
- ❑ Project management and/or support

For further details contact:
HYDROWELD
Tel: + 44 (0) 121 378 1230 Fax: + 44 (0) 121 378 1281
Web site www.hydroweld.com Email: info@hydroweld.com

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Atom Arc 7018



Atom Arc 7018 is an all-position low hydrogen moisture resistant electrode with a deep, penetrating arc. This premium quality electrode meets a multitude of codes and welding specifications. Atom Arc 7018 was developed to weld carbon and low-alloy steels, including a variety of hardenable steels.

Specifications	
Classifications	ASME SFA 5.1 : E7018 H4R AWS A5.1 : E7018 H4R
Approvals	ABS : 3Y(H5) ABS : E7018 (H4R) CWB : E4918-H4 DNV-GL : 3 YH10 LR : 3Y H10 MIL : MIL-7018M
Industry	Mobile Equipment Railcars Automotive Ship/Barge Building Bridge Construction Civil Construction Industrial and General Fabrication

Approvals are based on factory location. Please contact ESAB for more information.

Welding Current	AC, DC+
Diffusible Hydrogen	< 4.0 ml/100g
Alloy Type	Carbon Manganese

Typical Tensile Properties			
Condition	**Yield Strength**	**Tensile Strength**	**Elongation**
As Welded	469 MPa (68 ksi)	563 MPa (82 ksi)	32 %
Stress Relieved 8 hour(s) 621 °C (1150 °F)	395 MPa (57 ksi)	485 MPa (70 ksi)	33 %

Typical Charpy V-Notch Properties		
Condition	**Testing Temperature**	**Impact Value**
Stress Relieved 8 hour(s) 621 °C (1150 °F)	-29 °C (-20 °F)	260 J (192 ft-lb)
As Welded	-30 °C (-22 °F)	198 J (147 ft-lb)

Typical Weld Metal Analysis %				
C	**Mn**	**Si**	**S**	**P**
0.045	1.10	0.40	0.014	0.015

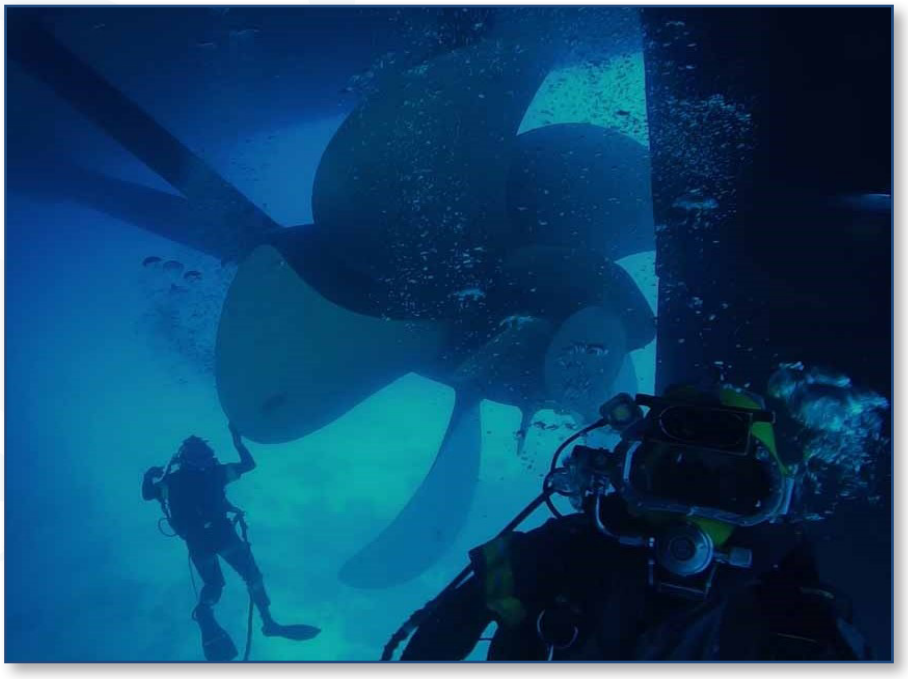
Deposition Data					
Diameter	**Current**	**Voltage**	**Deposition Efficiency (%)**	**Burn-off Time /Electrode**	**Deposition Rate @ 90% I max**
2.4 x 356 mm (3/32 x 14.0 in.)	70-110 A	23.2 V	69.01 %	60 sec	0.92 kg/h (2.0 lbs/h)
3.2 x 356 mm (1/8 x 14.0 in.)	90-160 A	23.9 V	72.23 %	70 sec	1.36 kg/h (3.0 lbs/h)
4.0 x 356 mm (5/32 x 14.0 in.)	130-220 A	24.3 V	72.06 %	75 sec	1.89 kg/h (4.2 lbs/h)

Atom Arc 7018

Deposition Data					
Diameter	**Current**	**Voltage**	**Deposition Efficiency (%)**	**Burn-off Time /Electrode**	**Deposition Rate @ 90% I max**
4.0 x 450 mm (5/32 x 17.7 in.)	130-220 A	-	73.5 %	-	1.7 kg/h (3.7 lbs/h)
4.8 x 356 mm (3/16 x 14.0 in.)	200-300 A	24.3 V	71.04 %	74 sec	2.53 kg/h (5.6 lbs/h)
5.6 x 457 mm (7/32 x 18.0 in.)	250-350 A	24.9 V	75.80 %	100 sec	3.28 kg/h (7.2 lbs/h)
6.4 x 457 mm (1/4 x 18.0 in.)	300-400 A	25.5 V	77.06 %	103 sec	4.22 kg/h (9.3 lbs/h)

SUBSEA GLOBAL
SOLUTIONS

Safe Practices Manual



Document No.: SPM-SGS-Rev 3.0

February 1, 2025

This document is the official Safe Practices Manual of Subsea Global Solutions. Prior to use, ensure that this is the most recent revision by checking the Master Document List. To request a change, submit a *Document Change Request* to the HSE Director.

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SPM ❖ CH. 1 | INTRODUCTION

1.1 Company Profile

Mission Statement
Delivering Excellence Globally, Above and Below the Water.

Brand Promise
The One Source for Global Underwater Solutions.

SGS Home Port Locations
Europe: Belgium (Antwerp)
Caribbean: Curacao (Willemstad), Trinidad and Tobago (Pointe-à-Pierre)
USA: Florida (Miami and Tampa), Texas (Galveston), California (Long Beach), Washington (Port Angeles)
Canada: British Columbia (Vancouver), Nova Scotia (Halifax), New Brunswick (Saint John)
Asia-Pacific: South Korea (Busan), Australia (Sydney), Singapore

Services Offered
Underwater Ship Husbandry

- Maintenance: Class surveys, inspections, hull cleaning, propeller polishing, blanking, transducer replacement, cathodic protection replacement, and more.
- Repair: Underwater welding/hull repairs, shaft seal exchange, thruster unit repairs and exchange, propeller repairs and exchange, rudder repairs, stabilizer repairs, sea chest installation, and more.

Marine Construction

- Inspections, surveys, pile restoration, power generation facilities maintenance and repair, and more

Other Services

- ROV inspections, light salvage, biofouling management

Corporate Departments
Health, Safety and Environment (HSE) and Training
Technical Services
Welding Services
Environmental Services
Finance

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1.2 Contact Information

Central Services (Miami, Florida)	+1-305-571-9700
HSE Field Support Line	+1-305-701-5254
HSE Email	hse@sgsdiving.com
Training Email	training@sgsdiving.com
CEO: Paul Peters - Direct Line	+1-786-439-2862
CEO: Paul Peters - Mobile	+1-305-502-9818
CEO: Paul Peters - Email	paul@sgsdiving.com
Director, HSE & Training: Zac Bowland - Mobile	+1-613-532-8421
Director, HSE & Training: Zac Bowland - WhatsApp	+1-562-453-8421
Director, HSE & Training: Zac Bowland - Email	zac@sgsdiving.com
HSE Field Support Officer: Matthew Barker - Mobile	+1-813-608-2668
HSE Field Support Officer: Matthew Barker - Whatsapp	+1-813-608-2668
HSE Field Support Officer: Matthew Barker - Email	matt.barker@sgsdiving.com
HSE Programs Officer: Hakim Ahmadjirony - Mobile	+65-9657-9738
HSE Programs Officer: Hakim Ahmadjirony - Whatsapp	+65-9657-9738
HSE Programs Officer: Hakim Ahmadjirony - Email	hakim.ahmadjirony@sgsdiving.com

The Designated Person in Charge (DPIC) of a team must notify HSE within 10 minutes of an accident or incident. The safety of our team always take priority, so notifying HSE is secondary to getting our people out of immediate danger, but the call still needs to be made as soon as possible. To notify HSE of an accident or accident, use the HSE Field Support Line listed above.

The DPIC must submit a completed incident report to HSE, Regional Manager and SAT Officer(s) within 7 hours for an accident or 24 hours for an incident.

In case of an emergency on shore in the U.S., dial 911 for assistance. For emergencies outside the U.S., refer to local emergency numbers. In Canada, call 911; in Curacao, call 911; in Trinidad, call 999; in South Korea, call 119; in Australia, call 000; in Singapore, call 995; and in Europe, call 112.

For ALL medical emergencies, injuries, incidents, material releases or evacuation situations, you must contact the HSE Field Support Line and local Subsea Global Solutions (SGS) management.

Supervisors must contact the HSE Field Support Line if a Stop-Work cannot be cleared to the satisfaction of the team in 30 minutes.

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1.3 Subsea Global Culture

At Subsea Global Solutions (SGS), our culture is the foundation of everything we do. It is defined by our shared values, expectations, and the way we interact with one another. Our culture is not just about the big decisions made by leadership; it is reflected in the countless small choices we make every day, shaping our work-life experience and guiding us toward collective success.

Core Values as Cultural Pillars
Our culture is deeply rooted in our core values, which serve as a compass to guide our daily actions and decisions. These values are not just abstract concepts but practical tools that help us navigate our responsibilities and interactions.

Safety: "Every Day & Everyone"
Characteristic Behaviors: Careful, Aware, Ready, Engaged
Safety is our top priority and the foundation of all our decisions. From the newest hire to the CEO, everyone is responsible for maintaining a safe work environment and addressing unsafe conditions immediately.

Teamwork: "Stronger Together"
Characteristic Behaviors: Supportive, Trustworthy, Attitude, Respectful
Effective teamwork is essential for our shared success. By working together, we balance each other's strengths and weaknesses, ensuring that we are collectively stronger.

Professionalism: "Delivering Excellence"
Characteristic Behaviors: Competent, Accurate, Motivated, Reliable
At SGS, we are committed to professional development and career progression. We strive to deliver excellence in all we do, holding ourselves to high standards and building a reputation for quality and reliability.

Integrity: "Trust & Accountability"
Characteristic Behaviors: Honorable, Transparent, Accountable, Effort
Integrity is the cornerstone of our culture. We earn trust through our actions, holding ourselves accountable and taking ownership of challenges and solutions. This trust is crucial for building healthy relationships with our teammates and clients.

By living these values daily, we contribute to a unified culture that makes our work more satisfying and less frustrating, helping us succeed both as individuals and as a team. At SGS, our culture is not just about what we achieve, but how we achieve it—together, with safety, teamwork, professionalism, and integrity at the core.



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1.4 Terms and Definitions

Accident: An event that results in personal injury or property damage.

Incident (General): An unplanned, undesired event that adversely affects the completion of a task.

Near Miss: An event where a slight shift in time or position could have easily resulted in damage and/or injury.

Non-Conformance: An event or situation where specified requirements, standards and/or expectations were not met.

ACFM: Actual cubic feet per minute. Refers to the actual volume of gas supplied to a diver, bell, etc., at ambient pressure.

AED: Automated External Defibrillator.

ATA: Atmosphere absolute, a unit of pressure equivalent.

ATM: Atmospheric (atm) unit equivalent to 14.7 psi or 760 (mm) of mercury.

Ambient Pressure: The surrounding pressure at depth (actual or simulated, in a hyperbaric chamber) to which the diver, bell, and so forth, is subjected.

Ascent Time: The time interval between leaving the deepest point of the dive and returning to the surface (1ATA).

BC: Buoyancy compensator

Bailout Bottle: The emergency air supply required to be carried by a diver while underwater.

Bends: See Decompression Sickness.

Bottom Time: The total elapsed time, measured in minutes, from the time that the diver leaves the surface in descent to the time that the diver begins ascent.

Breathing System: Device or apparatus for delivering appropriate breathing mixture.

Bursting Pressure: The pressure at which a pressure-containment device would fail structurally.

Cleaned for Oxygen Service: Cleaning of equipment or system to ensure elimination of all hydrocarbons and other potentially dangerous contaminants when system is to be used in oxygen service.

CNS: Central Nervous System; consisting of the brain and spinal cord.

CO2: Carbon Dioxide; a colorless, odorless, incombustible gas.

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Commercial Diver: An individual who has applied for and been awarded a certification card or other document recognized to reflect the formal training, field experience, on-the-job performance and capabilities to perform diving operations utilizing surface-supplied air.

Compressor: A machine that raises air or other gases to a pressure above 1 atmosphere.

CPR: Cardio-pulmonary resuscitation. A combination of artificial respiration and artificial circulation.

CSA: Canadian Standards Association.

Cylinder: A pressure vessel for the storage of gases.

DCBC: Divers Certification Board of Canada

Decompression: The reduction of environmental or ambient pressure to atmospheric pressure.

Decompression Chamber: A pressure vessel for human occupancy (PVHO) used to decompress divers by reducing pressure under controlled conditions; also used to treat decompression sickness by recompression.

Decompression Dive: A dive that does require a diver to take decompression stops during ascent to the surface and/or inside a hyperbaric chamber.

Decompression Schedule: A specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table. It is normally indicated as feet/minutes.

Decompression Sickness: A condition with a variety of symptoms, which may result from the formation of gas or gas bubbles in the blood or other tissue of divers during or subsequent to ascent or other pressure reduction.

Decompression Stop: A specified depth where a diver must remain for a specified length of time (stop time) during ascent.

Decompression Table: A structured set of decompression schedules, or limits, usually organized in order of increasing bottom times and depths.

Deepest Depth: The deepest depth recorded on the depth gauge during a dive.

Descent Time: The total elapsed time from the time the diver leaves the surface to the time the diver reaches the bottom. Descent time is rounded up to the next whole minute for charting purposes.

Designated Person in Charge (DPIC): An individual – usually the Diving Supervisor or Project Manager – assigned by management who has overall responsibility for a specific task/project and the employees assigned to that task/project team.

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Differential Pressure (Delta P): Occurs when there is suction of water, or where water moves from an area of high pressure to one of low pressure. This flow may be the result of the movement of water under its own weight or an active process involving powered machinery (e.g., pumps or thrusters).

Dive Location: A vessel or surface structure from which dives are supported.

Dive Station: The site from which diving operations are directly controlled. This site also includes any auxiliary or peripheral equipment necessary to conduct diving operations.

Diver: A person engaged in work using underwater apparatus which supplies compressed breathing gas at ambient pressure from a self-contained or remote source.

Diver-Worn or Carried Emergency Gas Supply (Bailout): The gas required to be worn/carried by the diver, while underwater.

Diving Operations: Any work operation that requires some type of diving or work underwater that involves planned human exposure to increased pressures to perform the job.

Diving Supervisor: An individual who, through training, experience, demonstrated competency, and certification, is appointed as the person responsible for executing the diving operation, ensuring the safety protocols are followed, and ensuring the overall safety of the diving operation.

DMT: Diver Medical Technician.

Dry Suit (Variable Volume): A diving suit capable of being inflated for buoyancy, which keeps the diver's body essentially dry.

EAD: Equivalent Air Depth; for a given nitrox mix and depth, is the table depth of a dive when breathing air that would have the same partial pressure of nitrogen.

EAN: Enriched-Air Nitrox; A gas mixture of nitrogen and oxygen, used in diving instead of air and having a higher oxygen (lower nitrogen) content than atmospheric air.

Employer: A person or business firm that hires people and pays them to perform work.

EGS: Emergency Gas Supply (bailout).

Exhaust Valve: A valve that controls the venting gas from a PVHO, diver's helmet, suit, or buoyancy-changing equipment.

FSW: A foot of sea water; a unit of pressure generally defined as 1/33 of a standard atmosphere, which represents the pressure exerted by a foot of sea water having a specific gravity of 1.027, equal to approximately .445 pounds per inch.

Gas Embolism: A condition caused by expanding gases that have been taken into and retained in the lungs while breathing under pressure, being forced into the bloodstream of other tissues during ascent.

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GFCI (GFI): A ground fault circuit interrupter attached to the topside AC power source having receptacles, any of which may be attached to underwater cables supplying power to tools or lighting.

Hard piping: Rigid permanent or semi-permanent piping, as distinguished from temporary, flexible hoses.

Harness: The combination of straps and fasteners used to attach equipment and umbilical to the diver that can be utilized as a lifting point to return the diver from the water in the event of an emergency.

HPU: Hydraulic Power Unit.

HSE: Health, Safety and Environment; SGS corporate department that oversees HSE-related matters.

Hyperbaric Condition: Pressure conditions in excess of surface pressure (1 ATA).

Hypothermia: Profound loss of body heat.

IMCA: International Marine Contractors Association.

JHA/JSA: Job Hazard Analysis/Job Safety Analysis.

LOTO: Lockout / Tagout

LP: Low Pressure (less than 500 psi, or less than 35 Bar).

Live Boating: The practice of supporting a surface-supplied air or mixed-gas diver from a vessel that is underway.

LST: Life-support technician/rack operator. Responsible for safe operation of hyperbaric system chambers; reports to diving supervisor.

Management of Change: A formal process by which changes to normal operations procedures and/or policies are managed.

Manifold: Panel for the distribution of diver breathing gas.

Manifold Operator: Individual, such as an LST, diving supervisor or mixed-gas diver, who is designated to perform the duties of gas distribution on a surface-supplied diving operation, who is experienced and trained in the operation of the manifold, and whose primary responsibility is to operate the manifold.

Mask (Open Circuit and/or Surface-Supplied): Breathing and protective equipment that covers a diver's face.

Maximum Depth: The deepest depth obtained by the diver after correction of the depth gauge reading for error. When conducting surface-supplied diving operations using a pneumofathometer to measure depth, maximum depth is the deepest reading on the pneumofathometer gauge plus the pneumo correction factor. Maximum depth is the depth used to enter the decompression tables.

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Mixed-Gas Diving: A diving technique in which the diver is supplied with a gas mixture other than air.

MSW: Meters Sea Water.

NOAA: National Oceanic and Atmospheric Administration.

No-Decompression Dive: A dive that does not require a diver to take decompression stops during ascent to the surface.

No-Decompression (No "D") Limit: The maximum time a diver can spend at a given depth and still ascend directly to the surface at the prescribed travel rate without taking decompression stops.

Non-Diving Supervisor: An experienced supervisor in accordance with the minimum qualifications, who is not in the diving rotation.

Non-Return Valve: A one-way check valve installed at the nose/helmet attachment point or elsewhere in the system, which is designed to prevent suction or loss of the diver's breathing mixture in the event the hose gets severed, or the gas supply gets interrupted.

NTP: Normal Temperature and Pressure (20^{o} C, 1 atm)

Oxygen Compatibility: The ability of a substance to come into contact with high-pressure oxygen without ignition.

Oxygen Toxicity (CNS O2) - A condition usually not encountered unless PPO2 approaches or exceeds 1.6 ATA. However, could be encountered as low as 1.4 ATA.

Oxygen Toxicity (Pulmonary O2): A condition from long exposures to increased PPO2 causing a direct pulmonary irritation. Can occur during treatment tables 4, 7, 8, and also through back–to-back administration of USN Treatment Table 6.

PFD: Personal Flotation Device

ppO2: Oxygen Partial Pressure.

PSI (psi): Pounds per square inch. An expression of pressure; for example, 1 atmosphere equals 14.7 psi.

PSIA: Pounds per square inch absolute (pounds per square inch gauge plus 1 atmosphere (14.7).

PSIG: Pounds per square inch gauge (pounds per square inch absolute minus atmosphere.)

PVHO: Pressure Vessels for Human Occupancy

Partial Pressure: That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

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Pneumofathometer: A depth measuring device indicating depth in fsw, consisting of an open-ended hose fixed to the diver, with the other end connected to an air supply and pressure gauge at the surface.

ppm: Parts per Million

Project Manager: A project manager is a professional in the field of management. Project managers have the responsibility of the planning, procurement, and execution of a project, in any domain of diving operations.

QVLs: Quality Verification Levels

Relief Valve: A pressure-relieving device that prevents pressure from rising above a preset level.
Repetitive Dive: Any dive conducted while the diver still has some residual nitrogen in his or her tissues from a prior dive.

Repetitive Group Designator: A letter used to indicate the amount of residual nitrogen remaining in the diver's body following a previous dive.

Residual Nitrogen: The excess nitrogen gas still dissolved in a diver's tissues after surfacing. This excess nitrogen is gradually eliminated during the surface interval. If a second dive is performed before all the residual nitrogen has been eliminated, the residual nitrogen must be considered in computing the decompression requirements of the second (repetitive) dive.

Residual Nitrogen Time: The time that must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive. Residual nitrogen time is expressed in minutes.

SAT Officer: Safety and Training Officer; SGS regional liaison to corporate HSE department.

SCUBA: Acronym for Self-Contained Underwater Breathing Apparatus. Used to describe apparatus in which the inspired air is delivered by demand regulator and exhaled into the surrounding water (open circuit); the air supply is carried on the diver's back. Primarily used for relatively shallow, recreation-related diving.

SGS: Subsea Global Solutions

Single Dive: Any dive conducted after all the residual nitrogen from prior dives has been eliminated from the diver's tissues.

SLED: Sea Level Equivalent Depth

Squeeze: A lack of equalization between parts of the body or between the body and the equipment. Extreme cases can cause severe injury or death.

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SPG: Submersible Pressure Gauge; indicates the amount of breathing gas in a diver's bailout bottle.

Standby Diver: Another qualified diver at the dive location who is in a state of readiness to assist the primary diver in the water.

Surface Interval: In the context of repetitive diving, the time a diver spends on the surface between dives. It begins as soon as the diver surfaces and ends as soon as the diver starts the next descent. In the context of surface decompression, the total elapsed time from when the diver leaves the 40 fsw water stop to the time the diver arrives at 50fsw in the recompression chamber.

Surface Supplied Diving: A diving in which the diver receives breathing gas from the surface.

SSDE: Surface Supplied Diving Equipment

SWA: Stop-Work Authority

TDT: Total decompression time (computed from leaving the bottom to reaching the surface). The total elapsed time from the time the diver leaves the bottom to the time the diver arrives on the surface. This time is also frequently called the total ascent time. The two terms are synonymous and can be used interchangeably.

Tender: A term reserved for an apprentice diver or diver helper.

Total Time of Dive: The total elapsed time from the time the diver leaves the surface to the time the diver arrives back on the surface.

Treatment Tables: A depth, time, and breathing gas profile designed to treat a diver for gas embolism or decompression sickness.

Umbilical: A composite hose/cable or separate cable extending from the surface to the diver or PVHO, which supplies breathing gas, power, heat, or communication.

Valve: A device that starts, stops or regulates the flow of fluids or gas.

Volume Tank: A pressure vessel connected to the outlet of a gas supply and used as a gas reservoir.

v/v: volume/volume

Working Pressure: The pressure to which a pressure-containment device is exposed under normal operations.

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1.5 Compliance with Safe Practice Manual

Adherence to the Safe Practices Manual (SPM) is mandatory for all personnel involved in diving operations. Non-compliance with any section of the SPM may result in disciplinary action, up to and including the suspension of dive status or termination of employment.

Any variance from the procedures outlined in the SPM must be approved by the HSE department (see section 3.6.2 SPM Variance Requests). This ensures that deviations are properly evaluated to maintain safety and operational integrity.

Compliance ensures safety, operational efficiency, and alignment with company standards and regulatory requirements. All personnel are responsible for understanding and following the procedures outlined in the SPM to maintain a safe and professional work environment.

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SPM ❖ CH.2 | FIELD PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

2.1 General Requirements of SGS Field Personnel

All SGS employees have general responsibilities. Specific responsibilities apply to Project Managers, Diving Supervisors, Divers, Standby Divers, Tenders, Vessel Operators and Deckhands. Each SGS employee who is engaged in diving or surface-support operations must possess the necessary competencies to perform his or her work assignments safely and in compliance with SGS requirements.

Each member of the dive team, regardless of position, has the following responsibilities:

- If a diver is assigned a task for which the diver does not consider himself or herself qualified, either by training and/or experience, the diver must immediately inform the diving supervisor.
- Each SGS employee must remain drug and alcohol-free while on the job. Every member of the SGS dive team has the right to know that his or her personal safety and wellbeing is not being jeopardized by a fellow employee whose performance might be influenced by mind-altering chemicals or drugs. Each SGS employee must read, understand, and sign the company drug policy and contraband policy.
- The dive supervisor and the local office must be informed and aware of any prescription medications in use by the dive team.
- Persons engaged as divers, or otherwise exposed to hyperbaric conditions, are responsible for staying in good physical condition to perform the requirements of their duties.
- Any person engaged as a diver, or otherwise exposed to hyperbaric conditions, will have a medical examination by a diving physician following a known or suspected decompression illness. Once the employee is physically fit to dive, based on a diving physician's report, the employee must get approval from HSE before returning to diving duties.
- Each SGS employee must read, understand, and work in compliance with the Safe Practices Manual and the Health, Safety, Environment (HSE) Manual.
- Each employee should be familiar with the Consensus Standards for Commercial Diving Operations (ADCI), OSHA Commercial Diving Standards, U.S. Army Corps of Engineers (Diving Operations), CSA (Canadian Standards Association), U.S. Coast Guard regulations on Commercial Diving, IMCA and local authorities wherever applicable. Each employee should also be familiar with the current U.S. Navy Diving Manual. These regulations should not be deviated unless it has an extremely positive effect toward reducing accidents. Look for problems and take action to eliminate them before someone gets hurt.
- Maintain good order and housekeeping at the dive station.
- Stop and correct unsafe acts or conditions and report unsafe conditions to SGS management.
- Each employee is responsible for being aware of surrounding work activities and for reporting any unsafe condition immediately to his or her supervisor.
- When returning to work, each employee is responsible for advising his or her immediate supervisor of any condition (personal or otherwise) that may keep the employee from being able to perform the job task in a safe and efficient manner.
- Must possess and wear appropriate Personal Protective Equipment (PPE), including but not limited to: Hard hat, Personal Flotation Device (PFD), safety glasses, safety boots, gloves, work vest (high visibility), coveralls (for gas and oil jobs), ear protection, knife, long pants and shirt with company logo, and appropriate environmental protection from UV radiation, cold exposure, etc.

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2.2 Tender

2.2.1 Qualifications

- Must be a qualified and trained diver.
- Required certifications: CPR, First Aid, and AED.

2.2.2 Responsibilities

- **General Duties:**
  - The tender is responsible for always following the diving supervisor's directions.
  - The general duties of a tender are to continuously tend the diver's umbilical, assist the diver in dressing/undressing, and continually monitor the diver after completion of the dive as directed by the supervisor. (Note: the diver is normally monitored for a minimum period of 10 minutes following a dive).
  - The tender shall not be assigned any task other than tending the diver, unless specifically directed to do otherwise by the supervisor and properly relieved as tender by another dive team member.
- **Specific Responsibilities:**
  - Assist the diver with checking and donning equipment.
  - Direct and assist the diver from the dressing area to the water-entry point (such as an in-water stage, ladder, or ramp).
  - Continuously tend the diver's umbilical during water entry/exit.
  - As the diver enters the water, ensure the diver's umbilical is kept away from sharp edges, rotating machinery, and other hazards that could damage or foul the umbilical.
  - While assisting the diver during water entry/exit, keep one hand on the umbilical close to the diver and the other hand on the diver's helmet or body harness to maintain positive control of the diver in case of a slip or fall.
  - Pay out the umbilical at a steady rate to permit the diver to enter the water smoothly and in a controlled manner, ensuring enough slack for the diver to move freely while maintaining control.
  - Never allow the umbilical to run free or be secured around a cleat, bitt, or other object.
  - Always be aware of the diver's general location while the diver is in the water.
  - During the dive, be alert for, and immediately report to the supervisor, conditions or situations that may be hazardous or unsafe to the diving operation.
  - The tender must remain within auditory and/or visual range of the supervisor, unless otherwise approved by the supervisor on a case-by-case basis.
  - Know all line-pull signals in case of loss of communication with the diver.

2.3 Entry Level Diver

2.3.1 Qualifications

- **Diving Certifications:**
  - Must possess a current certification from a recognized commercial diving school or organization (e.g., ADCI Entry Level Diver certification or equivalent).

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- **Medical Clearance:**
  - Must have a current annual dive physical that verifies the diver's fitness to dive, signed by a qualified diving medical examiner.
- **CPR/First Aid/AED Certifications:**
  - Must have current certifications in CPR, First Aid, and AED.
- **Dive Logbook:**
  - Must maintain a detailed dive logbook documenting all dives, including details such as depth, duration, tasks performed, and any incidents or observations. This logbook must be kept up to date and made available for inspection at any time.
- **Personal Dive Equipment:**
  - Must own and maintain a full set of personal dive equipment that meets SGS standards and is suitable for the types of dives being performed. This includes, but is not limited to:
    - Buoyancy control device (BCD) or dry suit with buoyancy compensation.
    - Harness with appropriate lift capability and quick-release mechanisms.
    - Dive knife, fins, gloves, and other personal protective equipment (PPE) as required by the dive profile.
    - Appropriate exposure suits for local working environments.
- **Workplace Familiarity:**
  - Must demonstrate a basic understanding of the diving operations and equipment used at SGS, including safety procedures, emergency protocols, and the chain of command.
- **Prerequisites:**
  - Graduate of an accredited commercial diver training program.
  - Must pass the new hire drug screening.

2.3.2 RESPONSIBILITIES

- **General Responsibilities:**
  - The Entry Level Diver qualification provides foundational knowledge and skills to teach new hires how to function as a contributing member of an SGS dive team.
  - Entry Level Divers are expected to model a safety-first approach, follow company policies and standards, maintain good working order of dive stations, and demonstrate efficiency and productivity.
  - Maintain a strong work ethic, complete training assignments without prompting, and keep dive logbooks, physicals, and certifications up to date.
- **Assist Senior Divers and Tenders:**
  - The Entry Level Diver works under the supervision of more experienced divers and tenders, assisting in the preparation and execution of diving operations. This includes helping with equipment setup, performing basic maintenance, and following instructions precisely.
- **Perform Pre-Dive Equipment Checks:**
  - Responsible for conducting thorough pre-dive checks on personal and assigned dive equipment. This includes verifying that all components, such as helmets, communication systems, harnesses, and bailouts, are in good working condition and properly secured.
  - Report completion of pre-dive checks to the supervisor, noting any discrepancies found.
- **Underwater Tasks:**
  - Assigned to perform routine underwater tasks such as inspections, basic repairs, and assisting with more complex tasks under the direct supervision of senior divers or the dive

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supervisor. These tasks might include cleaning structures, conducting visual inspections, and using basic underwater tools.
    - Required to correctly set up and test typical dive spreads, dive helmets, communication systems, and lights.
- **Safety and Compliance:**
    - Must adhere to all safety protocols and procedures established by SGS, including participating in safety briefings, completing daily Job Safety Analysis (JSA) forms, and following the guidance of the dive supervisor.
    - The Entry Level Diver is responsible for demonstrating safe and correct operation of shop tools and equipment, always wearing appropriate PPE, and understanding how to use Stop Work Authority when necessary.
- **Maintain Communication:**
    - Must maintain clear and constant communication with the surface team and dive supervisor during the dive. This involves being proficient in both voice communication and understanding standard line-pull signals in case of communication equipment failure.
- **Post-Dive Monitoring:**
    - After completing a dive, the Entry Level Diver will be observed by the tender or supervisor for 1 hour to ensure there are no delayed symptoms of decompression sickness or other dive-related conditions.
- **Documentation and Reporting:**
    - Must document each dive accurately in their dive logbook, including details of the tasks performed, dive conditions, and any incidents or observations. This documentation is critical for maintaining accurate records of dive experience and for use in debriefings or incident investigations.
- **Participate in Post-Dive Debriefings:**
    - Required to participate in post-dive debriefings with the dive team, discussing the dive's outcomes, any issues encountered, and areas for improvement. This is an opportunity for learning and skill development, as well as contributing to the overall safety and efficiency of future dive operations.

2.4 Diver Technician

2.4.1 Qualifications

- **Prerequisites:**
    - Must be qualified as an Entry Level Diver.
    - Must have a current annual diving physical.
    - Must hold current certifications in First Aid, CPR, and AED.
- **Professional Qualifications:**
    - The Diver Technician qualification builds on the foundational knowledge and skills gained as an Entry Level Diver. This role requires an in-depth understanding of SGS services and the ability to perform these services safely and effectively as part of a team.
    - Must demonstrate strong mechanical skills, including the ability to troubleshoot and repair commonly used diving equipment to keep operations running smoothly.
    - Must maintain a detailed dive logbook, stay current with physicals and certifications, and complete training assignments as required without prompting.

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2.4.2 RESPONSIBILITIES

- **General Responsibilities:**
  - The Diver Technician must always follow the Safe Practices Manual unless pre-approval is given for any variation from the manual.
  - Must be alert for the safety of others as well as oneself.
  - Properly use and maintain personal protective equipment (PPE) and clothing.
  - Report accidents, incidents, near-miss incidents, defective tools, and equipment to the diving supervisor.
  - Participate in safety meetings and provide suggestions to improve safety/reduce risks.
  - Know the emergency response plan and the actions to take in case of an emergency.
  - Report to work on time, free of any influence from drugs or alcohol.
  - Recognize that the use of drugs or alcohol represents a major safety hazard to everyone on the dive team. The Diver Technician must report all observed or suspected substance abuse to the diving supervisor.
  - Recognize hazardous situations and avoid them or employ controls to eliminate the probability of injuries or illness.
  - Report all job-related injuries and/or illnesses, no matter how minor, to the diving supervisor immediately.
  - Accomplish all assigned tasks, both underwater and topside, in a safe and efficient manner under the direction of the diving supervisor. If a task is beyond the diver's qualifications or experience, the diver must immediately inform the diving supervisor.
  - Read, understand, and comply with all SGS policies and applicable governmental regulations related to the diver's qualifications or performance during diving operations.
  - Maintain a high level of physical fitness and ensure compliance with pre-employment and ongoing physical examination requirements as per SGS policy and local regulatory authorities. The diver is responsible for scheduling their physicals.
  - Ensure that the deepest depth of the dive has been established prior to ascent and communicate this to the supervisor, along with any subsequent changes in depth.
  - Report the exact condition of the work site to the diving supervisor, including any safety hazards that could affect subsequent divers.
  - Report conditions during the dive, such as extreme cold, hard work, or fatigue.
  - Act as a standby diver when directed by the diving supervisor.
  - Act as a chamber operator if qualified and as required by the diving supervisor.
  - Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation.
  - Ensure that personal diving equipment is correctly maintained, prepared, and tested before each dive; this responsibility should not be delegated to others.
  - Ensure that personal bailout equipment is in certification, tested, and filled with the appropriate breathing gas before every dive requiring this gear. If the bailout equipment drops below 1,700 psi during a dive, the dive must be terminated, and the bottle refilled.
  - Report any recent medical treatment, medications, or illness to the diving supervisor to ensure a proper determination can be made regarding fitness to dive.
- **Leadership and Mentorship:**
  - Expected to mentor and support the learning of teammates, particularly Entry Level Divers, by sharing knowledge and demonstrating proper techniques and procedures.

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- Must model a safety-first approach in all situations and tasks, contributing to a culture of professional excellence within the dive team.

- **Mechanical and Technical Skills:**
  - Responsible for accurately setting up and testing various dive equipment, including fly-away dive spreads, HPUs, welding and gouging equipment, and air compressors.
  - Be proficient in troubleshooting and repairing dive helmet communications, pneumatic tools, LP compressors, and hat lights.
  - Expected to demonstrate safe and correct use of electrical tools, including wiring various plugs, using multimeters, and performing soldering tasks.
- **Emergency Readiness:**
  - The Diver Technician must be fully prepared to respond effectively during emergency situations, including performing rapid neurological exams, administering emergency oxygen, and recognizing and treating various dive-related injuries such as decompression sickness (Type I and II), arterial gas embolism (AGE), and carbon monoxide poisoning.
  - Must demonstrate the ability to safely recover an unconscious diver, including removing their gear in the water, securing an injured person to a spineboard, and using a bag valve mask and tourniquet correctly.
- **Safety and Compliance:**
  - The Diver Technician is responsible for maintaining compliance with all SGS safety protocols and the Safe Practices Manual (SPM). This includes understanding and implementing all SPM emergency procedures, SGS Spill Procedures, and the SGS Code of Conduct.
  - Must contribute to the maintenance of good morale and discipline within the dive team, ensuring that the dive station and job site are kept in good working order and compliant with the SPM.
- **Communication:**
  - Expected to communicate clearly and professionally with the dive team, especially when operating on comms during diving operations. This includes the ability to give and receive instructions accurately and efficiently.

2.5 Assistant Supervisor

2.5.1 Qualifications

- **Prerequisites:**
  - Must be qualified as a Diver Technician.
  - Must have a current annual diving physical.
  - Must hold current certifications in First Aid, CPR, and AED.
  - Minimum of two years of relevant experience, with at least one year with SGS.
  - Must be sponsored by a Regional Manager and at least one current Project Manager.
  - Vetted and approved by the HSE department.

2.5.2 Responsibilities

- **General Responsibilities:**
  - The Assistant Supervisor must always follow the Safe Practices Manual (SPM) and ensure compliance with all SGS standards and applicable regulations.

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  - Responsible for producing high-quality work and maintaining dive stations in good working order, ensuring they are SPM compliant.
  - Must act as a role model by demonstrating a safety-first approach in all situations and tasks, contributing to a culture of professional excellence within the dive team.
  - Expected to mentor and support the learning of teammates, particularly by explaining the Assistant Supervisor's role in mentoring and guiding others.
  - Participate in safety meetings and conduct monthly drills to prepare the team for emergencies.
  - Responsible for planning, organizing, and executing assigned projects, ensuring jobs are completed within the time quoted to clients.
  - Keep operations and management updated on job progress, and interact and communicate with clients in a professional manner.
- **Leadership and Mentorship:**
  - Expected to lead by example, setting a positive tone for the team and maintaining good morale and discipline.
  - Must debrief the team after jobs to provide feedback and guidance, helping to improve overall team performance.
  - Contributes to job planning and preparation, ensuring that all aspects of the project are well-organized and that the team is fully prepared for the task at hand.
  - Take ownership of problems and solutions, demonstrating strong situational awareness and forethought in managing the team and the project.
  - Expected to model effective leadership and personnel management skills, ensuring the team works efficiently and cohesively.
- **Mechanical and Technical Skills:**
  - Responsible for troubleshooting and repairing commonly used equipment, including small gas engines, diesel LP compressors, HPUs, and underwater video, comms, and lights.
  - Must demonstrate proficiency in performing thorough lockout/tagout procedures and maintaining accurate records of equipment maintenance and repairs using Maintenance Pro Web.
  - Expected to have a solid understanding of the contents and layout of the USN Diving Manual, as well as the ability to calculate gas volume requirements and explain in-water decompression processes.
  - Must be able to research local medical support and understand the Vessel General Permit and hot work permit processes.
- **Safety and Compliance:**
  - The Assistant Supervisor is responsible for maintaining compliance with all SGS safety protocols and the Safe Practices Manual. This includes understanding and implementing all SPM emergency procedures, SGS Spill Procedures, and the SGS Code of Conduct.
  - Must ensure that no team member works unsafely, taking immediate action if any unsafe behavior is observed.
  - Expected to be familiar with and capable of performing rapid neurological exams and recognizing the signs, symptoms, and treatments for Type I and II Decompression Sickness (DCS), arterial gas embolism (AGE), and carbon monoxide poisoning.
  - Must demonstrate the ability to recover an incapacitated diver in the water, remove an unconscious diver's helmet safely, secure an injured person to a spine board, and correctly use a tourniquet and bag valve mask.

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- **Project Management:**
  - Responsible for maintaining detailed, accurate, and timely job files and reporting, using the SGS Online Report Tool.
  - Expected to contribute to efficient use of time, money, and materials, ensuring that the team works productively and that resources are used wisely.
- **Communication:**
  - Must communicate clearly and professionally with the dive team, management, and clients, ensuring that all parties are well-informed and that instructions are understood and followed.
  - Expected to interact with clients in a professional manner, addressing their concerns and keeping them updated on job progress.

2.6 Dive Supervisor

2.6.1 Qualifications

- **Prerequisites:**
  - Must be qualified as an Assistant Supervisor.
  - Must have a current annual diving physical.
  - Must hold current certifications in First Aid, CPR, and AED.
  - Minimum of three years of relevant experience, with at least one year with SGS.
  - Must be sponsored by a Regional Manager and at least two current Project Managers.
  - Vetted and approved by the HSE department.

2.6.2 Responsibilities

- **General Responsibilities:**
  - **Designated Person-in-Charge (DPIC):** The Dive Supervisor, commonly referred to as the Designated Person-in-Charge (DPIC), is immediately responsible for the safety and health of the dive team.
  - **Authority:** The Dive Supervisor is in charge of their dive station. No individual can override or instruct a supervisor on how to run the dive station during diving operations unless an unsafe situation is observed. In such cases, a Stop-Work Authority (SWA) order must be implemented. An SGS officer can advise or relieve the supervisor, but the supervisor ultimately remains responsible for the safety and well-being of the team.
  - **Leadership:** Responsible for leading dive teams to safely execute large and complex projects in accordance with company standards. The Dive Supervisor must also mentor junior personnel, helping them to learn and become effective team members.
  - **Safety and Monitoring:** The supervisor's initiative and efforts toward accident prevention largely determine whether a high degree of safety exists on the job. The supervisor is responsible for planning and executing the diving operation, including the occupational health and safety of the dive team.
  - **Compliance:** Must ensure all diving operations comply with SGS standards and the Safe Practices Manual (SPM). The supervisor is responsible for enforcing company policies and maintaining SPM compliance at all times.

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- **Leadership and Mentorship:**
  - Expected to set a positive example for others, modeling a safety-first approach in all tasks and contributing to a culture of professional excellence within the dive team.
  - Responsible for mentoring teammates, particularly in developing their leadership skills and problem-solving abilities. This includes writing detailed and professional dive and emergency plans and effectively managing project costs and client expectations.
  - Must debrief the team after jobs to offer feedback and guidance, helping to improve overall team performance and ensure that lessons are learned and applied.
- **Mechanical and Technical Skills:**
  - The Dive Supervisor must demonstrate proficiency in setting up, testing, and troubleshooting a wide range of dive equipment, including small gas engines, diesel LP compressors, portable HPUs, and underwater video, comms, and light systems.
  - Must be able to perform thorough lockout/tagout procedures and maintain accurate equipment records using company asset management tools like Maintenance Pro Web.
  - Expected to understand hyperbaric treatment tables and procedures, in-water decompression processes, and surface decompression on oxygen (SurD-O2).
- **Emergency Readiness:**
  - Must be fully prepared to respond effectively during emergencies, including performing rapid neurological exams, administering emergency oxygen, and managing various dive-related injuries such as decompression sickness (Type I and II), arterial gas embolism (AGE), and carbon monoxide poisoning.
  - Responsible for training the dive team in emergency procedures, including the safe recovery of an incapacitated diver, removal of an unconscious diver's helmet, and the use of a tourniquet and bag valve mask.
- **Safety and Compliance:**
  - The Dive Supervisor must ensure that all team members work safely and comply with SGS safety protocols. This includes implementing Stop-Work Authority when necessary and maintaining compliance with the SPM, SGS Spill Procedures, and the SGS Code of Conduct.
  - Expected to be familiar with and able to execute all SPM emergency procedures, as well as perform accurate and timely job reporting using the SGS Online Report Tool.
- **Project Management:**
  - Must effectively manage the execution of complex projects, ensuring that jobs are completed on time, within budget, and to the satisfaction of the client.
  - Responsible for maintaining detailed, accurate, and timely job files and reports, as well as contributing to the efficient use of time, money, and materials.
- **Communication:**
  - The Dive Supervisor must communicate clearly and professionally with the dive team, management, and clients. This includes providing regular updates on job progress and addressing any concerns that arise during operations.
  - Must be skilled in reading and interpreting technical drawings, Gantt charts, and other planning tools necessary for the successful execution of diving projects.

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2.7 Project Manager

2.7.1 Qualifications

- **Prerequisites:**
  - Must be qualified as a Dive Supervisor.
  - Must have a current annual diving physical.
  - Must hold current certifications in First Aid, CPR, and AED.
  - Minimum of six years of relevant experience, with at least two years with SGS.
  - Must be sponsored by a Regional Manager and at least two current Project Managers.
  - Vetted and approved by the PM Selection Committee.

2.7.2 Responsibilities

- **General Responsibilities:**
  - The Project Manager (PM) is responsible for day-to-day project operations, ensuring that activities are carried out in accordance with the project specifications and meet the applicable requirements stated in the SGS Safe Practices Manual and HSE manuals.
  - The PM must provide quality control and coordinate with subcontractors to ensure that all project components are completed to SGS standards.
  - Must ensure that all diving personnel are competent, qualified, and able to fulfill their duties safely and efficiently according to SGS procedural requirements and guidelines.
  - The PM is responsible for planning and performing risk assessments for all safety-critical areas and developing Job Safety Analysis (JSA) and risk assessment documentation.
  - Oversees the implementation of the SGS safety management system and directs diving supervisors in the execution of tasks.
  - The PM is required to conduct, lead, and promote safety meetings and briefings, and must ensure that readiness exercises are conducted regularly, either in the field or on company property. The PM must stay up to date with these readiness exercises. While this task can be delegated to a supervisor, it must have oversight from the PM.
- **Leadership and Mentorship:**
  - The Project Manager is expected to model a safety-first approach to all situations and tasks, contributing to a culture of professional excellence within the dive team.
  - The PM must mentor and support the learning of teammates, particularly by explaining the role of the Project Manager in managing complex projects and leading large teams.
  - Responsible for debriefing the team after jobs to offer feedback and guidance, helping to improve overall team performance and ensure that lessons are learned and applied.
  - The PM is also responsible for maintaining good morale and discipline within the team, ensuring that all personnel work efficiently and cohesively to complete jobs within the time quoted to clients.
- **Project Management and Planning:**
  - The Project Manager must effectively manage project costs and client expectations, ensuring that jobs are completed on time, within budget, and to the client's satisfaction.
  - Responsible for maintaining detailed, accurate, and timely job files and reporting, using the SGS Online Report Tool.

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- The PM must demonstrate the ability to create scaled drawings, multi-view drawings, and illustrated lift plans using computer software, as well as create Gantt chart timelines for multi-shift jobs.
- Must demonstrate good decision-making abilities, effective personnel management skills, and the ability to manage multiple tasks and projects simultaneously.
- The Project Manager must be able to solve complex technical issues that arise during project execution, utilizing their technical knowledge and experience to develop effective solutions that ensure project success.

- **Safety and Compliance:**
  - The Project Manager is responsible for ensuring that all project activities comply with SGS safety protocols and the Safe Practices Manual. This includes the enforcement of the SGS safety management system and compliance with the SGS Code of Conduct.
  - Must explain and enforce the use of Stop Work Authority and the reporting process, ensuring that any safety concerns are addressed promptly and effectively.
  - The PM is expected to be familiar with all SPM emergency procedures, the role of the local Safety and Training Officer, and the responsibilities of the SGS Safety Committee and HSE Department.
- **Technical and Emergency Readiness:**
  - The Project Manager must be prepared to manage emergency situations effectively, including demonstrating the ability to perform rapid neurological exams and administer emergency oxygen.
  - The PM must be knowledgeable about hyperbaric treatment tables and general procedures, as well as the signs, symptoms, and treatment of various dive-related injuries such as Type I and II Decompression Sickness (DCS), arterial gas embolism (AGE), and carbon monoxide poisoning.
  - Must demonstrate the correct use of a tourniquet, bag valve mask, and other emergency response equipment, and must be able to lead the team in the safe recovery of an incapacitated diver.
- **Communication:**
  - The Project Manager must communicate clearly and professionally with the dive team, management, and clients, ensuring that all parties are well-informed and that instructions are understood and followed.
  - The PM must interact with clients in a professional manner, addressing their concerns and keeping them updated on job progress.
  - Responsible for creating professional documents, presentations, and spreadsheets in MS Word, PowerPoint, and Excel, ensuring that comms are clear, concise, and organized.

2.8 CROV Technician

2.8.1 QUALIFICATIONS

- **Prerequisites:**
  - Must have a current annual physical.
  - Must hold current certifications in First Aid, CPR, and AED.

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2.8.2 RESPONSIBILITIES

- **General Responsibilities:**
  - The CROV Technician is responsible for the operation, maintenance, and troubleshooting of Cleaning Remote Operated Vehicles (CROVs) used in underwater operations. This includes ensuring that all CROV systems are functioning correctly and safely before, during, and after deployment.
  - Must ensure that all CROV operations comply with SGS standards, the Safe Practices Manual, and any applicable regulations.
  - The CROV Technician is responsible for setting up and testing CROV systems, including cameras, lights, hydraulic systems, and control units, prior to deployment.
  - Must demonstrate the ability to effectively troubleshoot and repair CROV systems, including hydraulics, electrical, electronics, and mechanical components.
  - Responsible for the proper rigging and handling of CROV, ensuring that all equipment is securely rigged and safely operated.
- **Mechanical and Technical Skills:**
  - Must be proficient in setting up, testing, and troubleshooting various CROV systems, including cameras, lights, and electronic control systems.
  - The ROV Technician must demonstrate the ability to perform effective troubleshooting and repairs on hydraulic, electrical, electronic, and mechanical systems.
  - Must be capable of selecting and changing CROV hardware, including wheels, brushes, springs, and motors, ensuring that the correct components are used for specific tasks.
  - Responsible for conducting pre-dive function tests on the CROV to ensure all systems are operational and safe for use.
  - Must demonstrate the ability to accurately identify and repair hydraulic leaks, replace damaged components, and maintain the CROV's buoyancy system.
  - Expected to maintain accurate records of all CROV equipment running hours and maintenance activities.
- **Operational Responsibilities:**
  - The CROV Technician is responsible for piloting the CROV during underwater operations, ensuring that the vehicle is maneuvered accurately and safely.
  - Must demonstrate the ability to produce high-quality underwater photos and videos during CROV operations, ensuring that the footage is informative and meets the project's requirements.
  - Responsible for accurately assessing and documenting the underwater condtions, including identifying coating discrepancies, fouling coverage and types.
  - Expected to provide detailed and accurate Field Survey Reports, including assessments of the CROV's performance and any issues encountered during operations.
- **Safety and Compliance:**
  - The CROV Technician must ensure that all operations are conducted safely, adhering to SGS safety protocols and the Safe Practices Manual (SPM).
  - Responsible for participating in safety meetings, conducting safety briefings, and ensuring that all team members are aware of the safety protocols related to CROV operations.
  - Must be prepared to respond effectively during emergency situations, including executing emergency recovery procedures for the ROV and addressing any immediate technical issues that could compromise safety.

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- **Communication:**
  - The CROV Technician must communicate clearly and professionally with management, and clients, ensuring that all parties are informed of the CROV's status and any technical issues encountered.
  - Expected to interact with clients in a professional manner, providing updates on the progress of CROV operations and addressing any questions or concerns.
  - Responsible for documenting all CROV operations, including detailed maintenance logs, operation reports, and client-facing documentation, ensuring that all records are accurate and up to date.

2.9 CROV Supervisor

2.9.1 Qualifications

- **Prerequisites:**
  - Must be qualified as a CROV Technician.
  - Must have a current annual physical.
  - Must hold current certifications in First Aid, CPR, and AED.
  - Minimum of two years of relevant experience.
  - Must be sponsored by the employee's Regional Manager.

2.9.2 Responsibilities

- **General Responsibilities:**
  - The CROV Supervisor is responsible for overseeing the operation, maintenance, and troubleshooting of Cleaning Remote Operated Vehicles (CROVs) used in underwater operations. This includes ensuring that all ROV systems are functioning correctly and safely before, during, and after deployment.
  - Must ensure that all CROV operations comply with SGS standards, the Safe Practices Manual, and any applicable regulations.
  - The CROV Supervisor is responsible for coordinating with clients, diving supervisors, and other team members to ensure that all tasks are completed efficiently and to standards.
  - Must demonstrate effective leadership and personnel management skills, ensuring that the CROV team operates cohesively and safely.
  - The CROV Supervisor is responsible for writing detailed and professional CROV project plans, emergency plans, and risk assessments, ensuring that all potential risks are evaluated and controlled effectively.
- **Pre-Job Preparation:**
  - Ensure that all necessary equipment and tools for the job are included in the loadout.
  - Verify that all travel arrangements are complete (transportation, hotels, visas) if applicable.
- **Equipment Setup:**
  - Meet with the client and conduct lockout/tagout as necessary for the job.
  - Conduct Job Safety Analysis and Onsite Safety Meetings with the team.
  - Check all connections and move brushes by hand to check suspension.
  - Connect and function test hydraulics, electrical power, lights, and video on the CROV.

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- **Operational Responsibilities:**
  - Oversee the testing and safe deployment of the CROV, ensuring no harm comes to people or equipment.
  - Activate brushes once the CROV is aligned and close to the hull to suction into place.
  - Perform in-water function checks of the CROV, ensuring it is operational before beginning cleaning operations.
  - Evaluate and note the extent and types of fouling for inclusion in reports.
  - Operate the CROV to remove biofouling if serving as the pilot or oversee pilots to ensure the vehicle is maneuvered accurately and safely.
  - Take photos and videos of the hull fouling before and after cleaning for reports.
  - Maintain awareness of the CROV's position on the hull and the progress of cleaning operations.
  - Troubleshoot and repair issues with the CROV unit, video, or steering boxes during operations.
  - Oversee the repositioning of the workboat/barge as needed.
- **Recovery and Post-Job Responsibilities:**
  - Oversee the recovery of the CROV with a primary focus on the safety of the team.
  - Download media files before securing power, disconnect all connections, and remove the top cover and buoyancy.
  - Clean the CROV with fresh water, spray hydraulic connections with WD-40, and verify that all fittings are tight with no leaks or damage.
  - Blow-dry electrical connections and coat them with dielectric grease or Vaseline.
  - Pack up gear for return, follow the shipping manifest if applicable, and secure for travel.
- **Safety and Compliance:**
  - The CROV Supervisor must ensure that all operations are conducted safely, adhering to SGS safety protocols and the Safe Practices Manual (SPM).
  - Responsible for implementing effective risk control and supervision, ensuring that all team members are aware of the safety protocols related to CROV operations.
  - Must be prepared to respond effectively during emergency situations, including executing emergency recovery procedures for the CROV and addressing any immediate technical issues that could compromise safety.
- **Leadership and Communication:**
  - The CROV Supervisor must demonstrate strong leadership, ensuring that the CROV team works efficiently and cohesively. This includes providing clear instructions, managing personnel effectively, and ensuring that no team member is allowed to work unsafely.
  - Must communicate clearly and professionally with management, and clients, ensuring that all parties are informed of the CROV's status and any technical issues encountered.
  - Expected to interact with clients in a professional manner, providing updates on the progress of CROV operations and addressing any questions or concerns.
  - Responsible for documenting all CROV operations, including detailed maintenance logs, operation reports, and client-facing documentation, ensuring that all records are accurate and up to date.

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2.10 Deckhand

2.10.1 Qualifications

- **Prerequisites:**
  - Non-qualified personnel can serve as deckhands to assist on dive stations.
  - Deckhands cannot replace a qualified diver to complete a dive team.
  - Must be certified in basic first aid.
  - Must bring and wear personal protective equipment (PPE) and gear appropriate to the job at hand.

2.10.2 Responsibilities

- **General Responsibilities:**
  - The Deckhand is responsible for keeping decks and team areas free of slip and trip hazards, ensuring a safe working environment for all personnel.
  - Responsible for the safe and proper stowage of deck supplies, paint, flammables, tie-down chains, and mooring lines to prevent accidents and ensure easy access when needed.
  - Must wear a work vest or Personal Flotation Device (PFD) when working near the side to ensure personal safety in case of a fall into the water.
  - The Deckhand must advise the boat operator or diving supervisor of any safety hazards observed during operations.
- **Safety and Compliance:**
  - Before entering a tank, the Deckhand must refer to the HSE Manual for confined space requirements, ensuring all safety protocols are followed.
  - Must exercise caution when using power tools, including wearing safety goggles, gloves, and ensuring the use of properly grounded plugs.
  - The Deckhand must consider the effects that their actions may have on the diving operations, particularly when a diver is in the water, and adjust behavior accordingly.
  - Must know and understand their duties in the event of an emergency, including knowing and understanding all company safety rules.
  - In the event of an emergency, the Deckhand is responsible for passing the word to others and requesting assistance before attempting to solve the problem alone whenever possible.
  - Responsible for pointing out unsafe conditions and practices to the persons involved. If the problems are not resolved, the Deckhand must report them to the boat operator or diving supervisor.
- **Emergency Readiness:**
  - The Deckhand must be fully prepared to act in emergency situations, ensuring they know how to respond effectively and safely.
  - The Deckhand is responsible for reporting all observed or suspected substance abuse to the HSE Director to ensure the safety of all personnel on board.

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2.11 Vessel Operator

2.11.1 Qualifications

- **Prerequisites:**
  - Must be trained and qualified to SGS standards.
  - Must have a current annual physical examination.
  - Must be certified in First Aid, CPR, and AED.
  - Must have extensive experience in vessel operations, including handling in various weather and sea conditions.

2.11.2 Responsibilities

- **General Responsibilities:**
  - The Vessel Operator, commonly referred to as the boat captain, is responsible for the safe operation and navigation of the vessel, ensuring that all activities are conducted in compliance with SGS standards, maritime regulations, and safety protocols.
  - The Vessel Operator must maintain a thorough understanding of the vessel's systems, including propulsion, navigation, communication, and safety equipment, and ensure they are in proper working order before departure.
  - Responsible for planning and executing the vessel's route, taking into consideration weather conditions, tides, and any other factors that could impact the safety and efficiency of the voyage.
  - Must conduct pre-departure safety briefings with the crew, ensuring that all personnel are aware of emergency procedures, the location of safety equipment, and their specific duties during an emergency.
- **Safety and Compliance:**
  - The Vessel Operator must ensure that all operations on board the vessel comply with SGS safety protocols and the Safe Practices Manual (SPM).
  - Responsible for enforcing the use of Personal Protective Equipment (PPE) by all personnel on board and ensuring that all safety equipment, such as life jackets, fire extinguishers, and emergency signaling devices, are readily accessible and in good condition.
  - Must continuously monitor the vessel's operating conditions, including engine performance, fuel levels, and navigational hazards, and take immediate action to address any issues that arise.
  - The Vessel Operator must remain vigilant for any safety hazards on board and take corrective action or report them to the appropriate authority.
- **Operational Responsibilities:**
  - Must ensure that the vessel is properly manned and that all crew members are qualified and capable of performing their duties safely and effectively.
  - Responsible for the coordination and communication with the dive team, ensuring that the vessel's movements are synchronized with diving operations and that the vessel remains in a safe position relative to the divers.
  - The Vessel Operator must manage the mooring and anchoring of the vessel, ensuring that the vessel is securely positioned and that mooring lines are properly handled.
  - Must oversee the loading and unloading of equipment and supplies, ensuring that all items are securely stowed and weight is evenly distributed to maintain vessel stability.

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- **Emergency Preparedness:**
  - The Vessel Operator must be fully prepared to respond to emergencies, including man-overboard situations, fire, flooding, and medical emergencies. This includes knowing how to use all emergency equipment on board and being able to direct the crew in an emergency response.
  - Must maintain communication with the dive supervisor and other relevant authorities during an emergency, providing updates and coordinating rescue efforts if necessary.
- **Communication:**
  - The Vessel Operator must communicate clearly and professionally with the crew, dive team, and clients, ensuring that all instructions are understood and followed.
  - Responsible for maintaining accurate logs of the vessel's operations, including voyage details, fuel consumption, maintenance activities, and any incidents that occur.

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SPM ❖ CH.3 | SAFE WORK PRACTICES AND OPERATIONAL CONTROLS

3.1 General Safe Practices

The following general safe practices establish the foundation for all operations conducted by Subsea Global Solutions (SGS). These practices ensure that safety remains the top priority in every task, protecting personnel, equipment, and the environment.

3.1.1 Commitment to Safety

- **Safety as a Core Value:** Safety is the primary consideration in all operations. Every decision and action must reflect a commitment to avoiding harm.
- **Stop Work Authority:** All personnel have the authority to stop operations if they observe unsafe conditions or actions. This authority is essential to maintaining a safe working environment.

3.1.2 Personal Protective Equipment (PPE)

- **Mandatory PPE:** Personnel must use the required PPE for each task, including hard hats, gloves, safety glasses, and protective footwear.
- **PPE Maintenance:** Regular inspection of PPE is necessary to ensure it is in good condition and capable of providing the intended protection.

3.1.3 Communication and Incident Reporting

- **Clear and Effective Communication:** Communication must be clear, concise, and understood by all parties. This includes using approved devices and following SGS communication protocols.
- **Incident and Near Miss Reporting:** Any incident, near miss, or unsafe condition must be promptly reported to HSE department to ensure swift corrective action.

3.1.4 Environmental Protection

- **Environmental Stewardship:** All operations must be conducted with consideration for the environment, following procedures to minimize impact.
- **Spill Response and Wildlife Protection:** Immediate action must be taken in case of spills, and operations should avoid harm to wildlife, complying with relevant environmental regulations.

3.2 Risk Management

Effective risk management is essential for maintaining a safe operational environment. This section outlines the procedures and practices for identifying, assessing, and mitigating risks in all SGS operations.

For jobs including but not limited to technical repair, diving deeper than 100 feet, altitude diving, penetration diving, dam work, and unusually challenging job locations, a thorough risk assessment and emergency plan are mandatory, and the following steps must be adhered to before commencing work.

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3.2.1 Pre-Job Risk Assessment

- **Risk Evaluation:** Prior to commencing any operation, a risk assessment should be performed to identify potential hazards and determine appropriate measures to manage these risks effectively.
- **Hazard Identification and Control:** Each task should be thoroughly evaluated for hazards, and suitable control measures must be in place. This includes preparing for unexpected situations and ensuring all personnel are briefed on emergency procedures.
- **Job Safety Analysis (JSA):** A JSA must be completed for every operation, covering key topics to be discussed by the crew, including potential hazards, safety measures, and control strategies. Job Safety Analysis (JSA) forms are mandatory and must be filled out by the supervisor and signed by all personnel involved on a dive site. The following rules apply:
  - Forms must include a verbal Emergency Procedures drill every day.
  - All tagout discrepancies must be discussed and documented.
  - JSA briefings must be attended by all members of the dive team, including subcontractors.

3.2.2 Dynamic Risk Assessment

- **Continuous Risk Monitoring:** Field personnel must continuously monitor and reassess risks throughout the operation, adapting controls as necessary to address changing conditions.
- **Adaptability:** Risk management is an ongoing process, requiring adaptability to new information and evolving circumstances to ensure safety measures remain suitable and effective.
- **Communication and Mitigation:** Communicating identified risks and mitigation strategies, as well as updating information throughout the operation, is crucial to maintaining awareness and ensuring that all team members are aligned with current conditions.

3.2.3 Emergency Preparedness

- **Preparedness Planning:** All personnel should be trained in emergency procedures, including evacuation routes and the use of emergency equipment.
- **Regular Drills:** Regular drills must be conducted to ensure personnel are prepared to respond to emergencies effectively.

3.3 Safety Awareness

Safety awareness is a critical component of a safe work environment. It involves the active participation of all personnel in recognizing and addressing potential hazards.

3.3.1 Promoting a Safety Culture

- **Proactive Safety Engagement:** All personnel are encouraged to be proactive in identifying and addressing safety concerns. A strong safety culture is built on the collective efforts of the entire team.
- **Continuous Improvement:** Feedback and observations from personnel are vital for improvement.

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3.3.2 Training and Education

- **Ongoing Safety Training:** Regular safety training sessions are required to keep personnel informed about the latest safety protocols and best practices.
- **Knowledge Sharing:** Sharing knowledge and experiences related to safety helps build a collective understanding of potential hazards and effective mitigation strategies.

3.3.3 Safety Observations and Feedback

- **Encouraging Observations:** Personnel are encouraged to report any safety observations or suggestions for improvement. These reports are crucial for maintaining a safe work environment.
- **Non-Punitive Reporting:** Reports of safety concerns are encouraged and protected from any punitive action, ensuring that all personnel feel comfortable contributing to safety improvements.

3.4 Stop Work Authority

SGS is a Stop-Work Authority (SWA) company. The Stop-Work Authority program empowers every employee and contract worker with both the responsibility and obligation to halt operations when they perceive an unsafe condition or behavior that may lead to an unwanted event.

3.4.1 Exercising Stop Work Authority

- **Universal Responsibility:** Every individual, regardless of position, has the authority and is encouraged to call for a STOP WORK if they identify any dangerous situation.
- **Immediate Action:** If a Stop-Work Authority (SWA) is called, indicating that SWA has been exercised by a team member, immediate corrective action must be taken by the Dive Supervisor / Project Manager. If the issue cannot be resolved immediately on-site, the office must conduct a follow-up investigation to determine the reasons behind the SWA activation.

3.4.2 Resolution Process

- **30-Minute Resolution Requirement:** After a Stop-Work Authority card is pulled, the situation must be resolved within 30 minutes by the Dive Supervisor. If the issue cannot be resolved within this timeframe, the SWA card can only be cleared by the HSE Department or the local SAT Officer.
- **Documentation:** Any activation of SWA must be recorded in the running log for the job, with no exceptions. The Designated Person in Charge (DPIC) is required to submit a Stop Work form to report the details to the HSE Department.

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3.5 Lifesaving Rules

The nine Life-Saving Rules are shown in this section. These Rules focus on the activities which, through rigorous data analysis, have been shown to most likely result in fatalities. Each Rule consists of an icon and simple life-saving actions individuals can take to prevent a work-related fatality.

Bypassing Safety Controls

Obtain authorisation before overriding or disabling safety controls



- I understand and use safety-critical equipment and procedures which apply to my task
- I obtain authorisation before:
  - disabling or overriding safety equipment
  - deviating from procedures
  - crossing a barrier

Confined Space

Obtain authorisation before entering a confined space



- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and is monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm a rescue plan is in place
- I obtain authorisation to enter

Driving

Follow safe driving rules



- I always wear a seatbelt
- I do not exceed the speed limit, and reduce my speed for road conditions
- I do not use phones or operate devices while driving
- I am fit, rested and fully alert while driving
- I follow journey management requirements

Energy Isolation

Verify isolation and zero energy before work begins



- I have identified all energy sources
- I confirm that hazardous energy sources have been isolated, locked, and tagged
- I have checked there is zero energy and tested for residual or stored energy

Hot Work

Control flammables and ignition sources



- I identify and control ignition sources
- Before starting any hot work:
  - I confirm flammable material has been removed or isolated
  - I obtain authorisation
- Before starting hot work in a hazardous area I confirm:
  - a gas test has been completed
  - gas will be monitored continually

Line of Fire

Keep yourself and others out of the line of fire



- I position myself to avoid:
  - moving objects
  - vehicles
  - pressure releases
  - dropped objects
- I establish and obey barriers and exclusion zones
- I take action to secure loose objects and report potential dropped objects

Safe Mechanical Lifting

Plan lifting operations and control the area



- I confirm that the equipment and load have been inspected and are fit for purpose
- I only operate equipment that I am qualified to use
- I establish and obey barriers and exclusion zones
- I never walk under a suspended load

Work Authorisation

Work with a valid permit when required



- I have confirmed if a permit is required
- I am authorised to perform the work
- I understand the permit
- I have confirmed that hazards are controlled and it is safe to start
- I stop and reassess if conditions change

Working at Height

Protect yourself against a fall when working at height



- I inspect my fall protection equipment before use
- I secure tools and work materials to prevent dropped objects
- I tie off 100% to approved anchor points while outside a protected area

3.6 HSE Approval Rules

This manual provides guidelines for the baseline planning and execution of common scopes of work in normal working environments without any additional review/approval needed from HSE. When a proposed job is outside the normal for SGS or has increased risk, HSE may require additional review of the plan before granting approval for the job to proceed. When in doubt, contact HSE@sgsdiving.com or call the HSE Field Support Line at +1-305-701-5254.

3.6.1 HSE Review of Dive Plans

HSE requires a written Diving Project Plan (DPP) to be submitted at least 72 hours prior to the job for any project that involves:

- Unfamiliar hazards
- Planned decompression
- Diving deeper than 99 feet (30m)
- Salvage operations
- Isolated worksite (insufficient availability/access to medical support)
- Penetration diving
- Altitude diving

3.6.2 SPM Variance Requests

Every dive job is different. Even routine services have different combinations of people, equipment, location, conditions, etc. that all affect the risk profile of the job and the safety of our teams.

The SGS Safe Practices Manual aims to provide guidelines that are general enough to be broadly applicable, yet specific enough to help our people manage these risks effectively. The rules and standards in this SPM are written to provide guardrails for our least experienced field personnel to still conduct safe diving operations. If you encounter a situation that conflicts with a rule/standard in this manual, contact HSE to discuss the situation and potential solutions. If HSE determines that it is safe and reasonable to do so, permission will be granted to vary from standard practices. If the request is made on the job, the diving supervisor shall note the time and details of the approved variance in the job's Running Log.

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3.7 Lockout / Tagout

The SGS Vessel Pre-Dive Lockout / Tagout (LOTO) Verification Form and process are essential to keeping our divers safe.

3.7.1 SGS LOTO Form and Process

- **Isolation Checklist:** The *SGS Vessel Lockout / Tagout (LOTO) Verification Form* includes an isolation checklist organized by vessel system. This form is designed to define the vessel equipment configuration, identify the systems requiring isolation, and document that LOTO has been correctly performed prior to commencing diving operations.

3.7.2 Roles and Responsibilities

- **Dive Supervisor:** Responsible for checking the boxes in the SGS LOTO form to indicate the systems and types of isolation (lock, tag, or both) required for the planned work. The systems must be properly de-energized and isolated as indicated by the checked boxes to prevent activation or use during diving operations. The vessel's staff must initial each system after it has been isolated and the Dive Supervisor must visually verify all isolations are safe for diving.
- **Vessel Engineering Staff:** Responsible for isolating all systems indicated by the Dive Supervisor in accordance with their vessel's LOTO program. They must tag out each system by filling out the SGS danger tags and placing them in plain view on the indicated equipment.
- **Vessel Bridge Officer and Engineering Officer:** Responsible for filling out and signing the endorsement section to certify that all systems have been rendered inoperative for the duration of SGS diving operations.

3.7.3 LOTO Equipment and Notification

- **LOTO Kits:** SGS LOTO Kits are required on every dive station and must contain the following minimum items: 6 LOTO locks, 2 lockable switch clamps, 3 chains (1 meter long), and a stock of consumable SGS danger tags.
- **Danger Tags:** SGS danger tags must be affixed to every vessel system isolated for diving operations.
- **Notice Display:** SGS dives at work notice must be prominently displayed in the control room and gangway.

3.7.4 Vessel Operations During Diving

- **Equipment Deactivation:** Upon completion of the *SGS Vessel Pre-Dive LOTO Verification Form*, the vessel is not allowed to operate propulsion equipment, cycle rudders, throw anything overboard, allow small craft alongside, operate CAPAC systems, turn on pumps, or operate suction or discharge valves unless cleared by the Diving Supervisor.
- **Advance Notification:** The Dive Supervisor must be notified in advance of any service vessel movements, any changes in equipment status, and/or any other known hazards.

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3.8 Crewing Standards

The size and composition of field teams vary depending on the scope of work, operating environment, and other factors unique to each job. The following standards apply for crewing SGS jobs:

3.8.1 Minimum Crew Requirements

- A **four-person team** is the default minimum for SGS diving jobs to ensure adequate support and safety during complex operations.
- Not every job is complex, so a **three-person team** may be utilized only for basic operations such as propeller polishes and inspections, only in protected waters and with case-by-case approval from the HSE department.

3.8.2 Assistant Supervisor Requirements

- Any job managed by an Assistant Supervisor must have a minimum of a **four-person team**. The Assistant Supervisor is authorized to oversee propeller polishes, class surveys, and inspections. However, they are not authorized to manage hull cleaning or technical repairs without prior approval from the HSE department or the presence of a senior supervisor on-site. This ensures that more complex and high-risk operations are conducted under appropriate supervision and with necessary safety precautions.

3.8.3 On-Premises Crew Requirements

- A minimum of **two SGS employees** must be present on the premises when working in the shop, on dive boats, or in boat-staging areas before or after normal working hours. This requirement applies when completing maintenance, conducting load outs, or any manufacturing tasks.
- Prior to starting any such work, approval must be obtained from the local shop foreman or the operations department. This ensures that the work is conducted safely and in accordance with company standards.

Minimum Crew - Assistant Supervisor	**Minimum Crew - Dive Supervisor**
Assistant Supervisor	Dive Supervisor
Diver Technician	Diver Technician
Diver Technician	Entry Level Diver
Entry Level Diver	Tender

3.9 Fitness to Dive

3.9.1 Physical Fitness

All diving personnel are expected to maintain a sufficient level of physical fitness to safely perform tasks common to commercial diving and underwater ship husbandry without excessive exertion.

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3.9.2 Medical Fitness

All diving personnel must have a current (within 12 months) commercial divers physical examination form that finds the diver Fit for Diving and signed by a medical doctor certified to perform and dive physical exams (DMAC Level 1 or equivalent).

3.9.3 Returning to Work

Any employee who has had their work clearance revoked for any reason, must meet any requirements set forth by local management and corporate HSE before returning to work. The specific return to work requirements will be dependent on the details of the case, but will typically involve obtaining clearance to work from any relevant medical specialists and an updated dive physical.

3.9.4 Ready to Work

All personnel scheduled to work must arrive at the meetup area and be ready to work by the designated start time. “Ready to work” means sufficiently rested, sober, and prepared for the day with all necessary personal gear and supplies.

3.9.5 Drug & Alcohol Use

Subsea Global Solutions is committed to maintaining a workplace free of substance abuse. No employee is allowed to consume, possess, sell, purchase, or be under the influence of alcohol or illegal drugs, as defined by federal law, on any property owned by or leased on behalf of Subsea Global Solutions, or in any vehicle owned or leased on behalf of Subsea Global Solutions.

The use of over-the-counter drugs and legally prescribed drugs is permitted only if they are used in the manner for which they were prescribed and provided that such use does not hinder an employee's ability to safely perform his or her job. Employees shall inform their supervisor if their medication could impair their job performance, safety or the safety of others, or if they believe they need a reasonable accommodation when using such medication.

Subsea Global Solutions, LLC will not tolerate employees who report for duty while impaired by the use of alcohol or drugs. All employees should report evidence of alcohol or drug abuse to their supervisor or the SGS Centralized Services immediately. In cases in which the use of alcohol or drugs creates an imminent threat to the safety of persons or property, employees are required to report the violation.

Subsea Global Solutions, LLC has an 8-hour rule of no drinking before any planned shift or during working hours, including hours of travel and standby. If you are injured, you will be required to take a drug and alcohol test within 8 hours of the injury or within 8 hours of the request for medical aid or treatment.

Employees found in violation of this policy may be subject to disciplinary action, up to and including termination of employment.

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3.10 Flying After Diving

A two (2) hour safety buffer shall be added to the required surface interval indicated for a diver's final Repetitive Group Designator in the 8,000' column of the US Navy's current flying after diving table before they are allowed to fly.

Example: The US Navy table indicates a diver with a final Repetitive Group Designator of M must wait 18 hours before they are cleared to fly. SGS policy mandates this minimum surface interval be increased to 20 hours.

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					

SGS Policy: Add 2-hour safety buffer to times listed in 8000' column before flying.

3.11 Working Hours and Team Rest

- **Minimum Rest Period**: A minimum of 8 hours off between jobs is required. The off-time starts as soon as you are off the clock.
- **Extended Dive Days**: Any dive day exceeding 16 hours requires prior approval from the HSE department. Upon completion of a dive day, a minimum of 8 hours of rest is mandatory.
- **Night Diving**: Night diving at anchorage requires prior approval from the HSE dept, or the regional manager.

3.12 Keel Clearance

- A minimum of 6 feet / 2 meters of clearance below the ship's keel is required prior to beginning diving operations. This requirement aims to ensure sufficient space for diver safety, equipment maneuverability, and proper conduct of operations. Supervisors must account for potential bottom obstructions and changes in sea conditions, including swells and fluctuations in sea state when determining if the clearance is sufficient to conduct specific operations safely.

3.13 Inclement Weather / Current

Diving operations may be suspended or canceled at the discretion of the Dive Supervisor due to adverse or inclement weather conditions, including lightning, high winds, strong currents, or other unsafe environmental factors.

Specific environmental conditions limiting diving operations include:

- Sea state with a wave height of 1 meter or less.
- Wind speeds sustained of 20 knots.
- Currents less than 1 knot.

If the above limits are exceeded, the Dive Supervisor must assess the situation and determine whether to suspend or cancel the operation.

In the event of lightning within 5 miles.

- Diving operations must immediately cease.
- Personnel should take shelter in a safe location.
- A minimum of 30 minutes must pass after the last observed lightning strike within 5 miles before diving operations can resume.

The Dive Supervisor is responsible for ensuring that all safety precautions are adhered to when diving in challenging environmental conditions.

3.14 Diving With 3rd Party Equipment and Divers

3.14.1 Scope

This section applies to all dive operations where third-party equipment is utilized or third-party divers are integrated into SGS teams. It encompasses all aspects of planning and execution.

3.14.2 Responsibilities

- **SGS Dive Supervisor:** Ensure third-party equipment and personnel meet SGS safety and operational standards before beginning operations.
- **Third-Party Personnel:** Comply with SGS safety standards, operational requirements, and instructions from the SGS dive supervisor.

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- **SGS Divers:** SGS divers will only conduct dive operations under the direct supervision of an SGS Dive Supervisor. This ensures adherence to SGS safety and operational protocols.
- **SGS Supervision Requirement:** All SGS divers must always be under the direct supervision of an SGS Dive Supervisor. Third-party supervisors or personnel may not oversee or direct SGS divers in any capacity.

3.14.3 Operational Protocols

1. **Equipment Integration:**
    - Test third-party equipment in conjunction with SGS systems before deploying underwater.
    - Third party equipment must meet the same safety standards as SGS equipment.
2. **Supervision:**
    - The SGS Dive Supervisor retains overall authority over the dive operation and ensures adherence to the established dive plan.
    - Third-party personnel must not modify SGS equipment without explicit approval.
3. **Diver Safety:**
    - Third-party divers must adhere to SGS safety procedures and wear SGS-approved personal protective equipment (PPE).
4. **Emergency Preparedness:**
    - Ensure all third-party personnel are briefed on emergency response plans, including but not limited to:
        - Diver recovery methods.
        - Emergency procedures.
        - SGS safe procedures.

3.14.4 Compliance

Failure of third-party personnel or equipment to comply with SGS standards may result in their removal from the operation or termination of their involvement in the project.

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SPM ❖ CH.4 | STANDARD OPERATING PROCEDURES

4.1 Job Planning

Effective planning is critical to conducting safe and successful dive operations. Before every dive operation, a comprehensive plan must be developed to address all aspects of the job, ensuring safety, efficiency, and compliance with company standards.

4.1.1 Pre-Dive Planning Meeting

- **Objective:** Discuss the scope of work, hazards, and safety procedures.
- **Participants:** Include dive team members, supervisors, safety officers, the regional operations team, and the DPIC; other supporting personnel (PM, SAT Officer, dive team, HSE, etc.) participate when beneficial.
- **Agenda:**
    - Review job details (location, scope, depth, etc.).
    - Identify potential hazards (weather, underwater obstructions, vessel traffic, etc.).
    - Discuss emergency procedures and evacuation plans.
    - Assign roles and responsibilities.
- **Documentation:** Document the outcomes of the meeting, including key decisions, assigned actions, and agreed-upon safety measures.

4.1.2 Risk Assessment

For all technical repair jobs, a thorough risk assessment and emergency plan are mandatory. The following steps must be adhered to before commencing any repair work:

- **Hazard Identification**: All known and potential hazards related to the technical repair must be documented. This includes environmental, operational, and site-specific risks that could affect personnel, equipment, the environment, or our reputation.
- **Risk Mitigation**: Based on the identified hazards, appropriate control measures must be developed and implemented to minimize risks. These measures should address both the likelihood and severity of potential incidents, ensuring that all reasonable precautions are in place.
- **Approval**: Before any work begins, the risk assessment document must be reviewed and approved by the relevant personnel, including the Project Manager / Dive Supervisor and HSE department. This ensures that all individuals involved in the repair are informed of the identified risks and control measures in place.

In addition to the risk assessment, an emergency plan must be prepared to address potential incidents, including injury, equipment failure, or environmental impact. This plan must include clear procedures for immediate response, reporting, and recovery actions. Additionally, the plan must verify contact information and admissions protocols for the designated hospital and chamber facility to ensure swift and efficient emergency response.

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4.1.3 Dive Site Assessment

- **Environmental Conditions:** Assess weather, tides, currents, and visibility.
- **Equipment Needs:** Confirm the availability and condition of necessary equipment.
- **Site Hazards:** Identify and plan for dealing with specific site-related hazards.

4.1.4 Personnel Requirements

- **Qualifications:** Ensure all team members have the required certifications and experience.
- **Personnel Assignments:** Clearly define the roles of each team member.

4.1.5 Communication Plan

- **Primary and Secondary Methods:** Establish clear lines of communication.
- **Communication Checks:** Perform checks before and during the dive.
- **Emergency Signals:** Review and confirm understanding of all signals.

4.1.6 Equipment Preparation

- **Inspection:** Ensure all diving and safety equipment has been inspected and is in good working condition.
- **Backup Equipment:** Prepare and stage backup equipment as necessary.
- **Equipment Logistics:** Confirm transportation and storage plans for the equipment, if applicable.

4.1.7 Emergency Response Plan

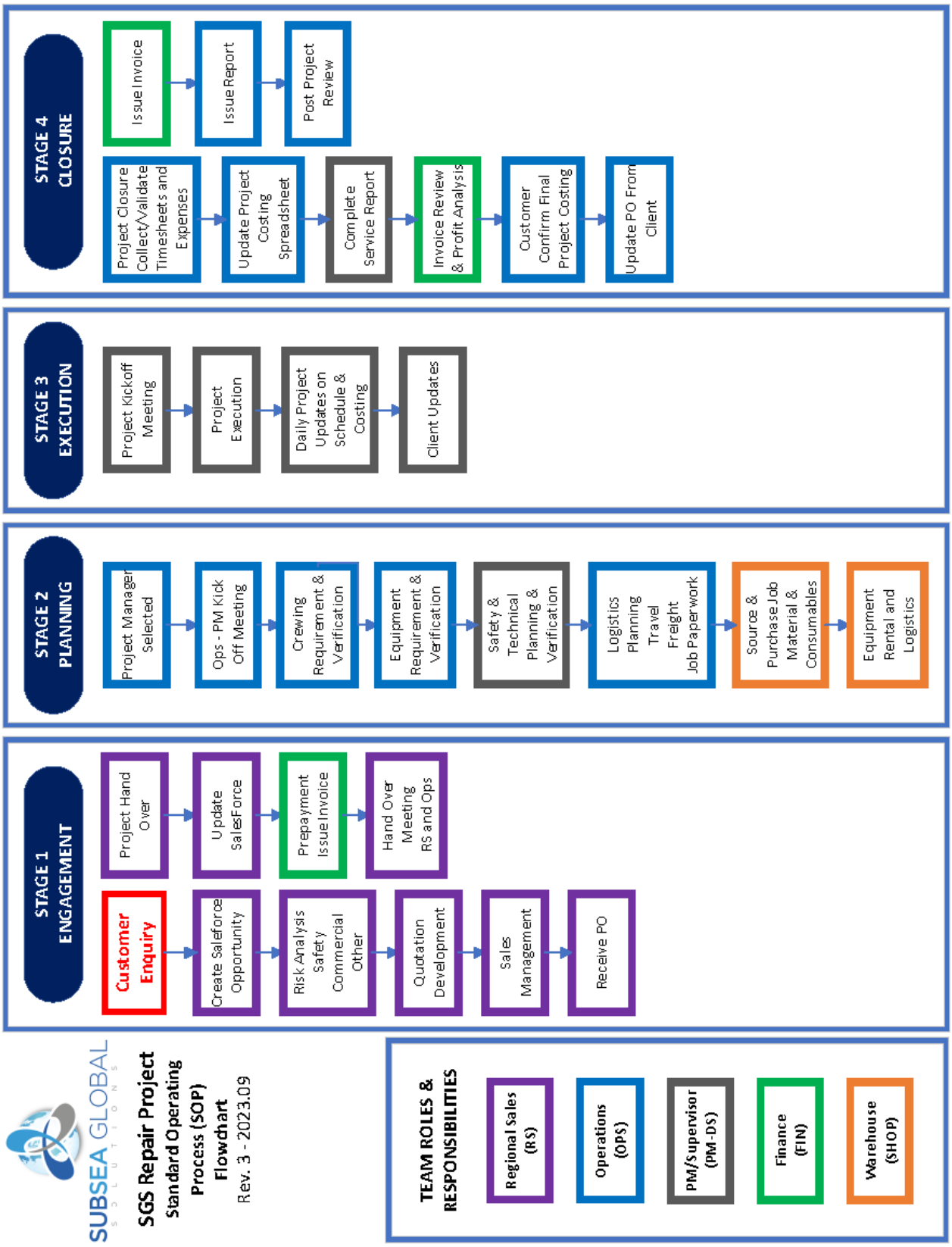
- **Emergency Contacts:** List local emergency contacts, including medical facilities and coast guard.
- **Evacuation Plan:** Outline procedures for evacuating injured personnel.
- **First Aid:** Ensure first aid kits are available and personnel are trained to use them.
- **Coordination with Local Emergency Services:** Pre-coordinate with local emergency services to ensure quick response if needed.

4.1.8 SGS Standard Operating Process

The Technical SOP (standard operating process) is the primary reference for conducting all technical repairs within Subsea Global Solutions. It outlines the necessary steps, protocols, and best practices that produce consistent safety, quality, and efficiency in repair operations.

The procedures described therein are mandatory for all technical repairs performed by SGS personnel. Any deviations from this document must be authorized in writing by the Technical Services Director or relevant department of the issue. This SOP should be used in conjunction with any project-specific documentation and relevant regulatory requirements.

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SUBSEA GLOBAL SOLUTIONS
SGS Repair Project
Standard Operating Process (SOP) Flowchart
Rev. 3 - 2023.09
STAGE 1 ENGAGEMENT
Customer Enquiry
Create Saleforce Opportunity
Risk Analysis Safety Commercial Other
Quotation Development
Sales Management
Receive PO
Project Hand Over
Update SalesForce
Prepayment Issue Invoice
Hand Over Meeting RS and Ops
STAGE 2 PLANNING
Project Manager Selected
Ops - PM Kick Off Meeting
Crewing Requirement & Verification
Equipment Requirement & Verification
Safety & Technical Planning & Verification
Logistics Planning Travel Freight Job Paperwork
Source & Purchase Job Material & Consumables
Equipment Rental and Logistics
STAGE 3 EXECUTION
Project Kickoff Meeting
Project Execution
Daily Project Updates on Schedule & Costing
Client Updates
STAGE 4 CLOSURE
Project Closure Collect/Validate Timesheets and Expenses
Update Project Costing Spreadsheet
Complete Service Report
Invoice Review & Profit Analysis
Customer Confirm Final Project Costing
Update PO From Client
Issue Invoice
Issue Report
Post Project Review
TEAM ROLES & RESPONSIBILITIES
Regional Sales (RS)
Operations (OPS)
PM/Supervisor (PM-DS)
Finance (FIN)
Warehouse (SHOP)

4.2 Equipment Mobilization

Efficient and secure mobilization of equipment is important for the safety and success of dive operations. This section outlines the procedures for preparing, transporting, and setting up diving equipment on-site.

4.2.1 Pre-Mobilization Inspection

- **Inventory Check:** Confirm that all required equipment is available and in good condition.
- **Inspection Standards:** Conduct inspections according to company standards and regulatory requirements.
  Equipment Functionality Verification: Ensure that all equipment is in proper working order and meets operational requirements through testing and inspection.

4.2.2 Packing and Securing Equipment

- **Packing Procedures:** Follow specific guidelines for packing diving gear, tools, and other equipment to prevent damage during transit.
- **Securing Loads:** Ensure all equipment is securely fastened and stabilized during transport.
- **Labeling:** Properly label all equipment and containers with identification, contents, and handling instructions.
- **Regulations:** Comply with all applicable customs and regulatory requirements when packaging goods for transport, particularly for hazardous materials (hazmat). Ensure equipment is packed and labeled according to customs clearance specifications.

4.2.3 Transportation Logistics

- **Transport Method:** Determine the appropriate mode of transportation (e.g., truck, vessel, air).
- **Permits and Documentation:** Obtain necessary permits and prepare transport documentation (e.g., customs, hazardous materials).
- **Safety During Transport:** Use safety measures to protect equipment and personnel during transportation.

4.2.4 Site Setup and Staging

- **Site Survey:** Conduct a site survey to identify the best location for staging equipment.
- **Equipment Placement:** Strategically place equipment to maximize efficiency and safety during operations.
- **Temporary Structures:** Set up any required temporary structures (e.g., tents, storage areas) for equipment protection and organization. Secure them appropriately for environmental conditions.

4.2.5 Safety Considerations

- **Load Limits:** Adhere to weight and load limits for transportation and on-site setup.
- **Hazard Identification:** Identify potential hazards associated with equipment mobilization and mitigate them accordingly.

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- **PPE:** Ensure all personnel involved in mobilization are equipped with appropriate personal protective equipment for the tasks they are performing.

4.2.6 Post-Mobilization Checks

- **Inventory Verification:** Verify that all equipment has arrived on-site and is accounted for.
- **Inspection:** Inspect equipment again after transit for any damage or issues.
- **Documentation:** Document any incidents, delays, or issues encountered with the gear and inform management. Red-tag defective equipment, including details of the issue.

4.3 Job Site Setup

Proper job site setup is crucial for ensuring a safe, efficient, and organized diving operation. This section outlines the procedures for establishing a controlled work environment, with specific guidelines for equipment placement, safety measures, and communication protocols.

4.3.1 Site Preparation

- **Area Clearance:** Ensure the work area is cleared of non-essential personnel and obstacles.
- **Environmental Controls:** Implement controls to manage environmental factors such as tides, pier traffic, and weather conditions.

4.3.2 Equipment Staging

- **Designated Areas:** Establish designated areas for staging diving equipment, tools, and emergency supplies.
- **Accessibility:** Verify that all equipment is within easy reach of the dive site and that emergency equipment is clearly marked and accessible.

4.3.3 Safety Perimeter and Barriers

- **Establishing a Safety Zone:** Mark and secure a safety perimeter around the dive site to prevent unauthorized access and ensure the safety of personnel.
- **Barriers and Signs:** Install barriers and appropriate signage to warn of hazards and restrict access to critical areas.

4.3.4 Communication Setup

- **Communication Systems:** Set up and test communication systems, including radios and underwater communication.
- **Emergency Communication Devices**: Verify the availability and functionality of emergency communication devices, including cell phones, satellite phones, VHF radios, and other relevant systems, to maintain communication in critical situations or system failures.
- **Communication Protocols:** Establish clear protocols for working and managing an emergency.

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- **Briefing on Communication:** Ensure all personnel are briefed on the communication plan and understand how to use the equipment.

4.3.5 Emergency Readiness

- **Emergency Equipment Placement:** Position first aid kits, emergency oxygen, rescue equipment, and other emergency supplies in accessible locations. Verify all are ready and adequate for use.
- **Evacuation Routes:** Identify and clearly mark evacuation routes and muster points in case of an emergency.
- **Emergency Drills:** Conduct periodic emergency drills to ensure that all personnel are familiar with procedures and equipment.
- **Recovery of Injured Diver:** Establish and discuss means for recovering an injured diver, including recovery equipment, procedures, and coordination with emergency services.

4.3.6 Operational Briefing

- **Final Pre-Operation Meeting:** Hold a final briefing to review the dive plan, assign roles, and address any last-minute concerns.
- **Safety Checklists:** Use safety checklists to verify that all equipment is set up correctly and that safety measures are in place.

4.3.7 Monitoring and Adjustments

- **Continuous Monitoring:** Continuously monitor site conditions and equipment during the operation, making adjustments as necessary.
- **Adaptation to Changing Conditions:** Be prepared to adapt the site setup in response to changing environmental conditions or operational needs.

4.4 Diving Operations

The following checklist provides general procedures for conducting safe commercial diving operations. Adherence to these procedures aims to ensures that all aspects of the dive are conducted safely and efficiently.

4.4.1 Pre-Dive Checks

- **Equipment Readiness:** Confirm that all necessary diving equipment is set up, tested, and ready for use, including personal protective equipment (PPE), diving gear, and support equipment.
- **Inspection:** Ensure that dive gear and support equipment has been inspected/checked and is ready for dive operations.
- **Dive Flags/Signals:** Ensure that all dive flags, shapes, and signals are prominently displayed during dive operations.
- **Dive Plan Review:** Review the dive plan with all team members to ensure understanding of objectives, procedures, and safety measures.

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4.4.2 Lockout/Tagout Procedures

- **Verification:** Verify that all relevant vessel and facility equipment and systems are sufficiently locked out and/or tagged out to prevent injuries and accidental activation.
- **Documentation:** Ensure that lockout/tagout procedures are documented and that all personnel are aware of the status of the equipment and systems effected by the lockout/tagout.

4.4.3 Safety Briefing

- **Team Roles and Responsibilities:** Clearly define and communicate roles and responsibilities to each team member.
- **Emergency Procedures:** Brief the team on emergency procedures, including the use of emergency equipment and evacuation routes.
- **Communication Protocols:** Reiterate communication protocols, including emergency communication procedures.

4.4.4 Dive Execution

- **Pre-Dive Inspection:** Perform a final inspection of the dive site, equipment, and safety measures before commencing the dive.
- **Monitoring:** Continuously monitor diver status and equipment performance throughout the dive. Ensure all communication systems are functioning properly.
- **Support and Supervision:** Ensure top side personnel are actively monitoring and providing assistance as needed.
- **Bailout Equipment Certification:** Ensure the bailout equipment is in certification, has been tested, and is filled with the appropriate breathing gas prior to every dive. Bailouts (emergency air) can never go under 1,700 psi during a dive. If it does, the dive must be immediately terminated, and the bottle topped back off.
- **Dive Log/Running Logs:** A record of each diver's hyperbaric exposure must be established and maintained. This record must contain the following information:
    - Location and date of diving operations.
    - Names of divers, tenders, and designated person-in-charge (DPIC).
    - Depth of dive.
    - Time of left surface and reached surface for each dive.
    - Type of gear.
    - Type of work performed.
    - Any unusual conditions.
    - Bailout updates every 2 hours.
    - Any pertinent information regarding the job itself, and/or items that may arise.
    - Any marine traffic movements or activities that impact operations or the job timeline.
    - Any accident, incident, near miss, or non-conformance.
    - Any welding operations to include type (position), length, and name of the welder(s).
    - Decompression tables: Decompression, repetitive, and no-decompression tables (as appropriate) must be available at the dive location. These tables serve as guides for determining decompression and no-decompression profiles for the diving operation.

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- Dive profiles: A written record called a depth-time profile must be maintained for each diver during the dive, including decompression. This record assists the supervisor in implementing the planned dive schedule and decompression interval and in making necessary adjustments in the decompression schedule if changes occur in planned bottom times or depths.

4.4.5 Post-Dive Procedures

- **Equipment Inspection:** Inspect all equipment post-dive for any damage or issues. Conduct any necessary maintenance or repairs.
- **Debriefing:** Conduct a post-dive debriefing with the team to discuss the dive, address any issues, and document lessons learned.
- **Documentation:** Complete all required documentation, including dive logs, incident reports, and work completions. Sign dive logbooks.

4.4.6 Emergency Response

- **Incident Management:** Follow established procedures for managing any incidents or emergencies that occur during the dive.
- **Recovery of Injured / Stricken Diver from Water:**
  - **Immediate Response:** Assess the situation and initiate the appropriate recovery plan for an injured diver.
  - **Recovery Techniques:** Utilize proper recovery techniques to safely extract the injured diver from the water, considering the diver's condition and the equipment available.
  - **Coordination:** Coordinate with surface support and emergency services to facilitate a rapid and safe recovery and tranfer to higher medical authorities, as appropriate.
- **Oil Spill Response:**
  - **Immediate Actions:** Identify and contain the source of the oil spill as quickly as possible.
  - **SGS Procedures:** Follow SGS oil spill response procedures to manage and mitigate the spill, including deploying spill response equipment and coordinating with environmental agencies.
  - **Documentation:** Document the incident thoroughly, including actions taken and any communications with relevant authorities.
- **Immediate Actions:** Take immediate actions as per the emergency procedures, including administering first aid or initiating rescue operations if needed.
- **Reporting:** Report any incidents or near-misses to the appropriate authorities and the SGS HSE department. Document them thoroughly.

4.4.7 Health and Safety Checks

- **Post-Dive Health Checks:** Ensure divers are monitored for any signs or symptoms of decompression illness, injuries, or other health issues.
- **PPE Inspection:** Inspect and clean all PPE after use to maintain its effectiveness and safety.

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4.5 Chamber Operations

This section outlines the procedures and safety measures for the operation of hyperbaric chambers used in commercial diving. All use of hyperbaric chambers must be approved by the HSE department prior to commencing diving operations.

4.5.1 Pre-Operation Checklist

- **Chamber Inspection:** Conduct a thorough inspection of the hyperbaric chamber to ensure it is in proper working condition. Check for any visible damage, leaks, or malfunctions.
- **Equipment Verification:** Verify that all chamber equipment, including communication systems, emergency supplies, and monitoring instruments, are functional and available.
- **Compressor Functionality:** Check that the compressor is functioning properly and that the required air flow is met to support operations.
- **Operational Readiness:** Confirm that all necessary operational procedures, including oxygen supply and pressure control systems, are properly set up and functioning.

4.5.2 Operational Procedures

- **Pre-Pressurization Procedures:** Follow the industry standard pre-pressurization procedures to prepare the chamber for use. This includes checking the integrity of seals, verifying pressure gauges, and ensuring the chamber is properly ventilated.
- **Pressurization and Decompression:** Adhere to industry standard practices for pressurizing and decompressing the chamber. Monitor pressure levels and make adjustments as needed to ensure a controlled and safe environment.
- **Decompression Tables:** Follow the U.S. Navy decompression tables for dive decompression scheduling and ensure all operators follow these tables accurately.
- **Monitoring:** Continuously monitor chamber conditions, including pressure, temperature, and gas levels. Maintain regular communication with divers and surface support personnel.

4.5.3 Trained Personnel

- **Qualifications:** Ensure that all personnel operating the hyperbaric chamber are properly trained and qualified. This includes certifications and experience in chamber operations and emergency procedures.
- **Roles and Responsibilities:** Define and communicate the specific roles and responsibilities of each trained personnel member involved in chamber operations. Ensure that all operators are familiar with the chamber's systems and emergency protocols.
- **Ongoing Training:** Provide regular training and refresher courses to keep personnel up to date with the latest procedures, safety standards, and technological advancements.

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4.5.4 Emergency Procedures

- **Emergency Situations:** Implement emergency protocols in case of chamber malfunctions, pressure loss, or other urgent situations. This includes initiating emergency depressurization if necessary and ensuring the safety of all occupants.
- **Medical Emergencies**: Adhere to the US Navy Dive Manual Recompression Chamber Operations (Chapters 17-6, 17-8, 17-11, 17-12) for managing medical emergencies within the chamber. This includes providing immediate first aid, utilizing chamber-specific procedures, and coordinating with medical professionals to ensure proper treatment.
- **Evacuation Procedures:** Ensure that clear evacuation procedures are in place and understood by all personnel. Practice regular drills/readiness exercises to prepare for emergency evacuations.

4.5.5 Post-Operation Procedures

- **Chamber Inspection:** Conduct a post-operation inspection of the chamber to identify any issues or necessary maintenance. Check for damage, leaks, or equipment malfunctions.
- **Cleaning and Maintenance:** Clean and maintain the chamber and all associated equipment according to manufacturer guidelines and safety standards. Document any maintenance or repairs performed.
- **Documentation:** Complete all required documentation, including chamber logs, incident reports, and maintenance records. Ensure that all data is accurate and up to date.

4.5.6 Health and Safety Checks

- **Occupant Monitoring:** Monitor the health and safety of chamber occupants throughout the operation, including checking for signs of decompression sickness or other health issues.
- **Regular Inspections:** Schedule and conduct regular inspections and maintenance of the chamber and its equipment to ensure continued safety and operational readiness.

4.6 ROV Operations

This section outlines the procedures for the safe and effective use of Remotely Operated Vehicles (ROVs) in commercial diving operations.

4.6.1 Pre-Deployment Checklist

- **ROV Inspection:** Conduct a thorough inspection of the ROV to ensure it is in good working condition. Check for any damage, leaks, or malfunctions in both the vehicle and its tether.
- **Equipment Verification:** Verify that all ROV-related equipment, including cameras, lights, manipulators, and sensors, is functional and correctly configured.
- **System Tests:** Perform system tests to confirm that navigation, communication, and operational systems are fully operational.
- **Defective Parts:** If any defective parts are found, fix or replace them before deploying the ROV to ensure reliability and safety during operations.

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4.6.2 Deployment Procedures

- **Site Assessment:** Evaluate the dive site to ensure it is suitable for ROV deployment, considering factors such as water currents, visibility, weather conditions, and potential obstacles.
- **Launch and Recovery Procedures:** Follow standardized procedures for safely launching and recovering the ROV. Ensure that all personnel involved are trained in these procedures.
- **Pilot Briefing:** Conduct a briefing for the ROV pilots detailing mission objectives, expected conditions, and specific operational protocols.

4.6.3 Operational Protocols

- **Navigation and Maneuvering:** Utilize established protocols for the navigation and maneuvering of the ROV, ensuring safe and efficient operation.
- **Data Collection:** Systematically collect data as per the operational objectives. This includes video recordings, photographs, and sensor data.
- **Real-Time Monitoring:** Ensure continuous monitoring of the ROV's operational status and environmental conditions during the mission.

4.6.4 Emergency Procedures

- **ROV Malfunctions:** Ensure protocols for dealing with ROV malfunctions, including loss of communication, power failure, or entanglement.
- **Rescue and Recovery:** Have a clear plan for the rescue and recovery of the ROV in case of a malfunction or entanglement. This plan should include equipment and procedures for retrieving the ROV and securing its data.
- **CROV-Specific Considerations**: The CROV is a hydraulic system, and its operations pose potential environmental risks. If the CROV becomes irretrievable on the bottom, address the issue of hydraulic hoses connected to the unit. Simply disconnecting them topside could create significant navigation hazards and liability until recovery operations can resume. For this reason, ensure that dive support is readily available for all CROV jobs to handle such emergencies effectively. Additionally, reference the SGS oil spill procedure to manage any potential hydraulic spills and mitigate environmental impact.

4.6.5 Post-Operation Procedures

- **Equipment Debrief:** Conduct a thorough debriefing to review the ROV’s performance and any issues encountered during the operation.
- **Maintenance and Repairs:** Perform necessary maintenance and repairs immediately following the operation. Document any changes or repairs made for future reference.

4.6.6 Training and Competency

- **Competency:** Ensure familiarity with all aspects of ROV operation, including troubleshooting and emergency handling, by actively participating in training sessions and seeking clarification on procedures when necessary.

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- **Ongoing Skill Development:** Take responsibility for staying updated on operational practices, safety protocols, and emergency response procedures through continuous learning and practice.
- **Emergency Preparedness:** Regularly review and practice emergency handling procedures to maintain readiness for unexpected situations during ROV operations.

4.7 Workboat Operations

This section outlines the procedures for the safe and effective operation of workboats used in commercial diving operations. It covers aspects from pre-operation checks through post-operation procedures to help ensure safety and compliance with maritime regulations.

4.7.1 Pre-Operation Checklist

- **Vessel Inspection:** Conduct a thorough inspection of the workboat to ensure it is seaworthy and in good operating condition. Check hull integrity, engine performance, safety equipment, and verify that all engine fluids (oil, coolant, fuel) are at appropriate levels.
- **Equipment Verification:** Verify that all necessary equipment onboard, including navigation aids, communication devices, safety gear, and all necessary diving equipment, is operational and properly stowed. Verify all other needed supplies, tools, and spares are onboard and stowed.
- **Crew Briefing:** Conduct a briefing for all crew members to review the day's objectives, weather conditions, and any specific safety concerns or instructions.

4.7.2 Deployment Procedures

- **Weather Assessment:** Check current and forecasted weather conditions to ensure they are within safe operating limits for the vessel.
- **Navigation Planning:** Plan and follow the navigation route carefully, considering factors like traffic, restricted areas, and environmental protections.
- **Safety Drills:** Conduct periodic safety drills, including man-overboard, fire, evacuation, and collision procedures, to ensure crew readiness to respond effectively as a team.

4.7.3 Operational Protocols

- **Vessel Operations:** Ensure the vessel operator navigating the workboat is fully qualified and familiar with the local maritime environment.
- **Communication Protocols:** Maintain continuous communication with divers, support personnel, and maritime traffic control using appropriate radio channels.
- **Environmental Compliance:** Follow applicable environmental regulations to prevent pollution and protect marine life during operations.

4.7.4 Emergency Procedures

- **Emergency Plans:** Have comprehensive emergency plans in place, including procedures for fire, flooding, medical emergencies, and diver rescue.

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- **Rescue Equipment:** Ensure that all rescue equipment, including life rafts, life jackets, and emergency beacons, are easily accessible and functional.
- **Evacuation Routes:** Clearly mark and routinely verify the accessibility of evacuation routes on the workboat.

4.7.5 Post-Operation Procedures

- **Vessel Debrief:** Conduct a post-operation debriefing to discuss any issues encountered, lessons learned, and suggestions for improvement.
- **Maintenance Check:** Perform a maintenance check to identify and repair any damage or wear that may have occurred during operations. Document all maintenance activities.
- **Cleaning Vessel:** Clean the vessel, including a fresh water rinse of all equipment as necessary.
- **Mechanical Issues Reporting:** Inform operations immediately if any issue needs to be fixed.
- **Documentation:** Complete all required documentation, including logs of vessel usage, crew hours, and any incidents or compliance checks.

4.7.6 Training and Competency

- **Crew Training:** Local management must ensure all crew members are trained on the operation and maintenance of the workboat and emergency response procedures.
- **Certification Updates:** Local management must ensure that all crew members maintain up-to-date certifications necessary for their roles, including safety and environmental compliance.

4.8 Crane Operations

This section outlines the procedures for safe crane operations in support of diving activities, with a focus on coordination, safety, and proper planning.

4.8.1 Crane Operations Control

- **Supervision:** The Dive Supervisor has control over all crane movements related to diving work. The Dive Supervisor must coordinate with the crane operator to ensure that crane activities are synchronized with diving operations and maximize safety.
- **Communication:** Clear and effective communication must be maintained between the Dive Supervisor and the crane operator. Use standard hand signals or communication devices to facilitate coordination and safety.

4.8.2 Planning and Coordination

- **Pre-Operation Planning:** Prior to any crane operations, the Dive Supervisor and crane operator must discuss and plan the sequence of operations. This includes determining the timing, load handling, and any potential impacts on diving activities.
- **Safe Work Area:** Ensure that the work area around the crane is clear of personnel and obstacles. Establish exclusion zones to prevent unauthorized access during crane operations.

4.8.3 Diving Operations

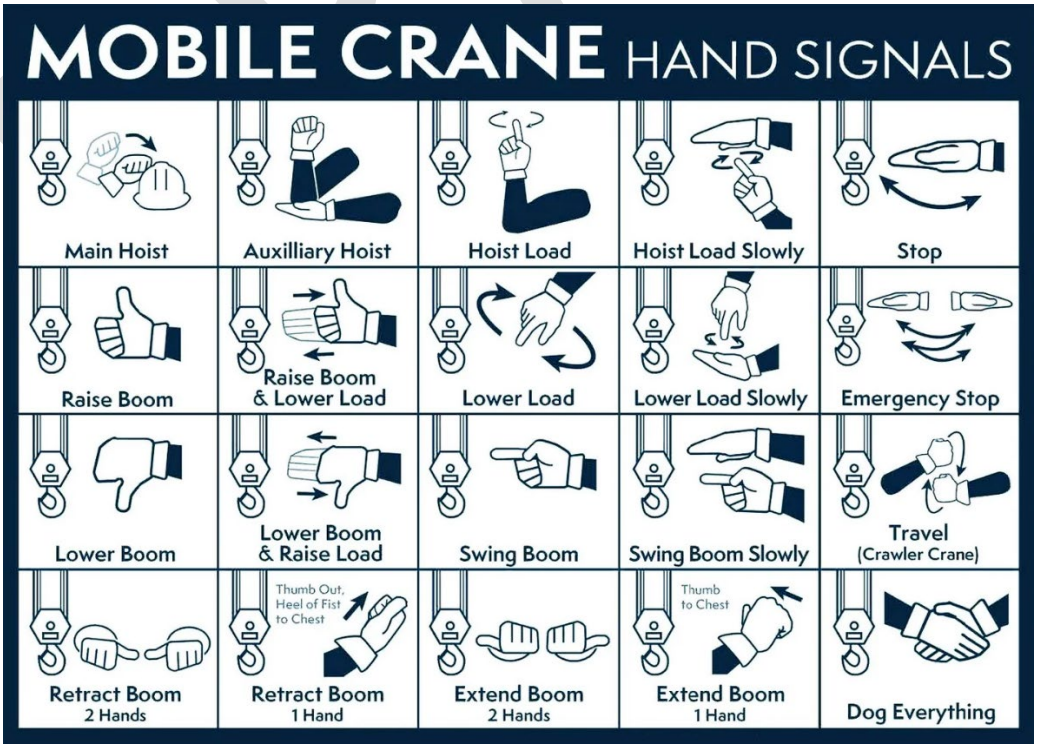
- **No Diving Under Unplanned Crane Operations:** Diving operations must not take place under or near unplanned or unscheduled crane movements. All crane operations affecting the dive site must be planned and coordinated in advance to avoid conflicts with diving activities.
- **Pre-Dive Briefing:** During pre-dive briefings, include information about crane operations and any potential hazards associated with the crane. Ensure that all diving personnel are aware of the crane's movements and their role in maintaining safety.

4.8.4 Safety Measures

- **JSA (Job Safety Analysis) and RA (Risk Assessment):** Conduct a Job Safety Analysis (JSA) and Risk Assessment (RA) briefing with the team prior to crane operations to identify potential hazards and implement control measures. Ensure that all personnel are aware of the JSA and RA findings and adhere to the safety protocols.
- **Lift Plan:** For critical lifts, develop and follow a detailed lift plan that includes the lift's specifications, safety considerations, and emergency procedures. Review the lift plan during a pre-lift meeting involving all relevant personnel, including divers, crane operators, supervisors, and project managers.

4.8.5 Training

- **Personnel:** Ensure that both the Dive Supervisor and crane operator are trained and qualified in their respective roles. Provide ongoing training to ensure they are up to date with best practices and safety procedures, including the correct use of hand signals for crane operations.



4.9 Self-Contained Underwater Breathing Apparatus (SCUBA) Diving

Subsea Global requires surface supplied diving as our default equipment configuration. However, using a SCUBA configuration can be safe and preferable in certain low-risk situations. If one of these situations arises, contact HSE to discuss. If SCUBA operations are authorized, the minimum standards described in this section must be observed during operations. Note that a full-face mask with comms to the topside dive supervisor is the default equipment standard for SCUBA operations.

4.9.1 Procedures for SCUBA Diving Operations

The following procedures are the minimum requirements that must be complied with when conducting SCUBA diving operations:

- **Standby Safety Diver:**
  A standby safety diver must be utilized during all SCUBA operations to ensure immediate assistance is available if required.
- **Line-Tending:**
  SCUBA divers must be line-tended from the surface or must be accompanied by another diver connected by a buddy line throughout the dive to maintain safety and communication.
- **Dive Profile Limitations:**
  SCUBA equipment must not be used for any decompression diving or for dives exceeding 50 fsw.
- **Current Limitations:**
  SCUBA equipment must not be used in currents stronger than ½ knot or in situations where the diver cannot make an unassisted direct ascent to the surface.
- **Enclosed or Confined Spaces:**
  SCUBA equipment must not be used in enclosed or confined spaces.
- **Prohibited Activities:**
  SCUBA equipment must not be used for underwater cutting, welding, or operating powered tools due to the inherent risks and limitations of the equipment.
- **Air Supply Management:**
  The planned duration of a SCUBA dive must not exceed the air supply available in the cylinders, exclusive of the reserve supply. The reserve air supply (minimum allowable pressure at the end of a dive) is 1000 psi / 70 bar with an 80 CuFt cylinder.
- **Cylinder Pressure Check:**
  The pressure of the SCUBA cylinders must be determined immediately before each dive to confirm adequate air supply.
- **Emergency Equipment:**
  Each SCUBA regulator must be equipped with an octopus (backup regulator) for emergency use only, ensuring an alternate air source is readily available in case of primary regulator failure.
- Each SCUBA diver must be equipped with:
  - A Buoyancy Compensation Device (BCD) and quick-release weight pockets or belt.
  - A submersible cylinder pressure gauge that can be monitored during the dive.
  - A bottom timer with to monitor diving depth and dive time.
- **Timekeeping:**
  The dive supervisor and each diver must carry a timekeeping device to track dive duration and ensure adherence to dive plans.

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4.10 Surface Decompression on Oxygen (SurD-O2)

4.10.1 Authorization

Surface decompression on oxygen (SURD-O2) is a controlled decompression procedure that must be authorized solely by the HSE Director. The procedure follows the U.S. Navy Regulation unless an alternative regulation is approved for use on a case-by-case basis.

4.10.2 Dive Plan Requirement

Before conducting a SURD-O2 operation, the team involved must develop a detailed dive plan and submit it to HSE for review and approval. This plan should outline all aspects of the dive, including decompression schedules, equipment requirements, emergency procedures, and the roles and responsibilities of the dive team.

4.10.3 Chamber Operator Qualification

The chamber operator conducting the SURD-O2 procedure must be qualified according to the SGS Professional Qualifications Standard for Chamber Operators. This includes proficiency in tasks such as chamber setup, pressure testing, controlling oxygen delivery, performing surface decompression runs, and understanding treatment tables. Only a chamber operator who has met these qualification requirements can manage a SURD-O2 procedure, ensuring that all operations are conducted safely and in accordance with established standards.

4.10.4 Dive Record Documentation

The SURD-O2 procedure must be meticulously documented using the SGS Decompression Diving Record form. This includes details such as air pressures, chamber times, oxygen start pressures, surface intervals, and other relevant data. The form also requires verification of the procedure by the chamber operator and signatures from both the diver and the supervisor to confirm that all protocols were followed and that no decompression sickness (DCS) or injury occurred.

4.10.5 Overview of Surface Decompression

Surface decompression is employed to fulfill all or part of a diver's decompression obligation within a recompression chamber rather than underwater. This method reduces the time spent in the water, enhancing diver safety by decompressing in controlled environments and preventing excessive chilling.

Advantages:

- **Reduced Water Exposure:** Divers spend less time in the water, minimizing the risk of hypothermia and in-water hazards like floating debris, vessel traffic, and umbilical entanglement.
- **Stable Conditions:** The recompression chamber maintains a constant pressure, shielded from surface sea conditions and resulting fluctuations in depth/pressure in the water.
- **Operational Efficiency:** A second dive may commence while the first diver(s) are safely decompressing in the chamber if: 1) there are separate air supplies for the recompression

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chamber and surface-supplied diving systems, and 2) – the chamber will be cleared, bibs cleaned, and inner lock blown back down and ready at least 10 minutes before the second diver(s) need it. This method significantly expedites the overall operation, but requires careful coordination.

4.10.6 SURD-O2 Procedure

To initiate Surface Decompression on Oxygen, follow these steps:

1. **Complete Required Decompression Stops:**
   Complete any required decompression stops on air at 40 fsw (feet of seawater) or deeper.
2. **Surface the Diver:**
   Upon completion of the 40 fsw stop, bring the diver to the surface at a rate of 40 fsw/min. If a 40 fsw water stop is not required, bring the diver from the bottom to 40 fsw at 30 fsw/min and then from 40 fsw to the surface at 40 fsw/min.
3. **Transfer to Recompression Chamber:**
   Once the diver is on the surface, tenders have approximately 3.5 minutes to remove the breathing apparatus and diving dress and assist the diver into the recompression chamber.
4. **Place Diver in Chamber:**
   Place the diver in the recompression chamber and initiate monitoring for signs of decompression sickness (DCS) and central nervous system (CNS) oxygen toxicity during the subsequent recompression. If two divers undergo surface decompression simultaneously, they will monitor each other while being observed by topside personnel.
5. **Compress to 50 fsw:**
   Compress the diver on air to 50 fsw at a maximum rate of 100 fsw/min. The surface interval, defined as the time from leaving the 40 fsw water stop to arriving at 50 fsw in the chamber, should not exceed 5 minutes. Exceeding this interval without penalty is not permitted.
6. **Begin Oxygen Breathing:**
   Upon arrival at 50 fsw, have the diver breathe 100% oxygen via mask. Ensure the mask is strapped tightly to maintain a good seal.
7. **Oxygen Periods:**
   In the chamber, have the diver breathe oxygen for the number of 30-minute periods and 15-minute half periods indicated in the next-to-last column of the US Navy Rev. 7 Air Decompression Table for that depth and time. The first period includes 15 minutes at 50 fsw followed by 15 minutes at 40 fsw. Periods 2–4 are spent at 40 fsw. If more than four periods are required, the remaining periods are spent at 30 fsw. Ascent from 50 fsw to 40 fsw and from 40 fsw to 30 fsw is at a rate of 30 fsw/min. Ascent time from 50 to 40 fsw is included in the first oxygen period. Ascent from 40 to 30 fsw, if required, should take place during an air break.
8. **Air Breaks:**
   Interrupt oxygen breathing with a 5-minute air break after every 30 minutes on oxygen. This air time is considered "dead time." Oxygen time begins when the diver is confirmed to be on oxygen at 50 fsw.
9. **Ascend to Surface:**
   Following decompression profile, the operator slowly vents the chamber to slide the depth from 40 fsw to surface over 10 minutes while the diver is breathing 100% O2. (SGS modification)

This procedure ensures that surface decompression on oxygen is conducted safely and in compliance with established U.S. Navy SURD-O2 dive tables, prioritizing the diver's health and operational efficiency.

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4.10.7 SGS DECOMPRESSION DIVING RECORD

Decompression Diving Record

Job #: _____ Vessel: _____ Diver: _____ Dive #: _____
Client: _____ Rack Oper.: _____ Supervisor: _____ Dive Hose #: _____
Date: _____ Stby Diver: _____ Tender: _____ Location: _____

AIR PRESSURES: Main: Stnby: H.P. Air: Bailout: 1st Stage Regulator: Deco Gas:

SEAS		WEATHER	WIND (Kts.)	BOTTOM		CURRENT (Kts.)	U/W VISIBILITY	WATER TEMP.
0-2 Ft ☐	6-8 Ft ☐	Clear ☐	Calm 0-5 ☐	Soft ☐	Sand ☐	Weak 0-.5 ☐	Excel. 20+ ☐	Warm 78+ ☐
2-4 Ft ☐	8-10 Ft ☐	Overcast ☐	Fresh 6-15 ☐	Med. ☐	Mud ☐	Mod .5-1 ☐	Good 5-20' ☐	Norm. 65-78 ☐
4-6 Ft ☐	Over 10 Ft ☐	Poor ☐	Strong 15+ ☐	Hard ☐	Shell ☐	Strong 1+ ☐	Poor 0-5' ☐	Cold <65 ☐

REPET

End Last Dive: Time: Date: Sur. Int.: Hrs. Min. Repet Gp.: to RNT:

DIVE

LS:	Pre-Dive Briefing: ☐	Equipment Inspected: ☐	Tools Selected: ☐	Notify Port Ops: ☐	Lockout/Tagout: ☐	Flag/Shapes Displayed: ☐	
RB:	Breathing Equipment:	Mask ☐	Helmet ☐	Diver Dress:	Wetsuit ☐	Drysuit ☐	Hot Water ☐	Coveralls ☐
LB:	Pre-Dive Condition:	Rested ☐	Tired ☐	U/W Workload:	Light ☐	Moderate ☐	Heavy ☐	Severe ☐
BT:	☐ **Diver instructed to report any physical problems or physiological effects before the dive.**						
RNT:	Type of Dive: NO - D.: ☐	STAND: ☐	SUR 02: ☐	OTHER: ☐			
TBT:	Depth of Dive: Ft	Schedule: Ft. Min.	Repet Gp.:				

WATER STOPS

DEPTH	MIX	ARRIVE	STOP	LEAVE	RATE	OK	INITIAL
1st							
2nd							
3rd							
4th							
5th							

REACHED SURFACE: TIME _____ Umbilical Flushed With AIR _____
DATE _____
SURFACE INTERVAL _____ TIME ON O2 _____

☐ **Watches Synchronized**

CHAMBER TIME O2 Start PSI

DEPTH	TIME	AIR/O2	ARRIVE	LEAVE	OK	INITIAL
50'	15 min	O2				
50'-40'	1 min	O2				
40'	14 min	02				
40'	5 min	Air				

Table Confirmed to:
☐ Diver
☐ Tender
Initial _____

CHAMBER CHECK OUT

O2 On ☐	Chamber at Depth ☐
Earmuffs in Outer Lock ☐	Compressor Running ☐
Towel ☐	Personal Effects ☐

O2 Finish PSI

REACHED SURFACE: DATE:
CHAMBER OPERATOR:

WORK SUMMARY:

I have reviewed the dive record and have reported any errors to the Supervisor for correction. I was informed of the procedures utilized during the dive and I have reported any physical problems or physiological effects, including DCS.

Diver's Signature _____
Date _____ Time _____

The Diver has been checked and reports no DCS or injury. The dive record has been reviewed with the diver, corrections have been made and the record is submitted as complete and correct.

Supervisor's Signature _____
Date _____ Time _____

4.11 Enriched Air Nitrox (EANx) Diving

Enriched air nitrox, commonly referred to as "nitrox," is a specialized diving practice that utilizes oxygen-enriched breathing gas mixtures ranging from 25-40% oxygen (O2). Nitrox diving extends the time a diver can spend at depth without decompression and reduces the decompression time compared to air dives at the same depth and duration. In SGS operations, nitrox diving depths are limited to a maximum partial pressure of oxygen (ppO2) of 1.4 ata. The use of nitrox must be authorized by the HSE Director before any diving operations are conducted.

4.11.2 Nitrox Diving Procedures

Nitrox Diving Using Equivalent Air Depths:
SGS employs U.S. Navy air decompression schedules and a tabulated Equivalent Air Depth (EAD) table to ensure nitrox diving operations are simple, safe, and standardized.

- **Using the EAD Table:**
  To use the EAD table, identify the oxygen percentage in the breathing gas from the heading and locate the diver's actual depth in the left column. The intersection of these two values provides the equivalent air depth, which determines the appropriate schedule from the Air Decompression Tables.
  - For example, for a dive with an actual depth of 70 fsw and a breathing gas mixture containing 40% oxygen, the EAD is 50 fsw which will provide the appropriate decompression schedule based on the reduced nitrogen absorption.

Repetitive Diving with Nitrox:
Repetitive diving is possible when using nitrox or combinations of air and nitrox. Once the EAD is determined for a specific dive, the Air Decompression Tables are applied throughout the dive using the EAD from the SGS EAD table. When performing repetitive nitrox dives, the Residual Nitrogen Timetable for Repetitive Air Dives is used, applying the EAD for nitrox dives.

- **Determining Repetitive Group Designator:**
  - After completing a dive, determine the Repetitive Group Designator using the repetitive group designator.
  - If the repetitive dive is an air dive, use the air-specific table (Figure 1) as normal.
  - If the repetitive dive is a nitrox dive, determine the EAD for the repetitive dive from the SGS EAD table and use that depth to reference the appropriate Air Decompression Tables.

4.11.3 Nitrox Mixtures for SGS Diving Operations

SGS allows dive teams to utilize the nitrox mixture best suited for the working depth, not to exceed 40% O2 or a ppO2 of 1.4 ata at the deepest depth. Before each dive, the oxygen content of all nitrox gases must be checked using an O_2 analyzer with an accuracy of ±0.5% to verify the mix is correct for the planned dive depth.

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Table 10-1. *Equivalent Air Depth Table.*

Diver's Actual Depth (fsw)	EAD Feet															
	25% O_2	26% O_2	27% O_2	28% O_2	29% O_2	30% O_2	31% O_2	32% O_2	33% O_2	34% O_2	35% O_2	36% O_2	37% O_2	38% O_2	39% O_2	40% O_2
20	20	20	20	20	20	20	20	15	15	15	15	15	10	10	10	10
30	30	30	30	30	30	30	30	25	25	25	20	20	20	20	20	20
40	40	40	40	40	40	40	40	35	30	30	30	30	30	30	25	25
50	50	50	50	50	50	50	50	40	40	40	40	40	35	35	35	35
60	60	60	60	60	60	60	50	50	50	50	50	50	50	50	40	40
70	70	70	70	70	70	60	60	60	60	60	60	60	50	50	50	50
80	80	80	80	80	70	70	70	70	70	70	70	60	60	60	60	60
90	90	90	90	90	80	80	80	80	80	80	70	70	70 (:107)	70 (:80)	70 (:61)	70 (:47)
100	100	100	100	90	90	90	90	90	90	80 (:113)	80 (:82)	80 (:61)	80 (:46)	80 (:36)	80 (:29)	70 (:23)
110	110	110	110	100	100	100	100	100 (:96)	100 (:69)	90 (:51)	90 (:39)	90 (:30)				
120	120	120	120	110	110	110 (:91)	110 (:64)	110 (:47)	100 (:35)	100 (:27)						
130	130	130	120	120 (:95)	120 (:65)	120 (:47)	120 (:35)	110 (:26)								
140	140	140 (:109)	130 (:73)	130 (:50)	130 (:36)											
150	150 (:89)	150 (:59)	140 (:41)													
160	160 (:50)	160 (:35)														

EAD = Equivalent Air Depth - For Decompression Table Selection Only Rounded to Next Greater Depth

▬ = 1.4 ata Normal working limit.

▢ = **Depth exceeds the normal working limit; requires the HSE Director's authorization and surface supplied equipment. Repetitive dives are not authorized. Times listed in parenthesis indicate maximum allowable exposure.**

Note[1]: **Depths not listed are considered beyond the safe limits of NITROX diving.**

Note[2]: The EAD, 1.4 ata Normal Working Limit Line and Maximum Allowable Exposure Time for dives deeper than the Normal Working Limit Line are calculated assuming the diver rounds the oxygen percentage in the gas mixture using the standard rounding rule discussed in paragraph 10-4.1. The calculations also take into account the allowable ± 0.5 percent error in gas analysis.

4.11.4 Personnel Training for Nitrox Diving Operations

Local management is responsible for ensuring that all personnel involved in nitrox diving, including those generating and handling nitrox, are sufficiently trained. This training should include:

- Oxygen analysis equipment and procedures.
- Equipment cleaning requirements for nitrox use.
- Identifying signs and symptoms of oxygen toxicity.
- Calculating EAD.
- Proper marking of bailout bottles and other pressure vessels used for nitrox.

4.11.5 Oxygen Toxicity

Although nitrox diving offers benefits such as increased bottom time and reduced nitrogen narcosis, it also raises the concern of oxygen toxicity due to the higher oxygen concentration. SGS mitigates this risk by ensuring that the partial pressure of oxygen (ppO_2) remains below the safe working limit of 1.4 ata. All SGS personnel qualified in nitrox diving are trained to monitor divers for signs and symptoms of oxygen toxicity. If any symptoms are observed or experienced, the dive must be aborted, and the effected diver will be monitored until symptoms resolve.

4.11.6 Dive Recording

The SGS Daily Dive Log is used to document all nitrox and air dives. Nitrox mixture used must be listed in the notes section for each dive. The log is completed according to the guidelines outlined in Chapter 9 of the U.S. Navy Dive Manual. For repetitive diving, the EAD is determined from the SGS EAD table and used to apply the Air Decompression Tables and the Residual Nitrogen Timetable for Repetitive Air Dives.

4.11.7 Special Procedures

Breathing Gas Change:
In the event that a switch to air is required during a nitrox dive, follow the Air Decompression Table for the actual depth of the dive using the diver's maximum actual depth and bottom time.

Omitted Decompression:
If an omitted decompression situation occurs that exceeds the maximum depth listed in the SGS EAD table, the dive supervisor shall rapidly calculate the diver's Equivalent Air Depth (EAD) and follow the omitted decompression procedures based on this EAD rather than the diver's actual depth. In situations where time does not permit this calculation, the dive supervisor may elect to use the diver's actual depth and proceed with omitted decompression procedures, adding an additional level of conservatism to ensure diver safety.

Dives Exceeding the Normal Working Limit:
The U.S. Navy Equivalent Air Depth Table was developed to restrict dives with a ppO_2 greater than 1.4 ata, limiting dive duration based on oxygen toxicity. Dives exceeding the normal working limits of the EAD table require authorization from HSE. Repetitive dives are not authorized after exceeding the 1.4 ata normal working limit.

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4.12 Habitat Operations

4.12.1 Gas Monitoring and Safety

In hyperbaric environments, monitoring the quality of breathing gases is essential for ensuring the safety of divers and maintaining operational integrity. All breathing gases supporting life in hyperbaric conditions must be sampled using a gas analyzers.

- A multi-gas detector, such as the GasAlert MaxXT II 4-gas detector, is required for monitoring gas sampling lines from habitats. While standardization is preferred, any multi-gas detector capable of accurately detecting the necessary gases is acceptable, provided it meets operational requirements and ensures safety compliance. Field teams should prioritize functionality and suitability over specific brand or model availability.
- Continued gas sampling ensures that levels of oxygen (O_2), carbon monoxide (CO), hydrogen sulfide (H_2S) and combustible gases (LEL) remain within safe working limits.

4.12.2 Habitat Material Inspection

All new SGS habitats include pull tabs that allow for material condition testing during scheduled inspections. This testing ensures the integrity of the habitat material, which is critical for maintaining safe hyperbaric environments.

- **Pull Tab Testing:** Each habitat is equipped with 10 pull tabs. During the yearly shop inspection, at least one pull tab must be removed to assess the condition of the habitat material.
    - If additional concerns arise during pre-use inspections, further pull tabs can be tested as needed.
    - Inspection results must be documented, with the test date recorded at the location of the removed pull tab. All documentation and test records must be completed and stored at the shop where the habitat is maintained.

4.12.3 Diver Safety and PPE Requirements

Once the habitat is operational, divers entering the habitat must follow strict personal protection protocols:

- Default equipment for habitat diving is an OTS Guardian full-face mask with comms, crash helmet, and a belt-worn sideblock for connecting the dive umbilical and bailout bottle.
- Habitat divers must wear their full-face mask at all times in the habitat to ensure they are breathing safe clean air and to maintain constant communications with the dive supervisor.
- The previous standard equipment (KM Bandmask with SCUBA bailout) may be used as a backup option only with prior approval from the HSE department. If using this configuration, habitat divers must wear their SCUBA bailout and crash helmets with attached scuba masks at all times to ensure they are equipped for an emergency. The emergency air supply regulator hose shall be positioned over the diver's right shoulder and taped to the harness shoulder for easy access.

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4.12.4 Hyperbaric Operations

Hyperbaric habitats are pressurized to provide a stable working environment at depth. The following safety and operational guidelines are enforced:

1. **Air Source and Redundancy:**
    - Each habitat must have two independent air sources available to ensure redundancy in case of failure. Both air sources must pass through a filtration system to maintain air quality within the habitat. Filters should be changed before every seal job.
    - The **minimum rate of air flow** to the habitat should be **185 cubic feet per minute (cfm)** to ensure adequate ventilation and to maintain the pressurized environment.
2. **Electrical Tools and Safety:**
    - When using electrical tools and heater cables in habitats, a marine Ground Fault Interrupter (GFI) must be used to prevent electrical hazards.
    - All hand-held power tools, including hydraulic, pneumatic, and electrical equipment, must be de-energized at the surface before entering the water and during retrieval from the water. This precaution ensures the safety of personnel and the integrity of the equipment.
3. **Pressure Management:**
    - Continuous monitoring air input inside the habitat ensures that water levels remain stable throughout the operation. Adjustments to airflow are made to maintain a safe and stable working environment and contain any oil that leaks from the seal system or stern tube.
4. **Communication and Monitoring:**
    - Communication lines must be maintained between divers/technicians and topside teams to coordinate operations and respond quickly to an emergency. Cameras inside the habitat allow real-time monitoring of operations for safety and quality assurance.

4.12.5 Care and Maintenance

Proper care and maintenance of the habitat after use are essential to ensuring its longevity and operational readiness for future missions:

- **Post-Operation Inspection:** After each deployment, the habitat must be inspected for damage. Any tears or defects in the material should be identified, photographed, and analyzed by the SGS shop. Any defects found should be brought to the attention of SGS Technical Services. Necessary repairs should be performed promptly and in accordance with the manufacturer's procedures.
- **Cleaning and Storage:** The habitat should be cleaned with mild soap and water, thoroughly dried, and stored in a manner that protects it from cuts, abrasions, UV radiation, and mildew or mold.
- **Workshop Procedures:** In addition to field inspections, the SGS maintenance procedure recommends regular checks at the workshop. During these checks, all components, including material seams and mounting hardware, must be inspected for wear and damage.

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SPM ❖ CH.5 | EQUIPMENT STANDARDS

5.1 General Equipment Standards

Introduction

- **Purpose of Equipment Standards:** These standards help ensure the safety, functionality, and reliability of all diving equipment used in commercial diving operations. Adhering to these standards minimizes the risk of equipment failure and enhances overall dive safety.
- **Scope:** These standards apply to all equipment used in SGS commercial diving operations, including breathing apparatus, communication systems, diving suits, tools, and emergency gear.

5.1.1 Record and Maintenance of Equipment

- Local management must maintain comprehensive schedules and records for critical equipment with details of inspections, maintenance, repairs, and operational hours (if applicable).
- Maintenance schedules must be strictly followed with records kept for a minimum of five years.

Identification Tagging:

- Equipment should ideally be marked or logged with an identification system, such as an SGS ID number, to provide useful information about the equipment, including its assigned unit and maintenance records. While this is a best practice, the absence of an ID tag should not preclude equipment from being deployed if it is functional and safe for use.

5.1.2 General Equipment Requirements

Certifications and Compliance:

- All equipment must meet or exceed industry standards set by locally-applicable regulatory bodies such as OSHA, ADCI, IMCA, and relevant national and international standards.
- Equipment must be purchased from reputable manufacturers with certification for commercial diving use.

Condition of Equipment:

- Equipment must be free from any defects such as cracks, corrosion, active leaks, or signs of wear that could compromise safety.
- Regular inspections must be conducted before and after each use, with any significantly damaged or defective equipment immediately removed from service until repaired or replaced.

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5.2 The SGS Dive Station

All SGS Dive Stations are required to have the following minimum items to conduct safe diving operations.

5.2.1 Administrative

The following items are required for administrating SGS diving operations:

- SGS Safe Practices Manual – current version.
- SGS job paperwork – Predive checklists, LOTO, JSA, Daily Log (includes dive log, running log, etc.).
- US Navy Rev. 7 No-Decompression Air Diving Table and Residual Nitrogen Timetable.
- Timekeeping device

5.2.2 Air System / Air Manifold

Requirements:

Breathing Air Supply:

- **Capacity:** The breathing air system must be capable of supplying all divers working at the site simultaneously. This ensures that every diver receives a consistent and adequate supply of breathing gas.

Independent Air Sources:

- **Primary Source:** The main source of breathing air, typically provided by a low-pressure compressor or a high-pressure bank.
- **Standby Source:** A backup air source that can be switched on if the primary source fails. This source must be capable of supporting all divers until the divers can be recovered on the surface.
- **Diver's Bailout:** Each diver must wear a bailout bottle that provides an immediate and sufficient supply of breathing gas to recover the diver to the surface.

Low Air-Pressure Alarms:

- **Alarm Settings:** Low air-pressure alarms must be audible and set to trigger when the pressure falls below 100 PSI. This provides a critical warning to surface personnel and divers to take corrective action before the air supply is compromised.

Air Manifold Specifications:

- **Material and Construction:** All components of the air manifold must be made of materials suitable for breathing gas, including corrosion-resistant materials. The pressure rating of all manifold components must be 200 PSI or greater to ensure durability and safety.
- **Gauges:** The manifold shall be equipped with visible gauges to monitor the supply pressure to all umbilicals. This allows surface personnel to continuously check the pressure levels and ensure that all divers receive adequate gas supply.

High-Pressure Regulators:

- **Function:** High-pressure regulators on the manifold must be rated for the pressure and flow requirements necessary to supply all divers effectively at maximum operating depths.
- **Pressure Gauges:** Regulators should be equipped with both an inlet pressure gauge and an outlet pressure gauge if not already installed on the air manifold. These gauges provide real-time pressure readings, ensuring proper regulation and supply. Gauges must be accurate to within 15 psi for LP and 150 psi for HP.

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Depth Gauges:

- **Approved Method:** A pneumofathometer is the only approved method for gauging the depth of a diver for diving operations. A diver-worn bottom timer can be used only as a secondary gauge.
- **Testing and Calibration:** Depth gauges used in surface-supplied systems must be calibrated every 6 months. A card or label that shows the date of test or calibration must be attached to the gauges. An entry will be made in the equipment log to identify the gauges tested or calibrated and to describe the method used.

Inspection and Maintenance:

- **Pressure Gauges:** Regularly check the accuracy and readability of all pressure gauges on the manifold.
- **Regulators:** Inspect high-pressure regulators for proper operation and check that gauges are functioning correctly.
- **Corrosion:** Examine all manifold components for signs of corrosion or wear, and address any issues immediately.

Testing:

- **Pressure Testing:** Perform annual pressure tests on the manifold system to verify integrity and performance under operational pressures.
- **Leak Checks:** Conduct daily leak checks on all connections and components to ensure there are no gas leaks.

Training:

- **Personnel Training:** Ensure that all personnel are trained in the operation, inspection, and maintenance of the air manifold system. They should be familiar with the procedures for addressing low-pressure alarms and managing air supply issues.

5.2.3 Surface Supplied Air Supply

Low-Pressure Compressors:

- **Purpose:** Low-pressure compressors provide the primary breathing air supply to divers. They typically operate at pressures between 90 to 150 PSI.

Specifications:

- **Capacity:** The compressor must have sufficient capacity to deliver a continuous supply of air to all divers, taking into account depth, number of divers, and any additional air demands (e.g., air tools, lift bags, etc.).
- **Filtration:** The system must include high-efficiency filters to remove oil, water, and particulate contaminants from the air supply. Filters should meet or exceed the air purity standards of EN12021 or equivalent.

Contaminant	Maximum Allowable Concentration
Oxygen (O_2)	21% ± 1% (for air)
Carbon Dioxide (CO_2)	500 ppm (0.05% by volume)
Carbon Monoxide (CO)	5 ppm (0.0005% by volume)
Oil (liquid and aerosol)	0.5 mg/m^3
Water Content	Varies with pressure; e.g., at 200 bar, a maximum dew point of -46°C
Odor and Taste	No significant odor or taste

- **Monitoring:** The system should include gauges to monitor air pressure and flow rate. An alarm system should be in place to alert the dive supervisor of any deviations from normal operating conditions.

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- **Backup Systems:** In the event of a compressor failure, a secondary low-pressure compressor or a high-pressure air storage system must be available to maintain continuous air supply to the divers.
- **Maintenance:** Regular maintenance according to the manufacturer's schedule is critical, including oil changes, filter replacements, and belt inspections. A maintenance log must be kept for each compressor.
- **Air Quality Testing:** Air purity tests must be performed every six months.

High-Pressure Air Bank:

- **Purpose:** High-pressure banks are used to store compressed air in storage cylinders, which can serve as a reserve air supply or be used for the main air supply.

Specifications:

- **Capacity:** High-pressure banks must be capable of maintaining storage cylinders at pressures typically ranging from 2000 to 5000 PSI, depending on operational needs.
- **Filtration and Purification:** Air supplied to high-pressure banks must be purified to remove moisture, oil, carbon monoxide, and other contaminants. The air must meet or exceed the purity requirements of EN12021 or equivalent listed above.
- **Safety Features:** The storage system should include automatic shut-off mechanisms to prevent over-pressurization, as well as pressure relief valves on all high-pressure lines. Whip checks are to be installed on all non-fixed air bottles (SCUBA bottles for EGS, mobile K-bottles).
- **Air Storage:** Cylinders or banks filled with air must be rated for the maximum operating pressure and undergo hydrostatic testing every five years. storage systems should be clearly labeled with their pressure ratings and last inspection dates.
- **Redundancy:** A secondary high-pressure bank or access to pre-filled reserve cylinders must be available to ensure continuous operations in case of primary system failure.
- **Inspection:** High-pressure banks require regular inspection of valves, hoses, and gauges.
- **Air Purity Testing:** Air purity tests must be performed every six months on breathing air compressors in use and meet or exceed the EN12021 standards listed above.

Reserve Air Supply:

- **Purpose:** A reserve air supply system ensures divers have access to breathable air in case of primary compressor failure or any other air supply disruption.
- **Storage:** Reserve air is typically stored in high-capacity, high-pressure cylinders, plumbed into the air control manifold at the dive station. When diving from HP air banks for primary supply, the reserve air must be independent in case of a hose or regulator failure in the primary system.
- **Capacity:** The reserve system must provide enough air to support all divers for a safe return to the surface. The amount of reserve air should be based on the maximum expected dive depth and duration. The minimum reserve air supply is 1500 PSI when using a K-bottle, or one full 80 cuft scuba bottle per diver when using a fly-away dive station.
- **Cross-Over Mechanism:** The system should include an automatic or easily operated manual cross-over mechanism that allows the supervisor to access the reserve air supply without significant delay.
- **Testing and Maintenance:** Reserve air systems must be tested regularly to ensure they are fully operational. This includes checking pressure levels, testing valves, and confirming that cross-over mechanisms function correctly.

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Monitoring and Control:

- **Air Quality Awareness:** Continuous awareness of air quality is essential, especially for detecting contaminants like carbon monoxide. If the diver notices any odor or feels symptoms of contaminated air, the dive supervisor is to be notified, and the air is to be switched to reserve air.
- **Pressure and Flow Monitoring:** Gauges must be installed to monitor air pressure throughout the system, including the compressors, air lines, and reserve supplies. Any significant deviation from normal parameters should trigger an immediate investigation.

5.2.4 VOLUME TANKS

Purpose and Overview:

- **Function:** Volume tanks are critical components in a surface-supplied diving system. They act as buffer tanks, ensuring a stable supply of breathing gas to the diver by minimizing pressure fluctuations from the compressors or gas supply system.
- **Location:** Typically situated between the compressor and the diver's umbilical, volume tanks help to smooth out the gas flow and provide an immediate reserve in case of a temporary drop in supply.

Specifications:

- **Construction:** Made from corrosion-resistant materials such as stainless steel or aluminum to withstand harsh marine environments.
- **Internal Coating:** The interior of the tank should be coated or treated to prevent corrosion and contamination of breathing gas.

Size and Capacity:

- **Capacity:** Volume tanks should be sized appropriately for the specific diving operation. Typically, tanks should hold enough gas to provide a few minutes of breathing supply at the maximum working depth if there is a supply disruption.
- **Pressure Rating:** The tank must be rated for the maximum expected pressure of the system with a 1.5 times safety margin. It should be able to handle the operational pressure without risk of failure or deformation.

Connections:

- **Inlet and Outlet Valves:** High-quality, corrosion-resistant valves should be installed for both the inlet from the compressor and the outlet to the air manifold.
- **Volume tanks or receivers must be equipped with a check valve on their inlet side.**
- **Pressure Gauges:** The tank should be equipped with accurate pressure gauges to monitor the internal pressure easily.
- **Safety Relief Valves:** To prevent over-pressurization, the tank must be fitted with relief valve set to relieve at the maximum allowable working pressure on the volume tank or receiver.

Inspection and Maintenance:

- **External Inspection:** Regular checks should be performed for signs of external damage, corrosion, or wear.
- **Internal Inspection:** The inside of the tank should be inspected annually. This will require depressurizing and opening the tank.
- **Leak Testing:** Annually, the tank and all fittings should be leak-tested to ensure there are no gas leaks.
- **Valve and Gauge Maintenance:** Valves and gauges should be checked for proper operation, and any worn or malfunctioning parts should be replaced before use.

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Operational Guidelines:

- **Proper Use:**
  - **Pressure Check:** Before use, ensure the volume tank is pressurized to the correct level and that all valves are functioning correctly.
  - **Valve Positioning:** Verify that inlet and outlet valves are in the correct positions before starting the dive operation.
  - Water Drainage: Periodically drain water from the volume tank to prevent corrosion and maintain optimal performance.

Training and Familiarization:

- **Dive Team Training:** The dive team should be trained in the operation, inspection, and maintenance of the volume tank, including emergency procedures in case of tank failure.

5.2.5 Communication Equipment:

Top-Side to Diver Communications

- Reliability: Systems must provide clear, uninterrupted communication between the surface and diver, even at maximum operational depth.
- Testing: Communication systems must be tested before each dive and inspected regularly for any signs of wear, corrosion, or damage to connectors and cables.

Diver-to-Diver Communication:

- 4-wire: All dive stations, umbilicals, and dive helmets should be setup for 4-wire communication for diver-to-diver communication.
- Clarity: Diver-to-diver communication systems should allow for clear and audible communication without interference.

5.2.6 Diver Umbilicals / Breathing Gas Hose

Main Air Hose:

- Material: Constructed from high-quality, kink-resistant material, suitable for marine environments.
- Pressure Rating: Rated for a minimum pressure of 300 PSI, with a safety margin for pressure surges.
- Purpose: Delivers primary breathing gas to the diver's helmet or mask.

4-Wire Communication:

- Shielding: Must be properly shielded to prevent interference and maintain clear communication.
- Durability: Resistant to water ingress, corrosion, and mechanical damage for reliable operation.
- Purpose: Ensures consistent, clear communication between the diver and surface team.

Pneumofathometer Hose:

- Material: Non-collapsible, durable material designed to withstand the pressures of depth.
- Usage: Specifically for gauge depth measurement only. Not to be used for tool air.
- Purpose: Provides accurate depth readings for monitoring by the surface team.

Strength Member:

- Material: High-strength synthetic fibers like Kevlar, integrated throughout the entire length of the umbilical.

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- Break Strength: Minimum break strength of 1000 lbs.
- D-Ring: Attached to the strength member for the diver to secure themselves. The D-ring must also have a minimum break strength of 1000 lbs.
- Attachment to Diver: Snap shackle or automatic locking-gate carabiner; rated at least 1000 lbs.
- Purpose: Provides support for emergency lifting and secures the diver during operations.

Umbilical Chafing Gear Requirements:

- Hull Cleaning Operations:
  - Sheathing Requirement: The primary umbilical must be fully sheathed for multi-brush cleaning operations. This protects the umbilical if it comes into contact with the cleaning machine.
- **Other Operations:**
  - Partial Sheathing: All other umbilicals must have 50 feet of sheathing on the diver's end. Flyaway umbilicals used for inspections are exempt from this requirement.

Main and Standby Umbilical Lengths:

- Length Consistency: All umbilicals (primary and standby) must be the same length to ensure the standby diver can reach a stricken diver during an emergency.
- Length Adjustment: If the umbilicals on-site are not of the same length, the longer one must be physically tied off to match the shorter length.

Umbilical Length Markings:

- Incremental Markings: Umbilicals are to be marked with color-coded tape, starting from the diver's end. Markings are made at 10 ft (3 m) increments up to 100 ft (30.5 m) and at 50 ft (15.2 m) increments beyond that.
- Purpose: These markings provide a clear reference for the surface team to monitor the diver's distance and ensure accurate tracking during operations.

Increment	Marking
10 ft [3 m]	one white band
20 ft [6.1 m]	two white bands
30 ft [9.2 m]	three white bands
40 ft [12.2 m]	four white bands
50 ft [15.2 m]	one yellow band
60 ft [18.3 m]	1 yellow/1 white
70 ft [21.3 m]	1 yellow/2 white
80 ft [24.4 m]	1 yellow/3 white
90 ft [27.4 m]	1 yellow/4 white
100 ft [30.5 m]	1 red band
150 ft [45.7 m]	1 red/1 yellow
200 ft [61 m]	2 red bands
250 ft [76.2 m]	2 red/1 yellow
300 ft [91.5 m]	3 red bands
For each 50 ft (15.2 m) thereafter the sequence continues by increasing the number of red bands at each even increment of 100 ft (30.5 m). In cases where the umbilical color matches an above band color, a reasonable substitute may be used (Contrasting outline on same-color tape, contrasting diagonal pattern, replacement with color not used above).	

Storage and Handling:

- Storage Conditions: Use proper coiling techniques to prevent kinks. Tape or cover breathing air hose ends to prevent contamination.
- Handling Procedures: Avoid dragging the umbilical over sharp edges during deployment and retrieval. Lay it out smoothly to prevent tangling.

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Emergency Procedures:

- Emergency Recovery: Procedures must be in place for rapid retrieval of the umbilical and the diver in case of an emergency. The strength member must be securely attached to facilitate this process.
- Backup Systems: Divers should always be equipped with a secondary air source (bailout bottle) in case of umbilical failure.

Training and Familiarization:

- Diver Training: Divers must be trained in handling, maintaining, and inspecting the umbilical, as well as being familiar with emergency procedures.

Inspection and Testing:

Identification Tagging: All umbilicals must be marked with an identification tag specific to each office for accurate maintenance records.

- Annual Pressure Testing:
    - Main Air Hose: An annual pressure test must be conducted on every main air hose, applying 1.5 times the designed working pressure. The test pressure should be maintained for 10 minutes without any loss of pressure.
    - Pneumofathometer Hose: An annual pressure test must be conducted on every pneumo hose, also at 1.5 times the designed working pressure. The test pressure should be maintained for 10 minutes without any loss of pressure.
    - Annual Inspection: Each umbilical must undergo an annual inspection to assess the overall condition and functionality of all hardware components. This inspection should include checking for wear, abrasions, kinks, and secure attachment of connectors.
    - Inspection/Test Checklist: A standardized inspection and test checklist should be utilized during these procedures to ensure all critical areas are reviewed and documented. See below for reference.
- Pre-Dive Checks: Before each dive, the umbilical should be inspected for any visible signs of significant wear, cuts, abrasions, or kinks. All connectors should be checked for secure attachment, and a blow down of the umbilicals should be done to clear any foreign debris before hooking up the diving helmets.
- Electrical Testing: Communication cables should be tested for continuity and signal clarity as part of regular maintenance. Any signs of signal degradation should be addressed promptly.
- Regular Maintenance: Any significantly damaged components identified during inspection or testing should be repaired or replaced immediately to maintain operational safety.

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CERTIFICATION SHEET

UMBILICAL INSPECTION & TESTING

DATE OF INSPECTION	COMPANY/ORGANIZATION	DATE OF MANUFACTURE (if applicable)	SERIAL NUMBER	LENGTH

MANUFACTURE	TYPE
○ UMBILICALS UNTERNATIONAL	○ I.E.
○ CORTLAND	○ TWISTED
○ GATES	○ SYNTHETIC
○ OTHER	○ OTHER

DIVERS COMM INTERFACE	TOPSIDE COMM INTERFACE	UMBILICAL FITTING	PNEUMO FITTING
○ 4 PIN WATER PROOF CON	○ 4 PIN WATER PROOF CON	○ O2 ○ -6AN Topside End	○ O2 ○ -4AN Topside End
○ BARE WIRE POST	○ BANANA PLUGS	○ O2 ○ -6AN Divers End	○ Divers End
○ OTHER	○ OTHER	○ OTHER:	○ OTHER:

HOSE WORKING PRESSURE	UMBILICAL PRESSURE TEST	PNEUMO HOSE PRESSURE TEST	FLOW TEST
PRESSURE _____ (psig)	PRESSURE _____ (psig)	PRESSURE _____ (psig)	DYNAMIC LP PRESSURE USED _____(psig)
N/A	TIME _____ (min)	TIME _____ (min)	FLOW _____ (slpm) ROOM TEMP_____°

CONDITION OF UMBILICALS / HARDWARE	GOOD	FAIR	POOR	REMARKS
UMBILLICAL FITTING DIVERS END	○	○	○	
UMBILLICAL FITTING MAIN GAS TOPSIDE	○	○	○	
TOPSIDE PNEUMO FITTING	○	○	○	
DIVERS MAIN GAS HOSE	○	○	○	
PNEUMO HOSE	○	○	○	
COMM WIRE	○	○	○	
STRENGH MEMBER	○	○	○	
DIVERS SNAP SHACKLE / D-RING	○	○	○	
LACING / RIGGING	○	○	○	
TOPSIDE TIE DOWN HARDWARE / D-RING	○	○	○	
OTHER HARDWARE ATTACHMENTS (see remarks)	○	○	○	

EXTRA REMARKS: (if any)

Print Name	Signature	Date

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5.2.7 Buoyancy Compensators / Dry Suits

Purpose and Overview:

- Function: Buoyancy compensators (BCs) and dry suits are essential components of a commercial diving system. They provide the necessary buoyancy control and thermal protection (dry suits) for divers, ensuring safety and comfort during operations.

Requirements:

- Connection and Equipment:
  - Connection: All buoyancy compensating devices must be connected to the diving helmet side block using a restrictor. This setup ensures that the buoyancy compensator or dry suit receives the appropriate amount of gas supply for inflation and deflation.
  - Restrictor: A restrictor is used to control the flow rate of gas to the buoyancy compensator, preventing rapid inflation and reducing the risk of over-pressurization or blow-up (uncontrolled ascent).
- Exhaust Valve:
  - Fitting: Each buoyancy compensator or dry suit must be fitted with an exhaust valve. The exhaust valve allows excess air to be released, providing precise buoyancy control and minimizing the chances of over-inflation or blow-up.

Mandatory Use:

- Operational Requirement: Buoyancy compensators (BC's) or dry suits are mandatory for all SGS diving operations. They are critical for maintaining neutral buoyancy and ensuring the diver's safety and stability while underwater.

Inspection and Maintenance:

- Routine Checks:
  - Connection Points: Inspect connections between the buoyancy compensator and the helmet side block to ensure they are secure and free from damage.
  - Exhaust Valve: Check the exhaust valve for proper operation and ensure it is not leaking or malfunctioning.

Training:

- Diver Training: Divers are expected to be competent in the proper use, adjustment, and maintenance of buoyancy compensators and dry suits.

5.2.8 Diving Helmets and Bandmasks

Ventilation Requirements:

- Airflow: **Kirby Morgan Demand Helmets**: Kirby Morgan demand helmets must be used and are required to ventilate at least **4.5 cubic feet per minute (CFM)** of gas when supplied at the pressure recommended by the manufacturer. This ensures adequate airflow and comfort for the diver.

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Qualified Hat Technician:

- Requirement: Each office must employ at least one current Kirby Morgan hat technician. This technician is responsible for the inspection, maintenance, and repair of diving helmets to ensure they meet safety standards and compliance requirements.

Communication Systems:

- Communication: For surface-supplied diving, all helmets must incorporate a 2-way / 4-wire audio communication system. This system ensures clear and reliable communication between the diver and surface support.

Valves:

- Non-Return Valves: Surface-supplied diving helmets must be equipped with non-return valves to prevent backflow and contamination. Non-return valves must be tested before hooking helmet to the umbilicals.

Band Masks:

- Usage Restrictions:
  - Limited Applications: The use of Kirby Morgan band masks (KMB 18 / KMB 28 is restricted to non-repair, non-construction, or non-hull cleaning operations. For operations that involve repairs, construction, or hull cleaning, a hard shell must be integrated to provide additional protection.
  - Hard Shell Integration: Kirby Morgan offers a hard shell that can be integrated with the soft hat.

Maintenance and Documentation:

- Annual Maintenance: All dive helmets, including personal helmets, must be maintained according to the manufacturer's standards. Documentation verifying the current maintenance must be available for review upon request.
- Maintenance Records: Maintain detailed records of all maintenance performed on each dive helmet. This includes dates of service, descriptions of work performed, parts replaced, and the name of the technician who conducted the maintenance.
- Documentation Storage: Ensure that maintenance records are stored securely and are readily accessible for review. These records should be kept for a minimum of five years or as required by regulatory standards.

Authorized Brands:

- Kirby Morgan is the only authorized brand for SGS diving operations. Any other helmet brands must receive case-by-case approval from the HSE Director before use. Any non-Kirby Morgan diving helmets will have to abide by the same maintenance standards.

Inspection and Maintenance:

- Routine Checks:
  - Helmet Function: Inspect helmets regularly for functionality, including ventilation, communication systems, neck dam, and valve operation.

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  - Band Masks: Check band masks for any damage or wear and ensure they are suitable for their intended use.
- Testing:
  - Airflow and Communication: Test ventilation systems and communication systems to confirm they are working effectively.
  - Structural Integrity: Ensure that all components, including hard shell integrations and non-return valves, are in good condition.

Cleaning and Maintenance:
- Cleaning: Clean helmets and band masks after each use to remove debris and contaminants.
- Component Replacement: Replace any worn or damaged components promptly to maintain equipment integrity and safety.

Training:
- Diver Training: Divers should be trained in the use and maintenance of diving helmets and band masks.

5.2.9 Bailout Requirements

Bailout Bottle Requirements:
The bailout bottle is to be within certification and suitable for the dive profile:

- Depth: 0'-59' = 30 cu ft. bottle
- Depth: 60'-99' = 50 cu ft. bottle
- Depth: 100' or deeper = 80 cu ft. bottle
- Penetration: 25' or more = 80 cu ft. bottle

First Stage Regulator: The first-stage regulator is to be within certification and include a hose-mounted submersible pressure gauge (SPG). Regulator-mounted button gauges are not permitted.

Hose and Connections: All hoses and connections are to be inspected and free from damage or wear before use. If using a quick connect fitting for bailout connection, it must be a twist-lock type. If not the emergency air hose must be hard plumbed to the diving helmet.

Mounting and Access: The bailout bottle is to be securely attached to the diver's harness or BCD, ensuring quick and easy access in an emergency. Quick-release cam buckle straps are preferred.

Training and Competency: Divers are to be trained and regularly practice switching to the bailout system during emergency scenarios.

Maintenance and Inspection: Regular maintenance and inspection of the bailout system are required, including checking for leaks, verifying the regulator's functionality, and ensuring the bottle is filled to the appropriate pressure.

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5.3 Dive Spread Requirements

5.3.1 Diving Equipment for Depth < 100 Feet

Qty	Item	Description
3	Air Supply	Adequate air source and volume tank (where applicable) to support two (2) divers. Three sources of air present at all times: primary, standby, and emergency. Minimum standby air is 160 cubic foot, (2 80's or one k-bottle) of air per diver
2	Umbilicals	Two - Four-member groups (umbilicals) required for redundancy and safety, each consisting of an air hose, strength member/strain relief, communications cable, pneumofathometer hose, and light cable.
1	Air Manifold	Must supply air to all divers with proper pressure gauges, controls, and two pneumofathometers. Also includes depth gauges and an optional lighting control system.
2	Communication System	A control station with a two-way communication system for clear and continuous contact between diver and surface, with redundancy.
1	Air Decompression and Treatment Tables	A set of US Navy air decompression and treatment tables must be available and used to guide decompression procedures and manage treatment in case of diver-related incidents.
2	Dive Helmets	Two dive helmets required for redundancy and safety.
2	Buoyancy Compensator	Buoyancy compensator device (BCD) appropriate for depth, providing controlled ascent and descent, as well as stability.
1	Means for Entering and Leaving the Water	A safe means for entering and leaving the water from the diving platform must be available. First diver enters by ladder; rest can jump after the area is cleared. This check is reset each shift.
2	Diver's Equipment	Personal dive equipment includes a wet suit with BCD or dry suit with weight belt, gloves, lifting harness, bailout bottle with 1st stage regulator and SPG, fins, dive knife.
2	Diver's Bailout	30 CuFt bailout bottle is required to ensure emergency air supply in case of primary air failure for depths of 0-59'. 50 CuFt bailout required for 60'-99' FSW. Penetration diving of more than 25' requires an 80 CuFt bailout bottle.
1	Documentation	Dive logbook and job paperwork must be maintained and updated for each diving operation to ensure proper record-keeping and compliance with operational and safety protocols.
1	Emergency Equipment	Includes diver recovery system, trauma kit, first aid kit, backboard, medical O_2 kit, oil spill kit, 20-foot line for decompression stops, SGS Safe Practices Manual, emergency contact numbers
	Additional Requirements	Any other equipment necessary based on specific operational environment.

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5.3.2 Diving Equipment for Depth 100-200 Feet

Amount	Item	Description
3	Air Supply	Adequate air source and volume tank (where applicable) to support two (2) divers. Three sources of air present at all times: primary, standby, and emergency. Minimum standby air is 160 cubic foot, (2 80's or one k-bottle) of air per diver
2	Umbilicals	Four-member groups (umbilicals) required for redundancy and safety, each consisting of an air hose, strength member/strain relief, communications cable, pneumofathometer hose, and light cable.
1	Air Manifold	Must supply air to all divers with proper pressure gauges, controls, and two pneumofathometers. Also includes depth gauges and an optional lighting control system.
2	Communication System	A control station with a two-way communication system for clear and continuous contact between diver and surface, with redundancy.
1	Decompression Chamber	A chamber system with an adequate air source for managing decompression procedures effectively. The chamber must be capable of accommodating divers promptly in case of decompression sickness or other pressure-related emergencies. Regular maintenance and inspections are required to ensure optimal functionality and compliance with safety standards.
1	Adequate Supply of Oxygen for Chamber	A sufficient supply of oxygen must be readily available for use in the decompression chamber to support treatment and emergency procedures.
1	Air Decompression and Treatment Tables	A set of air decompression and treatment tables must be available and used to guide decompression procedures and manage treatment in case of diver-related incidents.
2	Dive Helmets	Two dive helmets required for redundancy and safety.
2	Buoyancy Compensator	Buoyancy compensator device (BCD) appropriate for depth, providing controlled ascent and descent, as well as stability.
1	Means for Entering and Leaving the Water	A safe means for entering and leaving the water from the diving platform must be available. Adequate to facilitate rescue of personnel. First diver enters by ladder; rest can enter after the area is cleared. This check is reset each shift.
2	Diver's Equipment	Personal dive equipment includes a wet suit with BCD or dry suit with weight belt, gloves, lifting harness, bailout bottle with 1st stage regulator and SPG, fins, dive knife.
2	Diver's Bailout	An 80 CuFt bailout bottle is required to ensure emergency air supply in case of primary air failure.
1	Documentation	Logbook and dive sheets must be maintained and updated for each diving operation to ensure proper record-keeping and compliance with operational and safety protocols.
1	Emergency Equipment	Includes diver recovery system, trauma kit, first aid kit, backboard, medical O_2 kit, spill kit, 20-foot line for decompression stops, SGS Safe Practices Manual, emergency contact numbers
	Additional Requirements	Any other equipment necessary based on specific operational environment.

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5.4 HSE Equipment

General Requirements:

- Diver Recovery System: Essential for safely recovering divers in emergency situations. Must be readily accessible and maintained in good working condition.
- Trauma Kit: Equipped with supplies for treating severe injuries. Should include items such as bandages, splints, antiseptic, and materials for controlling bleeding.
- First Aid Kit: Contains basic supplies for treating minor injuries and illnesses. Regularly check and replenish as necessary.
- Back Board: Used for immobilizing and transporting injured divers. Ensure it is readily available, in good condition and functional straps.
- Medical Oxygen (O_2) Kit: Provides oxygen in case of emergencies. Should be easily accessible and checked regularly to ensure it is fully charged and functional. Min flow rate of 10-L/min and bottle size of 425 liters at 2,200 psi. Oxygen cylinder size D.
- Spill Kit: Required for containing and cleaning up any oil, hydraulic fluid and fuel spills that may occur during operations. Ensure it is well stocked and accessible.
- Decompression Line: A marked line, weighted at the bitter end, is essential for divers to maintain a consistent depth for a decompression stop at 20 fsw. The line must be marked at 20 feet from the bitter end. The line must be long enough to secure it on topside with the 20 foot mark positioned at the waterline when tied up.
- SGS Safe Practices Manual: Must be available on-site for reference, ensuring all procedures and safety measures are followed.
- Emergency Contact Numbers: Clearly posted and accessible, including emergency services and key personnel.
- US Navy Dive Tables: Required for dive planning and decompression calculations. Ensure they are up-to-date and available for use.
- Oil Spill Procedures: Clearly defined procedures for managing oil spills, including containment, cleanup, and reporting processes.

Training:

- Personnel Training: All personnel should be trained in the use of HSE equipment. Training should include proper handling, deployment, and usage of each piece of equipment to ensure effective response in emergency situations.

5.7 Hydraulic Equipment

5.7.1 Hydraulics

Hydraulic Hose Sheathing:

- Multi-Brush Hydraulic Lines:
  - Sheathing Requirement: Multi-brush hydraulic lines must be 100% sheathed. This complete sheathing provides maximum protection against abrasion and damage during operations.
- Other Hydraulic Lines:
  - Sheathing Requirement: All other hydraulic hoses need to be sheathed for at least 50 feet on both ends (though full hose length is recommended). This ensures protection from potential damage at the connection points and extends the lifespan of the hoses.

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Strain Reliefs:

- Strain Relief Configuration: Strain reliefs must be installed on all hydraulic hoses to prevent damage to the QD couplings and hose ends caused by tension and movement.
- D-Ring Placement: Attach a D-ring 2 to 3 feet back from the quick disconnect (QD) on each end of the hydraulic hose. This helps to manage strain on the connection points.
- Poly Line: Use a poly line for strain relief, back spliced on both ends and measuring 5 inches shorter than the QD. This setup ensures that the strain relief effectively absorbs tension without affecting the hose's performance.
- Clip-to-Clip Connection: When connecting two hydraulic hoses, the connection should be clip-to-clip. This method takes all strain off the QDs, reducing the risk of damage and/or disconnection.

Identification Tagging:

- Tagging Requirement: All hydraulic hoses must be marked with an identification tag specific to each office. This tagging is essential for maintaining accurate maintenance records and ensures proper tracking of each hose.

Inspection and Maintenance:

- Routine Checks:
  - Hydraulic Hose Inspection: Inspect hydraulic hoses for signs of wear, cracks, bulges, or other damage. Ensure that hoses are free from leaks and that connections are secure.
  - Leak Testing: Perform leak tests on all hydraulic connections to verify that no leaks are present at the QDs or along the hoses.
- Testing:
  - Pressure Testing: Conduct periodic pressure tests on hydraulic lines to ensure they can handle operational pressures without leaks or failures.

Maintenance:

- Component Replacement: Replace any damaged or worn components, including sheathing and D-rings to maintain system integrity.

Training:

- Personnel Training: Ensure that personnel are trained in the proper handling, inspection, and maintenance of hydraulic lines and strain relief systems.

5.7.2 High Pressure Hydraulics

Purpose:

- This section outlines the standards and practices for the safe and effective use of high-pressure hydraulic systems, specifically those operating at pressures up to 1500 bar/21,500 PSI. Proper management is crucial for ensuring operational safety and preventing equipment failure.

General Requirements:

- Compliance: High-pressure hydraulic systems must be designed and installed according to applicable design codes, standards, and regulations. This ensures that systems are safe and reliable under such extreme conditions.

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- Materials: All components, including hoses, fittings, and valves, must be made of materials capable of withstanding designed pressures. Components should be resistant to corrosion, fatigue, and wear.

Pressure Ratings:

- Hoses and Fittings: Hydraulic hoses and fittings must have pressure ratings appropriate for the maximum operating pressure. Components should be rated for at least 1.5 times the maximum operating pressure to provide a safety margin.
- Regular Checks: Pressure ratings of components should be regularly checked and verified to ensure they are within safe limits.

Safety Measures:

- Relief Valves: Systems must be equipped with pressure relief valves set to open at or below the maximum pressure rating to prevent over-pressurization.
- Protective Gear: Personnel handling high-pressure hydraulic systems should wear appropriate protective gear, including safety glasses and gloves, to guard against potential leaks or bursts.

Inspection and Maintenance:

- Routine Inspections: Systems must be inspected regularly for signs of wear, damage, or leakage. Hoses, fittings, and connections should be checked for integrity and replaced as needed.
- Leak Testing: Systems should be leak-tested during every use and after any repairs or replacements to ensure there are no leaks and all connections are secure.
- Documentation: Maintain up-to-date records of inspections, repairs, and any issues. Documentation should detail all maintenance activities and system conditions.

Operational Procedures:

- Training: Personnel must be adequately trained in the operation and safety procedures associated with high-pressure hydraulic systems, including those operating at pressures up to 1500 bar /21,500 PSI.
- Emergency Procedures: Operators should be familiar with emergency procedures for hydraulic failures or accidents, including how to quickly shut down the system and manage hazards.

System Integrity:

- Secure Connections: Ensure all hydraulic connections are securely fastened and checked for proper alignment and tightness.

PPE and Safety:

- Personal Protective Equipment (PPE):
- Safety Glasses: Required for all personnel working with high-pressure hydraulic systems to protect against potential splashes or debris.
- Gloves: Heavy-duty gloves must be worn to protect hands from sharp edges, high pressure, and potential chemical exposure.
- Protective Clothing: Wear appropriate protective clothing, such as coveralls or aprons, to shield against high-pressure fluid and other hazards.
- Hearing Protection: Use earplugs or earmuffs in noisy environments to prevent hearing damage.

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Trained Personnel:

- Qualifications: Only trained and qualified personnel should operate or maintain high-pressure hydraulic systems. Training should cover safe handling practices, system operation, and emergency response.

5.8 Electrical Equipment

5.8.1 Electrical Equipment

Equipment Specifications:

- Voltage Ratings: Ensure all electrical equipment is rated for the appropriate voltage. Equipment should be clearly marked with its voltage rating and comply with applicable safety standards.
- Condition: Electrical equipment must be in good working condition, free of damage or defects. Regular inspections should be performed to identify any issues.

Voltage Ranges:

- 110V Equipment:
  - Commonly used for low-voltage applications and small tools.
  - Ensure that all 110V equipment is equipped with proper insulation and protection devices to prevent electrical hazards.
- 220V Equipment:
  - Typically used for medium-power applications and larger tools.
  - Verify that 220V equipment is connected to the correct power source and that wiring is appropriately sized and installed to handle the voltage.
- 440V Equipment:
  - Used for high-power applications and industrial machinery.
  - Ensure that all 440V equipment is installed and maintained by competent personnel. Proper grounding and circuit protection devices must be in place to handle high voltage safely.

Safety Measures:

- Inspections: Conduct regular inspections of electrical equipment to ensure that it is operating correctly and safely. Look for signs of wear, damage, or overheating.
- Grounding: All electrical equipment must be properly grounded to prevent electrical shock and ensure safe operation.
- Circuit Protection: Use appropriate circuit breakers and fuses to protect against overloads and shorts. Ensure that these devices are rated for the specific voltage and current of the equipment.

Installation and Maintenance:

- Competent Personnel: Electrical equipment should be installed and maintained by competent personnel. Ensure that all installations comply with relevant electrical codes and standards.
- Wiring: Use appropriate wiring and connectors rated for the voltage and current of the equipment. Ensure that all wiring is installed correctly and securely.
- Checking for Correct Rotation: For equipment with rotating parts, such as motors, verify that the rotation direction is correct as per the manufacturer's specifications. Incorrect rotation can lead to equipment malfunction or damage.

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- Testing: Testing of electrical equipment should be done at the beginning of each job to verify proper operation and safety. This includes checking insulation resistance and conducting continuity tests.

Emergency Procedures:

- Power Failure: Have a procedure in place for handling power failures and electrical emergencies. Ensure that all personnel are aware of the procedures and know how to respond in case of an electrical incident.
- Electrical Hazards: Ensure that all personnel are familiar with safety practices related to electrical equipment.

Documentation:

- Record Keeping: Maintain records of inspections, maintenance, and repairs for all 440V electrical equipment. Documentation should include details of any issues identified and actions taken.

Training:

- Personnel: Ensure that all personnel working with or around electrical equipment are trained in electrical safety and familiar with the specific voltage ranges and equipment they will be using.

5.9 Rigging Equipment

5.9.1 Rigging and Lifting

Equipment Specifications:

- Selection: Choose rigging equipment based on the load requirements and environmental conditions. Ensure that all equipment is rated for the maximum load it will carry.
- Materials: Rigging equipment should be made of high-strength, corrosion-resistant materials suitable for the operational environment.

Types of Rigging Equipment:

- Slings: Use slings (such as wire rope, or synthetic) that are rated for the intended load. Inspect slings for wear, fraying, or damage before each use.
- Shackles: Use shackles with the appropriate load rating and ensure they are in good condition. Inspect shackles for deformation, cracks, or other damage.
- Hooks: Ensure hooks are of the correct size and rated for the load. Hooks should have safety latches to prevent accidental release of the load.
- Chains and Ropes: Chains and ropes must be inspected regularly for signs of wear or damage. Ensure they are adequately rated for the maximum load.
- Straps: Use webbing or polyester straps for lighter loads where appropriate. Ensure straps are rated for the load they will carry and are free from cuts, frays, or other damage. Check that straps are properly secured and positioned to distribute loads evenly.

Inspection and Maintenance:

- Routine Inspections: Inspect rigging equipment before each use for signs of damage, wear, or deformation. Replace any equipment that is not in good condition.

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- Periodic Inspections: Conduct thorough inspections of rigging equipment at regular intervals, including checking for any signs of fatigue, corrosion, or damage. Follow the manufacturer's guidelines for inspection criteria and frequency.

Rigging Procedures:

- Load Assessment: Before rigging, assess the load to ensure the equipment used is rated for the weight and type of load. Consider the load's center of gravity and rig accordingly.
- Safe Rigging Practices: Use proper rigging techniques to ensure loads are evenly distributed and securely fastened. Avoid sharp bends, kinks, or overloading of rigging equipment.
- Critical Lifts: For critical lifts that involve high-risk or complex operations, develop a detailed lift plan. The plan should include load calculations, rigging arrangements, personnel assignments, and emergency procedures.
- Communication: Ensure clear communication among personnel involved in rigging operations. Use standardized signals or communication devices to coordinate lifting and lowering activities.

Safety Measures:

- Training: Only trained and qualified personnel should handle rigging equipment. Training should cover safe rigging practices, equipment inspection, and emergency procedures.
- PPE: Personnel involved in rigging operations should wear appropriate Personal Protective Equipment (PPE), including safety glasses, gloves, and hard hats.
- Emergency Procedures: Establish and communicate emergency procedures for handling rigging equipment failures or accidents.

Documentation:

- Record Keeping: Maintain records of rigging equipment inspections. Documentation should include details of any issues found and actions taken.
- Equipment Tags: Use identification tags on rigging equipment to track inspection and maintenance records.

Trained Personnel:

- Qualifications: Rigging operations should only be conducted by personnel who are trained and qualified in rigging practices. Ensure that all personnel are familiar with the equipment and procedures.
- Ongoing Training: Regular refresher training is recommended to keep personnel updated on the latest safety practices and rigging techniques.

5.10 Decompression Chamber

5.10.1 Decompression Chamber

Purpose:

- The purpose of this section is to outline the essential requirements and safety measures for the operation and maintenance of decompression chambers (PVHOs). This section helps ensure that all chambers are equipped, and maintained to meet industry standards, providing a safe environment for divers undergoing decompression procedures.

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General Chamber Requirements:

- Compliance:

  Decompression Chambers should be constructed and outfitted in accordance with ASME PVHO-1, OSHA, USCG and the ADCI safety standards for commercial diving operations. Alternatively, they should be maintained in conformity with the code requirements to which they were originally built. This ensures that all chambers meet safety and operational standards.

Oxygen Piping on Pressure Vessels for Human Occupancy (PVHO):

- Material Requirements:
  - Corrosion-Resistant Metal: All hard piping systems, fittings, and tubing that carry pure, high-pressure oxygen must be made of corrosion-resistant metal. This prevents degradation and ensures the integrity of the oxygen delivery system.
- Valves:
  - Non-Return or Shut-Off Valves: Chamber internal oxygen outlets must be equipped with non-return valves or shut-off valves. For oxygen systems operating above 125 psi, shut-off valves should be of the slow-opening type, such as needle-type valves. This reduces the risk of sudden pressure changes and potential hazards.

Installed Oxygen Breathing System:

- BIBS: A built-in breathing system (BIBS) with at least one mask for each chamber occupant is required.
- Oxygen Concentration: Chambers equipped with oxygen breathing systems must have adequate ventilation to prevent the oxygen concentration inside the PVHO from rising above 25%. Proper ventilation is essential for safety and to mitigate the risk of fire or explosion. An oxygen monitoring system is required to continuously track and display the oxygen levels within the chamber, ensuring they remain within safe parameters.

Fire Protection:

- Elimination of Combustion Materials: PVHOs must be designed and equipped to minimize the presence of internal combustion materials and sources of ignition. This includes implementing measures to eliminate or control potential fire hazards.
- Prohibited Items Inside Chamber:
  - The following items are prohibited inside the chamber, including but not limited to:
  - Open flames or smoking materials
  - Flammable substances or materials
  - Electrical devices (unless specifically approved for chamber use)
  - Static electricity-generating clothing (e.g., fleece, polyester, nylon)
  - Oil-contaminated clothing or items
  - Jewelry or watches
  - Non-approved pressurized containers

  Other items that may pose a safety risk, create static electricity, or introduce contaminants should also be excluded as determined by the operator or supervisor.

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Lighting Requirements:

- Interior and Exterior Illumination: The interiors of PVHOs must be capable of being illuminated from either the interior or exterior. This allows for visual observation of the diver from the outside as necessary, ensuring safety and monitoring during decompression.

Exhaust Line Guard:

- Exhaust Outlet Guard: An exhaust line guard must be installed on the exhaust outlet inside the PVHO. This guard protects the exhaust system and helps prevent damage or obstruction.

Audio Communication:

- Two-Way Audio: A functioning 2-way audio communication system must be provided and used while the PVHO is in operation. This ensures clear and reliable communication between the divers and surface support, which is essential for coordinating decompression procedures and emergencies.

Safety Guidelines for Temperature Control

- Ensure the chamber is maintained within a safe and comfortable temperature range during operation to prevent heat-related stress or discomfort for occupants.
- Use external cooling measures, such as pop-up shelters or shade structures, to minimize direct exposure to sunlight or external heat sources.
- In the event of extreme heat or fire onboard, deploy a water pump and hose to cool the exterior of the chamber. This prevents overheating and ensures the internal environment remains safe for occupants.
- Continuously monitor the internal temperature of the chamber and adjust ventilation as needed to maintain safe conditions.

Inspection:

Regular Inspections:

- Conduct routine visual and functional inspections of the chamber before each use.
- Verify the structural integrity of the pressure vessel, ensuring there are no cracks, corrosion, or physical damage.

Pressure Testing:

- Perform hydrostatic pressure testing according to the schedule specified by the chamber's manufacturer or the applicable regulatory code.
- Maintain records of all pressure tests and any repairs conducted.

Oxygen System Inspection:

- Check all oxygen piping, fittings, and tubing for leaks, corrosion, and wear.
- Inspect and test non-return or shut-off valves to ensure proper operation.

Ventilation System:

- Inspect and clean exhaust lines and guards to prevent obstructions.

Audio Communication System:

- Test the 2-way communication system to ensure clear and reliable functionality.
- Replace damaged or malfunctioning components immediately.

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Maintenance:

Scheduled Maintenance:

- Follow the manufacturer's recommended maintenance intervals for all mechanical and electrical components.
- Replace worn or degraded components, including seals, valves, and gauges, as needed.

Calibration:

- Calibrate all pressure gauges and oxygen sensors per manufacturer's recommendation to maintain accuracy.
- Document calibration dates and results.

Cleaning and Storage:

- Clean the chamber interior and oxygen system components with non-corrosive, approved cleaning agents.
- Dry thoroughly to prevent mold or corrosion.
- Store the chamber in a dry, temperature-controlled environment when not in use.

Emergency Systems:

- Test emergency systems, including alarms, bypass valves, and manual controls, to ensure proper functionality during emergencies.

Operator Feedback:

- Document feedback from operators regarding the chamber's performance and address any issues identified during operations.

Trained Operator:

- Certification: All decompression chambers should be operated by qualified personnel trained in the use and maintenance of PVHOs. This ensures that operators are knowledgeable about the equipment, emergency procedures, and safety protocols.
- Continuous Training: Operators should complete refresher training before projects involving a chamber to stay current with the latest procedures and safety standards related to decompression chambers and chamber ops.
- Emergency Procedures: Operators should be proficient in emergency procedures, including decompression emergencies and chamber malfunctions. This proficiency is essential for ensuring the safety and effectiveness of decompression operations.

5.11 Launch and Recovery System (LARS)

Purpose:

- The purpose of this section is to provide guidelines and requirements for launch and recovery systems when used to transfer divers between the surface location and the work site. These systems are used when necessary for the safe and efficient deployment and retrieval of divers and must be designed, maintained, and tested to ensure their reliability and safety.

General Requirements:

- Compliance: Launch and recovery systems must be designed, manufactured, installed, and tested in accordance with applicable design codes, standards, and regulations. This ensures that the systems meet industry safety and performance standards.

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- Wire Ropes:
  - Installed, terminated and maintained in accordance with design criteria and/or manufacturer's recommendations.
  - Visually inspected every six months for damage, deterioration or deformation.
  - Periodically examined and tested to recognize applicable codes and standards.
  - Have wire ropes and fittings that are rated eight times the load.

Braking Systems:

- Independence: The system must be fitted with two independent braking systems. These brakes should be capable of holding 1.25 times the safe working load of the winch, ensuring reliable stopping power and safety.

Load Control:

- Emergency Stops: The system must be designed so that the load can be stopped and held in position in the event of power supply failure, disengagement, switch-off, or if the operating control is released. This prevents uncontrolled movement of the load and enhances safety.

Operator Controls:

- Visibility and Control: Controls must be located or equipped to afford the operator a clear view and control of the lifting operation. Alternatively, appropriate signaling arrangements should be in place to guide the operator.
- Before placing a diver in the LARS, conduct a pre-use test to verify the system's functionality, including all controls, safety mechanisms, and lifting components. This ensures the equipment is operating correctly and safely before diver deployment.

Post-Installation Testing:

- Examination and Testing: After any installation, alteration, repair, or failure, the system must be thoroughly examined and functionally and load tested to 1.25 times the safe working load. This ensures that the system remains safe and operational.
- NDT Testing: Non-Destructive Examination (NDE) must be conducted on all areas welded to the deck plate. This ensures the integrity of welds and structural connections, preventing potential failures.

Trained Personnel:

- Qualifications: All personnel involved in operating and maintaining launch and recovery systems should be appropriately trained and qualified. This ensures that they are familiar with the equipment and can handle it safely and effectively.

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5.12 Personal Equipment

All PPE (Personal Protective Equipment) gear must be at the dive station and worn by all surface personnel. Although not all of it will always be needed, it must be available if required. This equipment consists of, but is not limited to, the following items:
Topside:

- Hard hat
- PFD (Personal Flotation Device)
- Safety glasses
- Safety boots
- Gloves
- Work vest (high visibility)
- Coveralls when applicable (gas and oil jobs)
- Ear protection
- Long pants, shirt with company logo
- Knife
- Fall protection when applicable

Underwater:

- Dry suit or wetsuit appropriate for the water temperature
- Fins
- Dive knife
- Weights
- Gloves
- BCD (if not wearing a dry suit).
- Independent dive harness with jock strap and a lifting ring located on the back.
- Bailout bottle minimum 30 cu ft with first stage, SPG on a hose, and bailout whip.

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SPM ❖ CH.6 | SGS TRAINING AND COMPETENCY MANAGEMENT

6.1 Learning Philosophy

Subsea Global is a learning organization that develops new ideas, learns from both successes and failures, and recognizes the importance of constant improvement and personal growth. Our learning philosophy seeks to foster a culture of continuous learning and professional competence that yields adaptive, thinking leaders who create safe and workable solutions to complex problems.

Learning is developing skills, knowledge, and attitudes through study, experience, and training. *Competence* is having sufficient knowledge, judgement, and skills to perform a particular duty, job, or function. Developing these abilities requires time, deliberate practice, and the motivation to become a master of your profession.

SGS Learning Principles:

- Know yourself and seek self-improvement
- Be ready and willing to learn
- Understand why you are learning
- Provide and receive constructive feedback
- Learning is purpose-driven to develop professional competence

People with a *growth mindset* are willing to set goals and actively improve upon any personal weaknesses or knowledge gaps to further develop their skills, knowledge, and competencies. Individuals with a growth mindset understand that they have control over their individual learning, and that the additional effort pays off by increasing their professional abilities and opportunities.

Conversely, people with a fixed mindset believe that their qualities are innate and are interested in feedback only to confirm their abilities, avoiding feedback that indicates any perceived weaknesses. Avoiding feedback and having a fixed mindset leads to stagnation.

Leaders, mentors, and trainees all directly influence their teammates' mindsets through the learning climate they establish and the feedback they provide. Supporting and cultivating a growth mindset is the purpose of the SGS Professional Qualifications Standard (PQS) and Absorb learning management system. These tools provide a road map for professional development and career progression.

Successful people seek to master each qualification requirement rather than just trying to get it signed off. Mastering a topic or skill requires spending time questioning and reflecting upon information to gain deeper understanding. Another excellent way to master a topic is to teach it to others, so all employees are encouraged to work on qualifications as a team by helping each other learn and improve. Give each other constructive feedback and do not let ego get in the way of progress towards greater understanding and competence. Everyone, especially those in positions of leadership, should strive to remain humble so we are ready to and willing to learn from anyone.

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6.2 Absorb Learning Management System

The **Absorb Learning Management System (LMS)** is the backbone of the SGS professional development platform, providing a centralized and user-friendly environment for managing training, certifications, and continuous learning initiatives across the organization.

6.2.1 Purpose and Functionality

The Absorb LMS is designed to:

- **Deliver Training:** Host a wide range of training modules, from introductory courses to advanced technical training, accessible to all SGS employees.
- **Facilitate Certification:** Support the certification process by providing access to qualification exams and tracking the issuance of certifications upon successful completion.
- **Enhance Learning Accessibility:** Allow employees to access training materials and complete courses at their own pace, from any location, fostering a culture of continuous learning.

6.2.2 Integration with the PQS

The Absorb LMS is closely integrated with the Professional Qualifications Standard (PQS), serving as the primary tool for managing the various components of the PQS, including:

- **Qualification Booklets:** Digital copies of the PQS booklets are available within the LMS, providing easy access to the competencies required for each role.
- **Online Exams:** The system hosts the exams associated with each qualification, allowing employees to test their knowledge after completing their on-the-job training.
- **Certification Tracking:** Once a qualification is earned, the LMS automatically updates the employee's profile, reflecting their new certification and making it visible to managers.

6.2.3 User Experience and Accessibility

The Absorb LMS is designed with a user-friendly interface that simplifies navigation and enhances the learning experience. Key features include:

- **Dashboard Overview:** A personalized dashboard that displays upcoming training, completed courses, and certification statuses.
- **Mobile Compatibility:** Full access to the LMS via mobile devices, enabling learning on-the-go.
- **Automated Reminders:** The system sends automated reminders to employees about upcoming training deadlines or certification renewals, ensuring that they stay on track with their professional development.

6.2.4 Benefits to the Organization

The implementation of the Absorb LMS brings several benefits to SGS, including:

- **Standardization of Training:** Ensures that all employees receive consistent training and are assessed against the same standards, regardless of their location.
- **Increased Engagement:** Provides employees with a clear and structured pathway for their professional development, leading to higher levels of engagement and motivation.

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6.2.5 Continuous Improvement

The Absorb LMS is not static; it is continuously updated with new training modules, features, and improvements based on feedback from users. This ensures that the system remains relevant and effective in supporting the ongoing professional development of SGS personnel.

6.3 Professional Qualifications Standard

The **Professional Qualifications Standard (PQS)** is a structured program designed to develop, manage, and standardize the qualifications of field personnel within SGS. This system is integral in ensuring that all employees meet the necessary competencies required for their specific roles and that these competencies are maintained and enhanced over time.

6.3.1 Objective of PQS

The primary objective of the PQS is to create a robust framework for on-the-job training and professional development. This framework is designed to:

- **Develop Talent:** Equip employees with the necessary knowledge, skills, and attributes to perform effectively in their roles.
- **Manage Competency:** Provide a transparent and well-defined process for assessing and verifying the competencies of field personnel.
- **Enhance Career Growth:** Offer a clear path for career progression, allowing employees to take control of their professional development.

6.3.2 Structure of the PQS

The PQS program is divided into various levels and specialties, ensuring that personnel at different stages of their careers can advance their qualifications in a structured manner.

- **Level I:** Focuses on basic to intermediate competencies, providing foundational skills necessary for field operations.
- **Level II:** Covers advanced competencies, building on the foundational skills to develop expertise in specialized areas.
- **Level III:** Reserved for personnel who have achieved both a Dive Supervisor core qualification and Level II in a particular specialty.

Each qualification is documented in a booklet that outlines the specific competencies required for that role. The booklet serves both as a guide for trainees and a reference for trainers to monitor progress.

6.3.3 Professional Development Cycle

The PQS is integrated into the professional development cycle, which begins with the establishment of a personal development plan tailored to the individual's interests and the organization's needs. This cycle includes:

1. **Qualification Selection:** Employees, in consultation with their managers, choose the qualifications they wish to pursue.

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2. **Training and Sign-Offs:** Employees are responsible for seeking out instruction and obtaining sign-offs on their competencies from qualified personnel.
3. **Performance Evaluation:** An annual review process where managers assess the frequency with which employees meet the expectations outlined in their qualifications.

6.4 Advanced Training

SGS is committed to the ongoing professional development of its personnel through a variety of specialized training programs. These programs are designed to ensure that our teams possess the necessary skills and knowledge to perform underwater operations safely and effectively, aligning with the high standards established in the Professional Qualifications Standard (PQS).

6.4.1 Types of Training

- **Wet Welding:**
  - Focuses on developing and certifying divers in underwater welding techniques, including both basic and advanced skills.
- **Shaft Seal Bonding:**
  - Provides training in bonding techniques essential for the installation and maintenance of underwater seals, taught by the OEM (original equipment manufacturer).
- **Hyperbaric Shaft Seal Replacement:**
  - Covers the installation, maintenance, and repair of seals, as well as habitat installation, which is crucial for creating dry working environments underwater.
- **Hydrogouging and NDE:**
  - Teaches material removal using high-pressure water jets and non-destructive examination techniques for inspecting underwater structures.
- **Propeller Repair:**
  - Teaches proprietary techniques for propeller blade straightening and cropping operations.
- **Project Manager:**
  - Teaches experienced dive supervisors the tools and techniques used for planning and managing technical ship repair projects.
- **Chamber Operator:**
  - Covers use of multiplace hyperbaric chambers for SurD-O2 diving and DCI treatment. Includes use of SGS Decompression Diving log and emergency procedures.

6.4.2 Training Delivery Methods

SGS employs a variety of delivery methods to ensure that training is accessible and effective:

- **On-Site Training:**
  - Some courses, like Seal Tech I, are conducted on-site using portable training kits. This allows for training to be delivered directly at the local office, reducing downtime and ensuring that divers are trained in their working environment.

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- **Centralized Training Locations:**
  - Comprehensive training courses, particularly those involving advanced techniques or specialized equipment, are conducted at dedicated training centers. These facilities are equipped with the necessary resources to provide an immersive learning experience.
- **Remote and Online Learning:**
  - The Absorb Learning Management System (LMS) supports the theoretical aspects of training, allowing divers to complete courses remotely at their own pace before engaging in hands-on practice.

6.4.3 Importance of Certification

Certification is a critical outcome of SGS's training programs. It ensures that all personnel meet the required safety and technical standards and are fully qualified to perform their assigned tasks in underwater operations.

6.4.4 Continuous Improvement and Feedback

SGS is committed to the continuous improvement of its training programs. Feedback from participants is regularly sought and used to refine training content, methods, and assessments. This approach ensures that our training programs remain relevant, effective, and aligned with the latest industry standards.

6.5 QR Code to Absorb LMS

Scan to access Absorb LMS login page.

Username format: Firstname.Lastname

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SPM ❖ CH.7 | EMERGENCY MANAGEMENT

7.1 Emergency Readiness

Emergency readiness is a fundamental aspect of ensuring the safety and efficiency of diving operations. This section outlines the procedures, training, and equipment necessary to maintain a state of constant preparedness for any emergency situation that may arise during operations.

7.1.1 Purpose

The purpose of emergency readiness is to ensure that all personnel involved in diving operations are prepared to respond quickly and effectively to emergencies. This includes being familiar with emergency procedures, knowing how to use emergency equipment and verifying its functional, and understanding the roles and responsibilities of each team member during an emergency.

7.1.2 Planning

- **Emergency Preparedness Plan**: Develop and maintain a comprehensive emergency preparedness plan tailored to the specific needs and risks of the diving operation. This plan should detail the procedures for responding to a wide range of potential emergencies, including but not limited to medical emergencies, equipment failures, and environmental hazards.
- **Risk Assessment**: Conduct thorough risk assessments prior to operations to identify potential hazards and develop appropriate mitigation strategies. These assessments should consider the location, environmental conditions, and the specific tasks to be performed. Risk assessments should be shared with all involved SGS personnel before work commences.
- **Contact External Agencies**: Contact external agencies to check the status and availability of emergency services, decompression chambers, and other critical support resources.
- **Scenario Planning**: Engage in scenario planning to anticipate possible emergencies and outline the steps to be taken in each situation. This planning should involve input from all relevant team members and consider both common and rare emergency scenarios.
- **Emergency Contact List**: Maintain an updated list of emergency contacts, including local authorities, medical facilities, and key personnel within the organization. This list should be easily accessible to all team members.

7.1.3 Training and Drills

- **Regular Training**: All diving personnel must undergo regular training sessions that cover emergency procedures, the use of emergency equipment, and the management of specific scenarios such as loss of communication, gas supply issues, diver recovery, etc.
- **Readiness Exercises**: Conduct frequent emergency readiness exercises to simulate various emergency situations. These exercises help to ensure that all team members can execute their roles efficiently under pressure. Exercises should include:
    - Mock emergency scenarios that test the team's ability to respond to incidents.
    - Diver recovery drills to ensure all personnel are proficient in safely recovering a stricken (injured, exhausted, excessively cold) diver from the water.

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  - Rescue and evacuation operations, including provision of first aid and oxygen.
- **Evaluation and Feedback**: After each exercise, conduct a debriefing session to evaluate performance, identify areas for improvement, and reinforce best practices. Feedback from these sessions should be used to update training programs and procedures.

7.1.4 Equipment Readiness

- **Inspection and Maintenance**: Regularly inspect all emergency equipment, including oxygen supplies, first aid kits, trauma kits, diver recovery kit, spill cleanup kits, etc. to ensure they are in good working condition. Maintain a schedule for routine maintenance and testing of equipment.
- **Emergency Equipment Placement**: Ensure that all emergency equipment is strategically placed for quick access during an emergency. Equipment should be stored in clearly marked, easily accessible locations.
- **Inventory Management**: Keep an updated inventory of all emergency equipment. Regularly check that supplies are fully stocked and replace any expired or used items immediately.

7.1.5 Communication Protocols

- **Emergency Communication Plan**: Develop and maintain an emergency communication plan that outlines the methods and procedures for contacting team members, emergency services, and management during an emergency. This plan should include:
  - Primary and secondary communication channels.
  - Contact information for key personnel, including the HSE Department and local emergency services.
  - Procedures for relaying critical information quickly and accurately.
- **Regular Testing**: Test communication systems regularly to ensure they function properly in an emergency. Include communication checks as part of routine drills and inspections.

7.1.6 Roles and Responsibilities

- **Diving Supervisor**: The Diving Supervisor is responsible for coordinating the emergency response, ensuring that all procedures are followed, and that the safety of all personnel is maintained.
- **HSE Department**: The HSE Department is responsible for overseeing emergency preparedness, conducting regular audits of emergency readiness, and providing guidance on safety protocols.
- **Diving Team Members**: Each member of the diving team has a specific role during an emergency. All team members must be fully aware of their responsibilities and how they contribute to the overall safety of the operation.

7.1.7 Continuous Improvement

- **Review and Update**: Regularly review and update emergency procedures to incorporate lessons learned from exercises, real incidents, and changes in operational practices or regulations.
- **Learning from Incidents**: Analyze any incidents that occur to identify root causes and prevent future occurrences. Use these analyses to improve emergency readiness and training programs.

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7.2 Emergency Procedures

The emergency procedures outlined in this section are designed to ensure that every member of the dive team is fully prepared and knows their role during an emergency. It is crucial to familiarize yourself with these procedures well in advance, as there will be no time to read them once an emergency occurs. In such situations, every second counts. By thoroughly understanding these procedures ahead of time, all necessary actions and contingency plans can be executed swiftly and in coordination to safely mitigate the emergency.

In the event of an emergency, contact HSE as soon as it is safe to do so.

This section includes the following emergency procedures:

- **EP-1** Loss of Breathing Gas
- **EP-2** Loss of Diver Communication
- **EP-3** Compressor Failure/Main Breathing Gas Failure
- **EP-4** Fouled or Entrapped Diver
- **EP-5** Severance of Diver Umbilical
- **EP-6** Unconscious Diver Recovery
- **EP-7** DCS Type I and II
- **EP-8** Arterial Gas Embolism (AGE)
- **EP-9** Contaminated Air
- **EP-10** Emergency Evacuation
- **EP-11** Fire in Equipment
- **EP-12** Severance of Divers Umbilical
- **EP-13** Uncontrolled or Emergency Ascent
- **EP-14** Omitted Decompression
- **EP-15** Power Failure, Diver in the Water
- **EP-16** Injured Diver in Water

EP 1- Loss of Breathing Gas

Step	Procedure	Action Required By
1	Shift to secondary gas supply.	Dive Supervisor
2	Go on bailout bottle (emergency air).	Diver
3	Alert standby diver and tenders of the situation.	Dive Supervisor
4	Put air to diver's pneumo hose (if required).	Dive Supervisor
5	Insert pneumo hose into helmet (if required).	Diver
6	Diver return to ladder/LARS; bring to surface.	Dive Supervisor/Diver
7	Terminate dive	Dive Supervisor
8	Notify SGS HSE of the situation.	Dive Supervisor

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EP 2- Loss of Diver Communication

Step	Procedure	Action Required By
1	Flash hat light to let diver know that communication has been lost.	Dive Supervisor
2	Alert standby diver and tenders.	Dive Supervisor
3	Diver proceeds to ladder/Lars if no-decompression is applicable. If decompression is needed stand by diver must be put into the water to assist with communication and to guide diver without comms.	Diver/Dive Supervisor
4	If diver is unable to proceed to surface, deploy standby diver to assist diver returning to surface.	Dive Supervisor/Standby
5	Terminate dive, resolve issue with comms.	Dive Supervisor

EP 3- Compressor Failure/Main Air Failure

Step	Procedure	Action Required By
1	Notify diver, loss of main air.	Dive Supervisor
2	Shift to secondary air source topside.	Dive Supervisor
3	Ensure divers air is restored. If insufficient, diver to go on bailout.	Dive Supervisor/Diver
4	Inform standby diver and tenders of situation and that the standby diver might need to deploy.	Dive Supervisor/Standby Diver
5	Diver return to ladder/LARS and brought to surface.	Diver
6	Notify SGS HSE of the situation.	Dive Supervisor
7	Terminate dive and resolve issue. Diving cannot be conducted unless 3 sources of breathing gas are available. Main air, stand by, bailout bottle.	Dive Supervisor

EP 4- Fouled or Entrapped Diver

Step	Procedure	Action Required By
1	Inform topside.	Diver
2	Alert standby diver and tenders.	Dive Supervisor
3	Determine extent of entrapment.	Diver
4	Diver attempts to free himself.	Diver
5	If required, dispatch standby diver to diver's assistance.	Dive Supervisor, Standby Diver
6	If diver is unable to get free, example umbilical pinched between ship and fender. Move ladder directly over top of diver. If not possible inform ship to adjust ballast to list ship or slack lines.	Dive Supervisor, Tenders
7	When diver is free, return to ladder/LARS and diver brought to surface.	Dive Supervisor/Diver
8	Notify SGS HSE of the situation.	Dive Supervisor
9	Terminate dive, investigate and mitigate issue before returning to water.	Dive Supervisor

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EP 5- Severance of Diver's Umbilical

Step	Procedure	Action Required By
1	Activate bailout bottle.	Diver
2	Deploy standby diver and alert tenders.	Diving supervisor
3	Standby diver be prepared to cut away remaining members of umbilical if still partially.	Standby diver
4	Standby diver bring diver ladder/LARS and diver brought to surface.	Standby diver
5	Terminate dive.	Diving supervisor, diver
6	Notify SGS HSE of the situation.	Dive Supervisor

EP 6-Unconscious Diver Recovery

Step	Procedure	Action Required By
	*Before every dive, a diver recovery system should be set up and ready to pull an unconscious diver. Diver recovery system could be SGS approved rope and pulley, LARS, man basket etc. Recovery system should be rated to lift diver with full gear on.	Dive Supervisor
1	Alert stand by diver and deploy stand by diver into water.	Dive Supervisor/Stand by Diver
2	Standby diver assist with retrieving diver and inform topside of condition of unconscious diver. Free umbilical if needed.	Standby Diver
3	Diver supervisor instruct tenders start hauling in unconscious diver umbilical at a controlled rate of 30 FPM. Stand by diver assisting with swimming unconscious diver back to ladder.	Dive Supervisor/ Tender/Standby Diver
4	Diver will be removed from the water with dedicated diver recovery system. Take care to maintain divers airway and support neck during recovery operation.	Tender/ Standby Diver
5	Notify local emergency medical services of location and situation. Request on site assistance at your location. (Ships hospital, local emergency services, DMT, etc.). Make call asap.	Dive Supervisor or Tender
6	Dive team personnel trained and qualified in CPR and basic CPR will remove divers helmet and check for breathing and pulse. If pulse and breathing are absent remove divers suit and begin CPR.	Tenders/Dive Supervisor
7	When the medical team arrives, they will take charge providing care, providing the condition is non-diving related such as an air embolism. In the case of a diving related medical issue, the dive supervisor should notify SGS HSE dept to help diagnose and treat unconscious diver following the US Navy dive tables. Diver should be moved to a recompression chamber.	Dive Supervisor / EMS
8	Diver should be taken to Hospital/Hyperbaric Facility for further treatment and evaluation.	Dive Supervisor / EMS
9	Update SGS HSE of changes in the situation or diver's condition.	Dive Supervisor
10	Investigation to cause of incident to be conducted. Root cause established before diving may resume.	Dive Supervisor / HSE

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EP 7- DCS Type I and Type II

Feature	Type I DCS	Type II DCS
System affected	Musculoskeletal, skin, lymphatic	Nervous, respiratory, cardiovascular
Severity	Mild	Severe, potentially life-threatening
Symptoms	Joint pain, skin rash, lymph swelling	Neurological deficits, breathing issues, cardiovascular distress
Treatment	Recompression therapy, if relief of symptoms during first 10 min at 60 feet treatment table 5. If no relief table 6. Reference US Navy Dive Man Rev 7 page 17-40.	Recompression therapy, If relief of symptoms during first 20 min at 60 feet treatment table 6. If no relief treatment table 6a. Reference US Navy Dive Manual Rev 7 page 17-39

Step	Procedure	Action Required By
1	Recognize and report symptoms.	Diver, Dive supervisor
2	Perform neurological exam; contact nearest chamber.	Dive Supervisor
3	Administer oxygen topside if transferring diver to chamber not on site.	Dive Supervisor
4	Recompress and treat according to U.S. Navy Dive Manual Rev 7. Reference page 17-40 for type I and 17-39 for type II.	Dive Supervisor, Diver, Tenders
5	If the diver's pain is so severe that a neurological exam cannot be accomplished, then a Table 6 is mandatory.	Dive Supervisor and HSE Director
6	Immediately notify SGS HSE of the situation.	Dive Supervisor

EP 8- Arterial Gas Embolism (AGE)

Category	Symptoms
Neurological	Sudden loss of consciousness, confusion, seizures, paralysis, tingling, dizziness, visual disturbances, slurred speech
Respiratory	Chest pain, difficulty breathing (dyspnea), coughing (possibly with blood)
Cardiovascular	Rapid/irregular heartbeat, low blood pressure, circulatory collapse, shock
Other	Extreme fatigue, rare skin rash (mottling/marbling)

Step	Procedure	Action Required By
1	Recognize and report symptoms.	Diver, Dive Supervisor
2	If diver is conscious, start a neurological exam and contact nearest chamber.	Dive Supervisor
3	Administer oxygen topside if transferring diver to chamber not on site.	Dive Supervisor
4	Recompress and treat according to U.S. Navy Dive Manual Rev 7 Reference page 17-39 for AGE. Treatment table 6 if symptoms relief after first 20 min at 60 feet if no relief treat to table 6A.	Dive Supervisor, Diving Doctor, HSE Director
5	If diver is discovered unconscious, immediately start a treatment Table 6.	Dive Supervisor, Diving Doctor, HSE Director
6	Immediately notify SGS HSE of the situation.	Dive Supervisor

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EP 9- Contaminated Air

Step	Procedure	Action Required By
1	Vent air system.	Dive Supervisor, Tender
2	Secure main air and go on standby air.	Dive Supervisor, Tender
3	Diver to vent air from umbilical to clear remaining contaminated air from umbilical.	Diver, Dive Supervisor
3	Notify standby diver. Vent standby air from umbilical to clear remaining contaminated air from umbilical.	Dive Supervisor, Standby Diver
4	Diver returns to ladder/LARS and brought to surface. Terminate dive.	Dive Supervisor, Diver
5	Monitor diver for any complications from the contaminated air.	Dive Supervisor
6	Notify SGS HSE of the situation.	Dive Supervisor

EP 10- Emergency Evacuation

Step	Procedure	Action Required By
1	Notify diver of emergency and terminate dive.	Dive Supervisor, Tender, Diver
2	Diver returns to ladder/LARS and brought to surface.	Dive Supervisor, Tender, Diver
3	Tenders secure running equipment.	Tenders
4	Evacuate all personnel to muster station or dedicated evacuation area.	Dive Supervisor
5	Notify SGS HSE of the situation as soon as possible.	Dive Supervisor

EP 11- Fire in Equipment

Step	Procedure	Action Required By
1	Only fight a fire if it is safe to do so.	Dive Supervisor
2	Determine type of fire and isolate fuel if applicable. Type A – Solids (paper, cardboard, wood) Type B – Liquids (fuel, solvents, paint, adhesive, oils) Type C – Electrical (generator wiring, distribution box, electrical equipment) Type D – Metals (sodium, lithium, magnesium) Type K – Cooking oils (cooking oils, fats)	Tender, Support Team
2	Extinguish fire, with appropriate means. If it is unsafe to do so, call emergency services for your location.	Dive Supervisor, Tender
3	Switch to HP air.	Dive Supervisor
4	Inform diver to return to surface.	Dive Supervisor
5	Pull diver from water.	Dive Supervisor
6	Terminate dive.	Dive Supervisor, Diver
7	Notify SGS HSE of the situation as soon as possible.	Dive Supervisor

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EP 12- Severance of Diver's Umbilical

Step	Procedure	Action Required By
1	Activate bailout bottle.	Diver
2	Deploy standby diver and alert tenders.	Dive Supervisor
3	Standby diver be prepared to cut away remaining members of umbilical if still partially.	Standby Diver
4	Stand by diver bring diver to ladder/LARS following ascent rates for diving schedule.	Standby Diver
5	Removed diver from water and evaluate for injuries. Terminate diving.	Dive Supervisor, Diver
6	Notify SGS HSE of the situation.	Dive Supervisor

EP 13- Uncontrolled or Emergency Ascent

Step	Procedure	Action Required By
1	Exhale forcibly all the way to the surface.	Diver
2	Take up slack on the umbilical/lines.	Tender
3	Check if decompression stop was needed.	Dive Supervisor
4	Remove diver from the water.	Tender
5	Check for embolism, "AGE"	Dive Supervisor
6	Notify SGS HSE of the situation.	Dive Supervisor

EP 14- Omitted Decompression

Step	Procedure	Action Required By
1	If diver has omitted decompression, immediately have diver return to required decompression stop.	Dive Supervisor
2	If no ill effects are present, decompress the diver in accordance with the selected US Navy in water decompression table.	Dive Supervisor
3	If diver experiences any sign of DCS, refer to EP for DCS type I, II, III and follow procedure.	Dive Supervisor
4	Notify SGS HSE of the situation.	Dive Supervisor

EP 15- Power Failure, Diver in the Water

Step	Procedure	Action Required By
1	Inform Diver of problem and action planned.	Dive Supervisor
2	Alert topside team.	Dive Supervisor
3	Evaluate effect on diver.	Dive Supervisor, Tender
4	Alert standby diver.	Dive Supervisor
5	Switch to secondary power source if applicable.	Dive Supervisor
6	Assess situation and, if necessary, terminate dive.	Diver, Topside Team

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EP-16 Injured Diver in Water

Step	Procedure	Action Required By
1	Inform topside; terminate dive.	Diver
2	Alert standby diver.	Dive Supervisor
3	Determine nature and extent of injury. Notify local emergency medical services if needed.	Diver, Dive Supervisor
4	If required, send standby diver down to assist diver, administer first aid, and evaluate injury. Standby diver should remain with the diver.	Dive Supervisor, Standby Diver
5	Diver supervisor instruct tenders start hauling in unconscious diver umbilical at a controlled rate of 30 FPM. Stand by diver assisting with swimming unconscious diver back to ladder.	Dive Supervisor, Tenders
6	Diver will be removed from the water with dedicated diver recovery system. Take care to maintain divers airway and support neck during recovery operation	Dive Supervisor, Tenders
6	Dive team personnel trained and qualified in CPR and basic first aid will remove divers helmet, administer first aid utilizing trauma kit, medical O2 for type of injury.	Dive Supervisor, Tenders
8	Request required medical assistance and emergency evacuation (if required). If medical assistance is needed they will take charge providing care to injured diver.	Dive Supervisor
9	If needed, transport diver to medical facility for further treatment.	Dive Supervisor
10	Notify SGS HSE of the situation.	Dive Supervisor

7.3 Incident/Accident Management

Incident and accident management is a critical component of ensuring the safety and well-being of all personnel involved in diving operations. This section outlines the procedures and responsibilities for managing incidents and accidents effectively to minimize harm, document occurrences, and prevent future incidents.

7.3.1 Immediate Response

- **Assess the Situation**: The priority is to ensure the safety of the affected individual(s) and prevent further injury or damage. Assess the situation quickly and accurately to determine the severity of the incident or accident.
- **Provide First Aid**: If injuries are sustained, administer first aid immediately, following established medical protocols. If necessary, ensure the injured party is evacuated to receive further medical attention.
- **Secure the Area**: Ensure that the area where the incident occurred is secured to prevent further accidents. This may involve stopping operations, cordoning off the area, or other necessary measures.
- **Emergency Procedures**: In the event of an emergency, immediately implement the appropriate emergency procedure as outlined in the relevant sections of this manual. These procedures are designed to ensure a coordinated and effective response to various types of incidents.

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7.3.2 Reporting

- **Internal Reporting**: Immediately report the incident or accident to the Diving Supervisor, who will then notify the HSE Department within 10 minutes of the event. All team members should be informed of the situation to ensure transparency and collective awareness.
- **External Reporting**: If the incident meets the criteria for external reporting (e.g., regulatory requirements, significant injuries, or environmental impact), the HSE Department will notify the appropriate authorities and keep relevant SGS management team informed.

7.3.3 Investigation

- **Conducting an Investigation**: The local SAT officer, supported by the HSE Department, will initiate an investigation to determine the root cause of the incident. This investigation should begin as soon as possible after the incident to ensure accurate data collection.
- **Collecting Evidence**: Gather all relevant evidence, including witness statements, dive logs, photos and incident details.
- **Analyzing Findings**: Analyze the collected evidence to identify the contributing factors and root causes. This analysis should be thorough and consider all possible variables, including human error, equipment failure, and environmental conditions.

7.3.4 Documentation

- **Incident Report**: A comprehensive incident report must be completed, detailing the incident, the immediate response, cause analysis, and any corrective actions taken. This report should be submitted to the HSE Department and local SGS management with 7 hours for an accident, and 24 hours for an incident, near miss, or non-conformance.
- **Record Keeping**: All incident and accident reports, along with the investigation documentation, is maintained in the company's safety management system for future reference and trend analysis.

7.3.5 Corrective Actions

- **Implementing Corrective Measures**: Based on the findings of the investigation, implement corrective actions to address the root causes of the incident. This may include changes to procedures, additional training, or equipment modifications.
- **Monitoring Effectiveness**: After implementing corrective actions, monitor their effectiveness to ensure that similar incidents do not occur in the future. This may involve follow-up inspections, audits, or additional training sessions.

7.3.6 Communication and Training

- **Debriefing**: Conduct a debriefing session with all relevant personnel to discuss the incident, the findings of the investigation, and the corrective actions taken. This ensures that everyone is informed and can learn from the incident.
- **Training Updates**: If necessary, update training programs to incorporate lessons learned from the incident. This helps to reinforce safe practices and prevent future occurrences.

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7.3.7 Continuous Improvement

- **Review and Revise Procedures**: Regularly review and revise incident and accident management procedures based on past incidents, industry best practices, and regulatory updates. This ensures that the company's approach to incident management remains effective and up-to-date.
- **Learning from Incidents**: Encourage a culture of continuous improvement by learning from all incidents, regardless of severity. Use these lessons to enhance safety protocols and prevent future accidents.

7.4 Rapid Neurological Exam

The Rapid Neurological Exam (rapid neuro) is a crucial procedure used to assess the neurological status of a diver, particularly in emergency situations where a quick evaluation is necessary to identify any potential issues such as decompression sickness, gas embolism, or other dive-related injuries. This section provides an overview of the Rapid Neurological Exam process, which must be conducted promptly and accurately to ensure the safety and well-being of the diver.

7.4.1 Purpose and Importance

The purpose of the Rapid Neurological Exam is to quickly evaluate the diver's mental status, cranial nerve function, muscle tone, coordination, and balance. This assessment helps in identifying any neurological deficits that may have resulted from diving activities or head injuries. Prompt identification of these issues is critical for determining the appropriate course of action, including further medical intervention or immediate evacuation.

7.4.2 Procedure

The Rapid Neurological Exam should be conducted following the guidelines outlined in the attached document below, *SGS Rapid Neuro Exam Procedure*. This document provides step-by-step guidance on performing each aspect of the exam and ensuring comprehensive assessment and documentation. The key areas of focus include:

- **Mental Status**: Assess the diver's orientation to time, place, and recent activities, as well as the clarity and appropriateness of their speech.
- **Vital Signs**: If trained and equipped, check the diver's blood pressure, pulse, and respiration rate.
- **Cranial Nerves**: Evaluate the diver's sight, eye movements, facial movements, and hearing for any abnormalities.
- **Sensations**: Assess the diver's ability to perceive light touch, sharp/dull sensations, and any numbness or asymmetry in these sensations.
- **Muscle Tone**: Evaluate the diver's muscle tone to ensure it is symmetrical on both sides of the body.
- **Balance and Coordination**: Test the diver's ability to maintain balance and coordinate movements effectively.

7.4.3 Documentation

Document findings from the Rapid Neurological Exam using the *SGS Rapid Neuro Exam Checklist*, as referenced in the attached document below. This checklist ensures that all critical areas are evaluated and provides a record of the diver's condition during the assessment.

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SGS Rapid Neuro Exam Procedure

Mental Status

1. Ask the diver to state his name, where he is, the time of day, and describe his most recent activity.
2. Ask him for a SAMPLE History (**S**igns/Symptoms, **A**llergies, **M**edications, **P**ertinent History, **L**ast Oral Intake, **E**vents Preceding).
3. Evaluate diver's speech for clarity and appropriateness.

Vital Signs (if Trained and Equipped)

1. Blood Pressure
2. Pulse
3. Respirations per Minute

Cranial Nerves

1. Sight & Eye Movements
   a. Hold up different numbers of fingers for the diver to count.
   b. Have the diver follow your finger with his eyes while keeping his head held straight – Move your finger in a diamond share from 12:00 – 3:00 – 6:00 – 9:00 → Watch for symmetrical tracking of the eyes and nystagmus (quivering).
2. Facial Movements
   a. Place your fingers at the angle of the diver's jaw and ask him to clench his teeth.
   b. Ask him to wrinkle his forehead as you assess symmetry.
   c. Check the diver's smile and frown for symmetry.
   d. Instruct him to stick his tongue out and move it from side to side - Did it come out straight?
3. Head / Shoulder Movements
   a. Ask the diver to tilt his head back and swallow. Watch for his "Adams Apple" tomove
   b. Push down lightly on his shoulders, asking him to shrug.
   c. Put your hand on one side of the diver's face and ask him to push against it - Do the same with the other side, and on the forehead and back of the head.
4. Hearing
   a. Rub your fingers together close to the diver's ears to identify the sounds.
   b. Ask him to close his eyes.
   c. Move your hand away from his ear and make the sound again – diver acknowledges when he can and cannot hear the rubbing.
   d. Continue to make the sound as you move your hand back towards the ear - Ask him to tell you when he can hear the sound again.

Sensations (Light Touch and Sharp/Dull)

1. The objective is to evaluate the sense of light touch and sharp/dull perception to assess symmetry and look for numb patches.
2. Sensations are checked with the diver's eyes closed, pockets empty, and the diver dressed down to light clothing or bare skin.
3. Tell the diver that the light touch should feel normal and the same on both sides of his body - Identify any changes.
4. Evaluate the body sections, checking the right and left sides at the same time - Overlap the sections slightly.
5. Run your fingers across the forehead, down the sides of the face and along thejaw line.
6. Then run your fingers down the diver's chest, abdomen, front of arms, legs and across the hands.
7. Turn him around and run your fingers down his back, buttocks, and the backs of the arms and legs.
8. Repeat with pinwheel or a tongue depressor broken with a sharper point.

Muscle Tone

1. The objective is to evaluate muscle tone and determine that it's equal on both sides of the body.
2. Have the diver bend his arms so that his hands meet in the center of his chest. With his arms bent have him bring his elbows up level with his shoulders (or demonstrate the move and say "Do this").
3. Tell him to push against you as you push his elbows up, then down, and pull his hands away from his chest and push them back.
4. To evaluate grip strength in each hand, ask him to squeeze your fingers.
5. Legs evaluation (with diver sitting) – Put your hand on his thigh and ask him to pick the leg up against resistance / then put your hand under the thigh and ask him to pull down. Put your hands on the front of his lower legs and ask him to push out / then put your hands behind the legs and ask him to pull back. Evaluate both legs.
6. Legs evaluation (with diver laying) – Ask him to do a straight leg raise as you lightly push down on the leg / then have him bend the leg up and push against your hand as you hold his foot.
7. Foot evaluation: Have the diver pull his feet up as you push them down and then push against your hands as if pushing on a pedal.

Balance and Coordination

1. The objective is to make sure that the diver can hold himself upright, move without being off balance and that he has normal hand eye coordination → PROTECT THE DIVER FROM FALLING!
2. Romberg Test: Have the diver stand upright with his eyes closed, feet together and arms outstretched in front of him for 30 seconds / then ask him to walk in place, bringing his knees up (eyes remain closed).
3. Heel-Shin Slide Test: If the diver is laying down, have him run the heel of one foot down the opposite shin to the ankle – both.
4. Alternating hand movements: Have the diver alternately touch his index finger to his nose and then to your finger, held about 18" (0.5 meters) away from his face – repeat movement several times and test both hands.

SGS Rapid Neuro Exam Checklist

Diver's Name: _____ Name of Examiner: _____ Date: _____

Initial Complaint: _____

Times								
Mental Status – Do they know:	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Their name?								
Where they are?								
Time of day?								
Most recent activity?								
Speech is clear, correct?								

Sight / Eye Movements	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Correctly counts fingers?								
Vision clear?								
Eye Movements:								
- Move all four directions?								
- Nystagmus present?								

Facial Movements	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Teeth clench OK?								
Able to wrinkle forehead?								
Tongue moves all directions?								
Smile symmetrical?								

Head/Shoulder Movements	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
"Adams Apple" moves?								
Shouler shrug normal, equal?								
Head movements normal, equal?								

Hearing	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Normal for that diver?								
Equal both ears?								

Sensations → Present, normal and symmetrical across?	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Face								
Chest								
Abdomen								
Arms (front)								
Hands								
Legs (front)								
Feet								
Back								
Arms (back)								
Buttocks								
Legs (back)								

Muscle Tone → Present, normal and symmetrical for:	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Arms								
Hand grips								
Legs								
Feet								

Balance and Coordination:	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Romberg OK?								
If Supine: Heel-shin slide OK?								
Alternating hand movement OK?								

Vital Signs →Times Taken:				
Blood pressure				
Pulse				
Respirations				

Dive History:

Notes / SAMPLE History:

7.4.4 Action Based on Findings

If any abnormalities are detected during the Rapid Neurological Exam, immediate action must be taken according to the severity of the findings. This may include:

- **Notify HSE Department**: If any neurological deficits are identified, immediately notify the HSE Department. The HSE Department will consult with a diving doctor if necessary to determine the appropriate medical intervention, which may include recompression or evacuation.
- **Immediate Medical Evaluation**: Based on the consultation, a diving doctor may recommend further medical evaluation or treatment on-site or at a medical facility.
- **Monitoring and Follow-up**: Continue to monitor the diver's condition closely and conduct follow-up exams as needed.
- **Reporting**: All findings, actions taken, and any recommendations for further treatment must be reported to the HSE Department and included in the diver's medical records.

7.5 Safety Procedures

This section outlines the essential safety procedures required for all SGS diving operations, focusing on the prevention and management of diving-related hazards, emergency response, and the proper handling of hazardous materials.

7.5.1 Mandatory Certifications

All SGS employees engaged in diving operations are required to maintain current certifications in the following areas:

- **Cardiopulmonary Resuscitation (CPR)**
- **First Aid**
- **Automated External Defibrillator (AED)**
- **Oxygen Administration**

These certifications ensure that all personnel are prepared to respond effectively in the event of an emergency.

7.5.2 Safety Equipment Visibility and Accessibility

All safety equipment must be clearly labeled and placed in a location where it is visible and easily accessible to all personnel, including non-SGS staff. This requirement applies to the following types of equipment:

- First Aid Kits
- Trauma Kits
- Diver Recovery Kits
- Medical Oxygen Kits
- Automated Arterial Defibrillator (AED)
- Fire Extinguishers
- Vessel Emergency Kit (if applicable)
- Environmental Cleanup Kits (if applicable)

Proper labeling and visibility ensure that in the event of an emergency, necessary equipment can be quickly identified and used without delay.

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7.5.3 Non-Diving Safety Information

The SGS Health, Safety, and Environment Manual contains comprehensive safety programs and policies that are not specific to diving. Refer to the current HSE Manual for this information.

7.5.4 Emergency Aid Procedures

A comprehensive list of available emergency aid resources, including equipment and professional assistance, must be posted at all SGS dive locations, both on board dive boats and at dive stations. This list should include the following emergency contacts and resources:

- Decompression chamber
- Hospital or medical treatment facility options
- Emergency medical services
- Air transportation (as necessary)
- HSE Field Support Line
- Local SGS Regional Manger
- Local SGS safety officer

This information must be readily available to the dive supervisor, who is responsible for coordinating emergency responses.

7.5.5 Communication in Emergencies

Two-way communication is essential for accessing emergency aid and professional assistance. Reliable communication channels must be established and maintained throughout the operation to ensure swift and effective responses in the event of an emergency. If operating in a location without cellular coverage, a satellite phone is necessary to ensure emergency communication ability.

7.5.6 First Aid and Oxygen Kit Requirements

First-aid supplies appropriate for the diving operations must be readily available at all work sites. Each SGS dive station must be equipped with a well-stocked first aid kit and an O2 kit capable of delivering oxygen at minimum flow rate of 10 liters per minute for at least 30 minutes (oxygen cylinder size D – containing 425 liters at 2,015 psi – or larger). Dive sites located more than 1 hour from medical support require an additional O2 supply of 1 oxygen D-cylinder (or equivalent volume) per hour of delay until the stricken diver can be transferred to medical authorities.

Each member of the SGS dive team must hold a nationally recognized certification in first aid, AED, and CPR.

7.5.7 Handling Hazardous Materials

For guidelines and procedures on handling hazardous materials, refer to the *SGS Health, Safety, and Environment Manual.* All personnel must be familiar with these procedures to ensure safe and compliant operations.

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7.5.8 Managing Hazards in Diving Operations

Prior notice of planned diving operations, including daily start and finish times, must be provided to individuals or entities in the vicinity whose activities could interfere with or pose a hazard to the diving operations. Examples include:

- Movement of surface vessels
- Energizing/operating sea suctions or discharges
- Lifting material directly over the diving operations

The diving supervisor must continuously assess the conditions and activities around the dive site. If hazardous activities or adverse conditions, such as severe weather or dangerous sea states, are identified, the diving supervisor or diver can use **Stop Work Authority** to terminate diving operations. No diver will be required to dive under hazardous conditions or against their will.

7.5.9 Authorization for Diving Operations

Before diving operations commence, authorization must be obtained from the relevant port authorities. This authorization ensures compliance with local regulations and helps coordinate with other activities in the area to prevent incidents and ensure safe operations.

7.5.10 Underwater Determination of Safety

- A diver has the right at any time to refuse to dive or to terminate a dive if they believe underwater conditions have become unsafe. However, the diver does not have the authority to leave the water without the supervisor's approval. Approval will only be given when the supervisor determines that it is safe and ready on topside for the diver to exit the water.
- A minimum clearance of 6 feet below the ship's keel is required prior to beginning diving operations. This clearance must also account for swells and changes in sea state.
- Water current safety limits must also be considered. Generally, diving operations should not proceed in currents exceeding 1 knot. However, the diver has the authority to assess whether the current or other conditions. If the diver determines that conditions are unsafe, they must report this to the supervisor for reassessment of the operation's feasibility and safety.

7.5.11 Means for Entering and Leaving the Water

- A safe means for entering and leaving the water from the diving platform must be used. Additionally, the means of ingress and egress must be adequate to facilitate personnel rescue.
- The first diver must enter the water via ladder each day. After the first diver has entered the water and confirmed that the area is clear, the remaining divers may enter the water without using the ladder. This procedure must be reset and followed each day.
- Any height over 10 feet (3 meters), divers need to use a ladder for entering the water.
- If ladders are used as the means for entering and leaving the water, they must be designed to prevent the diver's hands or fingers from being pinched while climbing. Ladders used for ingress and egress must have a load rating of at least 300 pounds, extend at least 3 rungs into the water, and extend at least 3 feet above the pier or deck.

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- For drops greater than 30 feet (9 meters) or when a ladder is not feasible, a man basket or LARS should be used to safely lower and retrieve divers from the water. The man basket or LARS must comply with all safety standards.

7.5.12 Penetration Diving

- Divers must always have access to the surface. If access to the surface is not possible, this must be documented in a dive plan and approved by HSE. Any dive exceeding 25 feet in depth is considered penetration diving and must be detailed in a dive plan and approved by HSE.
- There is a clear and distinct difference between working beneath a vessel and working in a pipeline:
    - **Beneath a Vessel:** Working beneath a vessel is **not** considered penetration diving. The diver may be directly retrieved by the surface tender without the danger of entrapment or entanglement, as the umbilical is generally maintained in a horizontal direct line to the diver.
    - **Within a Pipeline:** When a diver enters an underwater pipeline, the umbilical will often turn a corner at the entrance or even within the pipeline. Therefore, it must be tended at these points by another diver acting as an in-water tender.
- When performing long penetrations, additional in-water tenders may be required.

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8.1 Environmental Spill Procedure (Reference current revision of the *SGS Spill Procedure*)

8.1.1 Introduction

Spills present a hazard that may pose risks to both human health and the environment. It is imperative that all personnel are familiar with the procedures to prevent, respond to, and clean up fluids, oil, fuels, and other contaminants spills. This section outlines the steps to be taken in the event of a spill, ensuring compliance with regulatory requirements and company policies.

8.1.2 Purpose

The purpose of this procedure is to establish guidelines for preventing spills, effectively responding to accidental spills, and ensuring proper cleanup. It aims to minimize environmental impact, protect personnel, and maintain regulatory compliance.

8.1.3 Scope

This procedure applies to all SGS personnel, contractors, and third-party vendors involved in operations where oil or hazardous materials are present. It covers spills that occur both onshore and offshore and provides a framework for immediate response actions.

8.1.4 Responsibilities

- **Health, Safety, and Environment (HSE) Department:**
  - Maintain and update the oil spill procedure.
  - Provide training on spill prevention and response.
  - Respond to and record any spill incidents.
- **Operations:**
  - Ensure all personnel are trained in spill response procedures.
  - Conduct regular drills to prepare for potential spill scenarios.
- **Employees/Dive Teams:**
  - Follow procedures to prevent spills during operations.
  - Immediately report any spills to the dive supervisor and HSE.
  - Participate in cleanup efforts as directed and in compliance with procedures.
- **Dive Supervisor:**
  - Ensure spill cleanup kit is properly stocked before starting the job.
  - Oversee spill prevention measures during diving operations.
  - Coordinate immediate response actions in the event of a spill.
  - Ensure communication with relevant agencies and management.

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8.1.5 Spill Prevention Measures

- **Equipment Maintenance:** Regular inspection and maintenance of hydraulic systems and other oil-containing equipment to prevent leaks and component failures. This includes pit-stop inspections of the internal components of brush carts when cleaning heavy hard fouling.
- **Training:** Ongoing training for personnel on spill prevention techniques and emergency response.
- **Job Safety Analysis:** Conduct pre-operation safety checks and reviews to identify potential spill risks.
- **Hose Service Life:** Hydraulic hoses are retired at the end of their SGS service life (2 years for steel-braided rubber hoses, 6 years for thermoplastic hoses with stainless steel fittings).
- **Protective Sleeves:** Hydraulic tool hoses shall have end-to-end abrasion protection.
- **Jumper Hoses:** Hydraulic tool hoses shall have sacrificial jumper hoses between the main hose body and the tool itself. Jumpers take most of the abuse and can be quickly changed out.
- **Thread Lock:** Threaded hydraulic fittings are to have Loctite 542 prevent loosening, and tamper-indicator paste stripes applied to the outside as a visual confirmation the fittings are tight.

8.1.6 Response to Spills

In the event of a spill, the following steps must be taken:

- **Control:** Stop the source of the spill if it is safe to do so. This may involve shutting off valves, stopping machinery, or other actions to prevent further release.
- **Contain:** Use spill containment materials, such as booms or absorbent pads, to prevent the spill from spreading. Ensure that the spill is contained away from any water sources or drainage systems.
- **Clean-Up:** Safely collect and dispose of spilled materials in accordance with local regulations. All contaminated materials must be handled according to the company's hazardous waste practices.

8.1.7 Spill Notification Procedure

Immediate notification of the spill is crucial. The dive supervisor or the first person on the scene must promptly notify the appropriate **internal contacts**, who will handle further communication with external parties if necessary.

- **Internal Contacts:**
  - HSE Department (HSE Field Support Line)
  - Operations Manager
- **External Contacts**:
  Internal contacts, such as HSE or the management team, will coordinate any necessary external reporting. This may include:
  - Notifying relevant local authorities responsible for spill response and environmental protection (e.g., National Response Center or local equivalent).
  - Engaging port authorities or other agencies as required by the location's regulations.

Notifications must be made promptly following the identification of a spill, with follow-up reports provided as required.

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8.1.8 Documentation and Reporting

All spill incidents must be documented in an incident report and submitted to the HSE Department. The report must include details of the spill, response actions taken, and recommendations for preventing future occurrences.

8.1.9 Emergency Contacts

A list of emergency contacts, including local environmental agencies, response contractors, and SGS management, should be readily available at all work sites.

8.2 Live Boating

8.2.1 Purpose

The purpose of this procedure is to establish clear guidelines for conducting live boating operations to ensure the safety of the dive team and to minimize the risk of accidents or incidents. This procedure ensures that all live boating operations are conducted under strict control and with proper authorization.

8.2.2 Scope

This procedure applies to all SGS personnel and contractors involved in live boating operations.

8.2.3 Authorization and Approval

- **HSE Director:**
  Live boating operations at SGS may only authorized with the prior approval of the HSE department. HSE must evaluate the proposed operation's risks, review the dive plan, and confirm that all safety protocols are in place before giving approval.

8.2.4 Pre-Operation Requirements

- **Risk Assessment:**
  A comprehensive risk assessment must be conducted before any live boating operation. The assessment should identify potential hazards, including vessel movement, weather conditions, water currents, and communication challenges.
- **Dive Plan:**
  A detailed dive plan must be developed and reviewed by HSE. The plan should include emergency procedures, vessel navigation protocols, and specific responsibilities for each team member.
- **Briefing:**
  All personnel involved in the live boating operation must participate in a pre-dive briefing led by the Dive Supervisor. The briefing should cover the dive plan, emergency procedures, communication protocols, and the specific hazards of live boating.

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8.2.5 Operational Procedures

- **Vessel Movement:**
  During live boating operations, the vessel must move at a controlled speed to minimize the risk of entanglement or injury to the diver. The vessel operator must maintain constant communication with the Dive Supervisor to ensure synchronized movements.
- **Communication:**
  Reliable communication between the diver, Dive Supervisor, and vessel operator is critical. The use of a dedicated radios and radio channel is mandatory. Any loss of communication requires an immediate halt to the operation.
- **Diver Monitoring:**
  The Dive Supervisor must continuously monitor the diver's status, including air supply, depth, and location relative to the vessel. Any signs of distress or equipment malfunction require immediate action. Tenders must actively tend the diver's umbilical to control slack and monitor position.
- **Emergency Readiness:**
  Emergency procedures must be in place and clearly understood by all team members. This includes protocols for diver recovery, man overboard, vessel positioning, and coordination with emergency services and SGS management.

8.2.6 Prohibited Practices

- **SCUBA Diving:**
  Under no circumstances is SCUBA diving permitted during live boating operations due to the increased risks associated with vessel movement and the limitations of SCUBA equipment in such scenarios.

8.3 Underwater Explosives

8.3.1 Purpose

The purpose of this section is to establish clear guidelines and safety protocols for the use of explosives in underwater operations conducted by SGS. The procedure aims to ensure the safety of all personnel involved and to minimize the risks associated with the use of explosives in a marine environment.

8.3.2 Scope

This procedure applies to all SGS personnel and contractors involved in operations where explosives are used underwater. It covers the planning, execution, and post-operation activities related to the use of explosives, specifically focusing on the safety of the dive team and the surrounding environment.

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8.3.3 Authorization and Approval

- **HSE Director:**
  The use of explosives during diving operations is strictly controlled and requires prior approval from the HSE Director. This approval is based on a thorough review of the Risk Assessment and Dive Plan prepared for the operation.

8.3.4 Pre-Operation Requirements

- **Risk Assessment and Dive Plan:**
  Before any explosives are used, a comprehensive Risk Assessment and Dive Plan must be created. These documents should identify potential hazards, assess the risks associated with the operation, and outline the necessary controls to mitigate those risks.
- **Explosive Types:**
  The selection of the appropriate explosive must be based on the specific requirements of the operation and must adhere to all safety and regulatory standards.

8.3.5 Operational Procedures

- **Diver Safety:**
  All divers must be out of the water before any explosives are detonated. This rule is non-negotiable and is crucial to ensuring the safety of the dive team.
- **Communication Protocols:**
  Effective communication is essential during operations involving explosives. A dedicated communication system must be in place to ensure that all team members are informed of the operation's status and any changes in the plan.
- **Detonation Procedure:**
  The detonation of explosives must be carefully controlled and executed according to the pre-approved plan. The Dive Supervisor must coordinate the timing of the detonation with the surface team to ensure that all safety measures are in place.

8.3.6 Prohibited Practices

- **Unauthorized Use:**
  The use of explosives in underwater operations without the prior approval of the HSE Director is strictly prohibited.

8.4 Diving at Altitude

8.4.1 Introduction

Divers may be required to dive in bodies of water at altitudes above sea level. Planning for such dives must address the effects of atmospheric pressures that are significantly lower than those at sea level. This section outlines the necessary considerations and procedures to ensure safe diving operations at altitude.

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8.4.2 Atmospheric Pressure and Decompression

At higher altitudes, the atmospheric pressure is lower, which affects both the diver's body and the decompression requirements. Air Decompression Tables are authorized for use at altitudes up to 300 feet above sea level without corrections. However, due to the reduced atmospheric pressure at higher altitudes, dives conducted at altitude require more decompression than identical dives conducted at sea level. The standard air decompression tables, therefore, cannot be used as written without adjustments. Additionally, in-water ascent rates should be reduced due to the greater pressure differential at the air-water interface at altitudes higher than sea level.

8.4.3 Altitude Correction Procedure

For dives conducted at altitudes above 300 feet, the following altitude correction procedures must be applied:

- **Sea Level Equivalent Depth**:
  - The sea level equivalent depth is determined by multiplying the depth of the dive at altitude by the ratio of atmospheric pressure at sea level to atmospheric pressure at altitude. This corrected depth is used to find the appropriate decompression schedule.
  - *Example*: A dive at 60 fsw at an altitude of 5,000 feet with an atmospheric pressure of 843 millibars (0.832 ATA) would have a sea level equivalent depth calculated as:
    Sea Level Equivalent Depth = 60 fsw × (1013 millibars / 843 millibars) = ~72 fsw.
- **Correction of Decompression Stop Depth**:
  - The depth of the corrected stop at altitude is calculated by multiplying the sea level equivalent stop depth by the ratio of atmospheric pressure at altitude to atmospheric pressure at sea level.
  - *Example*: If a decompression stop is required at 20 fsw at sea level for a dive at 5,000 feet, the corrected stop depth would be:
    Corrected Stop Depth = 20 fsw × (843 millibars / 1013 millibars) = ~17 fsw.
- **Ascent Rate Adjustments**:
  - While in-water ascent rates should generally be reduced due to the greater pressure differential at the air-water interface, precise reductions in ascent rate are not needed unless operating at altitudes above 8,000 feet.

8.4.4 Transporting Divers to Higher Elevations

Transporting divers out of the diving area, especially if this involves movement into even higher elevations, requires special consideration and planning. Reference US Navy Dive Manual Rev 7 Table 9-6 “Ascent to Altitude After Diving.” Leaving the dive site may involve temporary ascent to a higher altitude, such as driving over a mountain pass or flying from the dive site. Ascent to altitude after diving increases the risk of decompression sickness (DCS) because of the additional reduction in atmospheric pressure. The higher the altitude, the greater the risk. The diving supervisor must be alert for symptoms of hypoxia and DCS due to the lower oxygen partial pressure and atmospheric pressure.

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8.4.5 Use of Cross Correction Technique

For diving operations at altitudes significantly above sea level, decompression procedures that account for the reduced surface pressure must be utilized. SGS uses the Sea Level Equivalent Depth to the U.S. Navy No 'D' Tables to calculate the decompression schedule for dives above sea level.

An alternative approach is to correct the altitude dive to obtain the equivalent sea level dive, then determine the decompression requirement using standard tables. This procedure is commonly known as the "Cross Correction" technique. It always yields a sea level dive that is deeper than the actual dive at altitude, providing the extra decompression needed to offset the effects of diving at altitude.

To apply the "Cross Correction" technique, two corrections must be made for altitude diving. First, the actual dive depth must be corrected to determine the sea level equivalent depth. Second, the decompression stops in the sea level equivalent depth table must be corrected for use at altitude. Strictly speaking, ascent rate should also be corrected, but this third correction can safely be ignored.

The depth of the sea level equivalent dive is determined by multiplying the depth of the dive at altitude by the ratio of the atmospheric pressure at sea level to the atmospheric pressure at altitude.

$$\text{Equivalent Depth (fsw)} = \text{Altitude Depth (fsw)} \times \frac{\text{Pressure at Sea Level}}{\text{Pressure at Altitude}}$$

Example: A diver makes a dive to 60 fsw at an altitude of 5000 feet. The atmospheric pressure measured at 5000 feet is 843 millibars (0.832 ATA). Atmospheric pressure at sea level is assumed to be 1013 millibars (1.000 ATA). Sea level equivalent depth is then.

$$\text{Equivalent Depth (fsw)} = 60 \text{ fsw} \times \frac{1.000 \text{ ATA}}{0.832 \text{ ATA}} = 72.1 \text{ fsw}$$

8.4.6 Depth Measurement at Altitude

The preferred method for measuring depth at altitude is using a mechanical or electronic gauge that can be re-zeroed at the dive site. Once re-zeroed, no further correction of the reading is required. When using a recompression chamber for decompression, zero the chamber depth gauges before conducting surface decompression.

If using a sealed reference gauge, which cannot be adjusted for altitude, a correction factor of 1 fsw for every 1,000 feet of altitude should be added to the depth reading before entering the Sea Level Equivalent Depth tables.

8.4.7 Equilibration and Acclimatization

Upon ascent to altitude, the body undergoes equilibration, off-gassing excess nitrogen to align with the lower partial pressure of nitrogen in the atmosphere. This process typically takes about 12 hours. Full acclimatization usually takes 1-3 days. If a dive is conducted within 12 hours of arriving at altitude, the initial dive should be considered a repetitive dive, with the ascent to altitude treated as the first dive. (US Navy Dive Manual Rev 7 Table 9-5 gives the repetitive group with an initial accent to altitude). Using this group and time at altitude before diving, enter the Residual Nitrogen Timetable for Repetitive Air Dives (US Navy Dive Man Rev 7 Table 9-8) to determine the new repetitive group designator associated with that period of equilibration.

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

8.4.8 Repetitive Groups and Diving After Initial Ascent

When diving after an initial ascent to a higher altitude, use the repetitive group associated with the time spent at altitude before diving to determine the new repetitive group designator. This is necessary to calculate the residual nitrogen time and adjust the bottom time of the dive accordingly.

Example: A diver ascends rapidly to 6000 feet in a helicopter and begins a dive to 100 fsw 90 minutes later. How much residual nitrogen time should be added to the dive?

From Table 9-5 above, the repetitive group upon arrival at 6000 feet is Group E. During 90 minutes at altitude, the diver will desaturate to Group D. From Table 9-4, the sea level equivalent depth for a 100 fsw dive is 130 fsw. From Table 9-8 on the next page, we see the residual nitrogen time for a 130 fsw dive in Group D is 11 minutes. The supervisor should add 11 minutes to the diver's bottom time.

Table 9-5 can also be used when a diver who is fully equilibrated at one altitude ascends to and dives at a higher altitude. Enter Table 9-5 with the difference between the two altitudes to determine the initial repetitive group.

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.

Repetitive Group at Beginning of Surface Interval

Repetitive Group	Surface Interval
A	:10 2:20 *
B	:10 1:17 / 1:16 3:36 *
C	:10 :56 2:12 / :55 2:11 4:31 *
D	:10 :53 1:48 3:04 / :52 1:47 3:03 5:23 *
E	:10 :53 1:45 2:40 3:56 / :52 1:44 2:39 3:55 6:15 *
F	:10 :53 1:45 2:38 3:32 4:49 / :52 1:44 2:37 3:31 4:48 7:08 *
G	:10 :53 1:45 2:38 3:30 4:24 5:41 / :52 1:44 2:37 3:29 4:23 5:40 8:00 *
H	:10 :53 1:45 2:38 3:30 4:22 5:17 6:33 / :52 1:44 2:37 3:29 4:21 5:16 6:32 8:52 *
I	:10 :53 1:45 2:38 3:30 4:22 5:14 6:09 7:25 / :52 1:44 2:37 3:29 4:21 5:13 6:08 7:24 9:44 *
J	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 7:01 8:17 / :52 1:44 2:37 3:29 4:21 5:13 6:06 7:00 8:16 10:36 *
K	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:53 9:10 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:52 9:09 11:29 *
L	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:51 8:45 10:02 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:50 8:44 10:01 12:21 *
M	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:51 8:43 9:38 10:54 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:50 8:42 9:37 10:53 13:13 *
N	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:51 8:43 9:35 10:30 11:46 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:50 8:42 9:34 10:29 11:45 14:05 *
O	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:51 8:43 9:35 10:28 11:22 12:38 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:50 8:42 9:34 10:27 11:21 12:37 14:58 *
Z	:10 :53 1:45 2:38 3:30 4:22 5:14 6:07 6:59 7:51 8:43 9:35 10:28 11:20 12:14 13:31 / :52 1:44 2:37 3:29 4:21 5:13 6:06 6:58 7:50 8:42 9:34 10:27 11:19 12:13 13:30 15:50 *

Dive Depth	Repetitive Group at the End of the 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

8.4.9 ALTITUDE DIVING LIMIT: Diving at high altitudes can impose serious stress on the body, resulting in significant medical problems while the acclimatization process takes place. SGS limits altitude diving to no more than 6,000 feet, and all dives above 1,000 feet require dive plan review and HSE approval.

8.4.10 SUMMARY

Diving at altitude requires specific corrections to standard procedures to ensure diver safety. By applying the appropriate corrections to dive depths, decompression stops, and ascent rates, and by considering the unique physiological effects of altitude, divers can mitigate the risks associated with altitude diving. Proper planning and awareness of these factors are critical for safe and effective diving operations at higher altitudes.

8.4.11 Sea Level Equivalent Table

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	56	54	52	50	48	46	45	43	41

Note: ━━━ = Exceptional Exposure Limit

8.5 Confined Space Entry

Purpose:
To establish safe practices for the entry into confined spaces ensuring the safety of personnel by controlling hazards commonly associated with confined spaces.

8.5.1 General Requirements

- Confined spaces are defined as areas that are not designed for continuous occupancy, have limited means of entry or exit, and may contain hazards such as oxygen deficiency, toxic gases, or the potential for engulfment.
- Entry into confined spaces should only be conducted by personnel trained in confined space entry procedures and hazards.
- A comprehensive Job Safety Analysis (JSA) must be completed before any confined space entry. The JSA must identify hazards, control measures, and emergency response procedures.
- No personnel are allowed to enter a confined space without verification that all safety controls are in place.

8.5.2 Pre-Entry Preparation

- **Risk Assessment:**
  A thorough risk assessment should be conducted for every confined space operation, identifying potential hazards such as oxygen deficiency, toxic substances, flammable gases, and mechanical hazards.
- **Atmospheric Testing:**
  The atmosphere within the confined space must be tested for oxygen levels, flammable gases, and toxic substances. The acceptable limits are:
  - Oxygen: 19.5% to 23.5%
  - Flammable Gases: Less than 10% of the Lower Explosive Limit (LEL)
  - Hydrogen Sulfide (H2S): 10 PPM
  - Carbon Monoxide (CO): 35 PPM
  - Ammonia (NH3): 25 PPM
  - Carbon Dioxide (CO2): 5000 PPM
- **Ventilation:**
  Adequate ventilation must be provided to ensure a safe atmosphere within the confined space. Mechanical ventilation may be required if natural airflow is insufficient.
- **Isolation:**
  All energy sources (electrical, mechanical, hydraulic, etc.) must be de-energized and locked out to prevent accidental activation of equipment within or connected to the confined space.
- **Emergency Rescue Plan:**
  A rescue plan must be in place before entry, including the availability of trained rescue personnel and equipment. Rescue operations must be initiated without delay in the event of an emergency.

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8.5.3 Entry Procedures

- **Entry Permit:**
  A confined space entry permit must be completed, reviewed, and approved by the responsible supervisor before any entry. The permit must include:
  - Names of authorized entrants and attendants
  - Hazards identified and control measures
  - Results of atmospheric testing
  - Required personal protective equipment (PPE)
  - Emergency response procedures
- **Personnel Responsibilities:**
  - **Entrants:** Must wear appropriate PPE, including a harness for retrieval. They must communicate regularly with the attendant and follow all safety protocols.
  - **Attendants:** Must remain outside the confined space, continuously monitor conditions, and maintain communication with the entrant(s). They must be trained in emergency procedures such as calling rescue team, prohibiting unauthorized entry, non-entry rescue with retrieval system and assisting rescue team.
  - **Supervisors:** Responsible for ensuring all safety measures are in place and adhered to before, during, and after the confined space entry.

8.5.4 Monitoring and Communication

- **Continuous Monitoring:**
  Atmospheric conditions must be continuously monitored during confined space entry using portable gas detection equipment.
- **Communication Systems:**
  Clear communication methods between entrants and attendants must be established, such as radios or hardwired communication systems. Backup communication methods should be available in case of equipment failure.

8.5.5 Emergency Procedures

- **Rescue Plan:**
  The rescue plan must be reviewed and understood by all personnel before entry. The plan must include non-entry rescue methods where possible, such as the use of a tripod and winch system for retrieval.
- **Emergency Equipment:**
  Rescue equipment, such as retrieval lines, full-body harnesses, and breathing apparatus, must be readily available and in proper working condition.
- **Rescue Personnel:**
  Only qualified personnel are authorized to perform rescues. At least one qualified individual must always be present during confined space operations.

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8.5.6 Post-Entry Procedures

- **Permit Closure:**
  Upon completion of the work, the entry permit must be closed, and the confined space must be re-secured to prevent unauthorized access.
- **Incident Reporting:**
  Any incidents, including near misses or equipment malfunctions, must be reported to the supervisor immediately and documented as per company procedures.

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SPM ❖ CH.9 | DIVE THEORY

9.1 Dive Theory

9.1.1 Purpose

The purpose of this section is to provide an understanding of decompression theory and its application in diving operations. This knowledge is essential for ensuring the safety of divers during ascent and for preventing decompression sickness (DCS), a potentially serious condition caused by the formation of nitrogen bubbles in the tissues and bloodstream.

9.1.2 Scope

This procedure applies to all SGS diving personnel and operations where decompression is required. It covers the physiological principles of nitrogen absorption and elimination, the importance of controlled ascent, and the use of decompression schedules to ensure diver safety.

9.1.3 Nitrogen Absorption and Elimination

- **Nitrogen Absorption:**
  As a diver descends, the partial pressure of nitrogen in the lungs increases, exceeding the partial pressure of nitrogen in the tissues. This difference in pressure drives nitrogen from the lungs into the bloodstream, which then transports it to various body tissues. The rate at which different tissues absorb nitrogen depends on their blood flow. For example, tissues with high blood flow, like the brain, reach equilibrium with the nitrogen pressure in the lungs faster than tissues with lower blood flow, like muscles or tendons. The deeper the dive and the longer the bottom time, the more nitrogen is absorbed by the tissues, until they become saturated.
- **Nitrogen Elimination:**
  During ascent, the process of nitrogen absorption is reversed. The partial pressure of nitrogen in the tissues exceeds that in the lungs, causing nitrogen to be transported back to the lungs via the bloodstream. The ascent rate must be controlled to allow time for the nitrogen to be safely eliminated from the tissues and to prevent the formation of nitrogen bubbles, which can lead to decompression sickness.

9.1.4 Decompression Schedules

- **Importance of Controlled Ascent:**
  The risk of decompression sickness increases if the tissue nitrogen partial pressure exceeds the ambient pressure by too great an amount during ascent. To mitigate this risk, controlled ascent rates and decompression stops are essential. These measures allow nitrogen to be safely eliminated from the tissues, reducing the likelihood of bubble formation.
- **Decompression Tables:**
  Special decompression schedules have been developed for air diving to account for the amount of nitrogen absorbed by the body at various depths and times. These schedules consider the different rates at which nitrogen is eliminated from various tissues and the extent to which tissue nitrogen partial pressure can exceed ambient pressure without causing excessive bubble

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formation. Staged decompression, which involves making stops at specific depths for set periods, is the standard method used in air decompression.

- **The Air Decompression Tables:**
  At SGS, bottom times are limited to one designator back from the No-Decompression Limits (NDL) for all no-decompression tables. The following six tables are required to perform the full spectrum of air dives:
  - **No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives:**
    This table provides the no-decompression limits and the repetitive group designators for dives that do not require decompression stops.
  - **Air Decompression Table:**
    This table outlines the decompression schedules and repetitive group designators for dives that require decompression stops.
  - **Residual Nitrogen Timetable for Repetitive Air Dives:**
    This table allows the diver to determine Residual Nitrogen Time when performing a repetitive dive.
  - **Sea Level Equivalent Depth Table:**
    This table allows the diver to correct the sea level decompression tables for use at altitude.
  - **Repetitive Groups Associated with Initial Ascent to Altitude Table:**
    This table adjusts the decompression if the diver is not fully equilibrated at altitude.
  - **Required Surface Interval Before Ascent to Altitude After Diving Table:**
    This table indicates when it is safe to fly or ascend to a higher altitude after a dive.
- **Selecting the Decompression Schedule:**
  To select the proper decompression schedule, record the bottom time and the maximum depth attained by the diver. Enter the table at the exact or next greater depth and at the exact or next longer bottom time. When using a pneumofathometer to measure depth, first correct the observed depth reading by adding the pneumofathometer correction factor. When diving at depths less than 100 feet, add 1 foot to the table. For dives deeper than 100 feet, add 2 feet to the table when calculating decompression. Ensure that the pneumofathometer is located at mid-chest level to provide an accurate reading.

9.1.5 Definitions

- **Descent Rate:**
  The descent rate on an air dive is not critical, but in general, it should not exceed 75 feet of seawater per minute (fsw/min).
- **Ascent Rate:**
  The ascent rate from the bottom to the first decompression stop, between decompression stops, and from the last decompression stop to the surface is 30 fsw/min (20 seconds per 10 fsw). Minor variations in the rate of ascent between 20 and 40 fsw/min are acceptable. For surface decompression, the ascent rate from the 40 fsw water stop to the surface is 40 fsw/min.
- **Decompression Stop Time:**
  For in-water decompression on air, the time at the first decompression stop begins when the diver arrives at the stop and ends when the diver leaves the stop. For all subsequent stops, the stop time begins when the diver leaves the previous stop and ends when the diver leaves the

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stop. In other words, ascent time between stops is included in the subsequent stop time. The same rules apply to in-water decompression on air/oxygen with the exception of the first stop on oxygen and ends when the diver leaves the stop.

- **Last Water Stop:**
  The last water stop for all in-water decompressions is 20 fsw.
- **Eligibility for Surface Decompression:**
  A diver is eligible for surface decompression upon completion of the 40 fsw water stop. If a 40 fsw stop is not required by the decompression schedule, the diver may ascend directly to the surface without decompression stops and begin surface decompression.

9.1.6 Decompression Schedules and Tables

- **SGS Decompression Practices:**
  SGS does not conduct in-water decompression dives. If in-water decompression is used, it is only in an emergency situation or is pre-approved by the HSE Director. All diving performed by SGS is planned and conducted in accordance with the following established U.S. Navy Decompression Tables:
  - **No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives**
  - **Residual Nitrogen Timetable for Repetitive Air Dives**
  - **U.S. Navy Standard Air Decompression Table**
  - **Surface Decompression Table Using Air**
  - **Surface Decompression Table Using Oxygen**

  All SGS diving supervisors should be familiar with and understand the necessity of strict adherence to the appropriate decompression tables.

9.1.7 Application in Diving Operations

- **Strict Adherence to Decompression Tables:**
  The decompression tables are based on years of scientific research, calculations, and experimentation, providing the best available guidance for diver safety. However, they become less accurate as dive depth and bottom time increase. Therefore, it is crucial to strictly follow the tables during all diving operations to ensure maximum safety.
- **Emergency Deviations:**
  Deviations from established decompression procedures are not permitted except in emergencies. In such cases, the diver must follow the guidance and recommendations of a Diving Medical Officer (DMO) and obtain approval from the HSE Director before deviating from the standard decompression schedule.

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9.2 In-Water Decompression on Air

9.2.1 General Policy

SGS DOES NOT ALLOW PLANNED IN-WATER DECOMPRESSION WITHOUT PRIOR APPROVAL FROM THE HSE DIRECTOR. This mode of decompression is used only in emergency situations when a diver exceeds the planned no-decompression schedule.

9.2.2 Purpose

This section provides guidelines for conducting in-water decompression on air when it becomes necessary. The procedures outlined here are intended to ensure the safety of the diver by following a structured approach to decompression, reducing the risk of decompression sickness.

9.2.3 Decompression Process

- **Overview:**
  In-water decompression on air involves conducting the entire decompression process while the diver remains underwater, breathing air. The top row labeled "Air" under each depth/bottom time entry in the Air Decompression Table provides the decompression schedule for this mode.
- **Table Entry:**
  To determine the required decompression schedule, enter the Air Decompression Table at the depth that is exactly equal to or next deeper than the diver's maximum depth. Select the schedule for the bottom time that is exactly equal to or next longer than the diver's actual bottom time.
- **Decompression Stops:**
  Read across the row labeled "Air" to obtain the required decompression stop times. The last decompression stop is conducted at 20 feet of seawater (fsw). The total ascent time is given in the next column, and the repetitive group designator upon surfacing is provided in the last column.

9.2.4 Example of Decompression Calculation

A diver makes a surface-supplied air dive to 78 fsw for 47 minutes. What is the required decompression?

1. **Depth and Time Entry:**
   Enter the Air Decompression Table at the next deeper depth, which is 80 fsw, and the next longer bottom time, which is 50 minutes.
2. **Decompression Schedule:**
   Read across the row labeled "Air." The required decompression includes a 17-minute stop at 20 fsw.
3. **Ascent Procedure:**
   The diver ascends from 78 fsw to 20 fsw at a rate of 30 fsw/min, spends 17 minutes at 20 fsw, and then ascends to the surface at 30 fsw/min.
4. **Repetitive Group Designator:**
   The repetitive group designator for this dive is "M."

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9.2.5 No-Decompression Dives

If the bottom time of a dive is less than the first bottom time listed for its depth in the Air Decompression Table, decompression stops are not required. The diver may ascend directly to the surface at a rate of 30 fsw/min.

- **Repetitive Group Designator:**
  Refer to Figure 1 in the tables to obtain the repetitive group designator for a no-decompression dive.
- **Repetitive Dive Restrictions:**
  If the Air Decompression Table does not list a repetitive group designator for a dive, no repetitive dives deeper than 20 fsw are permitted following this dive. The diver must have an 18-hour surface interval before making another dive deeper than 20 fsw.

9.3 Repetitive Dives

9.3.1 General Overview

During the surface interval following an air dive, the quantity of residual nitrogen in the diver's body gradually reduces to its normal level. However, if the diver makes a second dive before the residual nitrogen has dissipated (a repetitive dive), the diver must account for this residual nitrogen when planning the subsequent dive.

9.3.2 Repetitive Group Designator

- **Assignment:**
  Upon completing the first dive, the diver is assigned a repetitive group designator from either the Air Decompression Table or the No-Decompression Table. This designator indicates the amount of residual nitrogen the diver has upon surfacing from the first dive. A diver in Group A has the lowest amount of residual nitrogen, while a diver in Group Z has the highest. As nitrogen is eliminated from the diver's body during the surface interval, the repetitive group designation moves to a lower letter group, reflecting the reduction in residual nitrogen.
- **Surface Interval:**
  The repetitive group designator at any time during the surface interval can be determined using the top half of Figure 2. The lower half of Figure 2 provides the Residual Nitrogen Time (RNT) corresponding to the repetitive group designator at the end of the surface interval and the depth of the repetitive dive.

9.3.3 Repetitive Dive Procedure

To use the repetitive dive procedure described below, the surface interval between dives must be at least 10 minutes. If the surface interval is less than 10 minutes, the bottom times of the two dives should be combined, and the decompression table should be entered at the deeper of the two depths.

To determine the decompression schedule for a repetitive dive when the surface interval is greater than 10 minutes:

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1. **Obtain Repetitive Group Designator:**
   Upon surfacing from the first dive, obtain the repetitive group designator from the Air Decompression Table or the No-Decompression Table.
2. **Determine Surface Interval:**
   Using the repetitive group designator, enter the top half of Figure 2 on the diagonal. Read horizontally across the row to locate the time interval that includes the diver's surface interval.
3. **Time Interval Selection:**
   The surface interval times are expressed in hours and minutes (e.g., 2:21 = 2 hours, 21 minutes). Each time interval has a minimum (top limit) and a maximum (bottom limit). The diver's surface interval must be within or equal to these limits. If the surface interval exceeds the longest time shown in the row, the dive is not considered a repetitive dive, and no correction for residual nitrogen is required.
4. **Determine Repetitive Group Designator:**
   Read vertically down the column to obtain the repetitive group designator at the end of the surface interval.
5. **Calculate Residual Nitrogen Time (RNT):**
   Continue down the same column to the depth row that matches or is next deeper than the depth of the repetitive dive. The time at the intersection of the column and row is the RNT in minutes.
6. **Calculate Equivalent Single Dive Time (ESDT):**
   Add the RNT to the actual bottom time of the repetitive dive to determine the ESDT.
7. **Determine Decompression Schedule:**
   Enter the Air Decompression Table or No-Decompression Table at the depth that is equal to or next deeper than the actual depth of the repetitive dive. Select the schedule that is equal to or next longer than the ESDT. Follow the prescribed decompression to the surface.
8. **Special Considerations:**
   At depths of 10, 15, and 20 fsw, some higher repetitive groups may not have a defined RNT. These groups are marked with a double asterisk (**) in the lower half of Figure 2. The RNT is undefined because the nitrogen loading associated with these groups is higher than what could be achieved even if the diver remained at those depths indefinitely. Divers in these higher groups can still perform repetitive dives at 10, 15, or 20 fsw because the no-decompression time at those depths is unlimited. If a subsequent repetitive dive to a deeper depth is planned, the diver should assume they surfaced from the 20 fsw dive in the same repetitive group.

Example: A diver surfaces from a dive in repetitive Group N. Thirty minutes later, the diver makes a dive to 20 fsw. The diver begins the 20 fsw dive in Group N. The RNT for Group N at 20 fsw is undefined, which is acceptable because the no-decompression time at 20 fsw is unlimited. Regardless of the starting repetitive group, the diver can spend any amount of time at 20 fsw without incurring a decompression obligation. If a subsequent dive deeper than 20 fsw is planned, the diver should assume that they surfaced from the 20 fsw dive in Group N, regardless of the duration of the 20 fsw dive.

9. **Restrictions on Repetitive Dives:**
   If a repetitive group is not shown in the decompression schedule, repetitive dives deeper than 20 fsw are not permitted following a dive on that schedule. The diver must remain on the surface for at least 18 hours before making another dive deeper than 20 fsw.

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10. **Exceptional Exposure:**
    Repetitive dives that require the use of Exceptional Exposure decompression schedules are not permitted.

9.3.4 RNT Exception Rule

In some cases, the RNT given in Figure 2 may be longer than necessary to provide adequate decompression for the repetitive dive. This situation is most likely when the surface interval between dives is short. After determining the decompression requirement for the repetitive dive using the repetitive dive procedure, the diver should recalculate by summing the bottom times of the two dives and using the deepest depth.

If the resultant table and schedule produce a longer no-decompression time or a shorter decompression time than the initial calculation, the diver may use the table and schedule with the lesser decompression obligation. This alternative method is known as the RNT Exception Rule.

Example: A diver makes a dive to 100 fsw for 25 minutes and plans to make a repetitive dive to 60 fsw for 20 minutes after a 30-minute surface interval. The diver surfaces from the first dive in repetitive group H. After 30 minutes on the surface, the diver remains in group H. The RNT for group H at 60 fsw is 46 minutes, making the ESDT 66 minutes. The 60 fsw / 70 min schedule calls for a 7-minute stop at 20 fsw. Alternatively, by summing the bottom times (45 minutes) and using the deeper depth (100 fsw), the schedule requires 36 minutes on air at 20 fsw. The diver may choose the shorter 60 fsw / 70 min schedule under the RNT Exception Rule.

This rule can be applied to a series of repetitive dives. The table and schedule for the next dive are determined first using the standard procedure, then by summing the bottom times of all repetitive dives in the series and taking the deepest depth. The table and schedule that produce the shorter decompression time or longer no-decompression time should be used for the repetitive dive.

9.4 Variations in Ascent Rate

9.4.1 General Guidelines

The following rules for correcting variations in the rate of ascent apply to all the tables provided in this section. The normal rate of ascent to the first stop and between subsequent stops is 30 feet of seawater per minute (fsw/min). Minor variations in the rate of travel between 20 and 40 fsw/min are acceptable and do not require correction.

9.4.2 Travel Rate Exceeded

If the rate of ascent exceeds 40 fsw/min, the following actions should be taken:

1. **Stop the Ascent:**
   Halt the ascent immediately.

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2. **Allow Watches to Catch Up:**
   Wait until the timing devices have synchronized with the actual time before continuing the ascent.
3. **Resume Ascent:**
   Once the watches are synchronized, continue the ascent at the correct rate.

9.4.3 Early Arrival at the First Decompression Stop

If the divers arrive early at the first decompression stop:

1. **Begin Timing the First Stop:**
   Start timing the first decompression stop when the required travel time has been completed.
2. **Oxygen Stops:**
   If the first stop is an oxygen stop, shift the divers to oxygen upon arrival. Begin the stop time when the divers are confirmed on oxygen and the required travel time has been completed.

9.4.4 Delays in Arriving at the First Decompression Stop

- **Delay Up to 1 Minute:**
  A delay of up to one minute in reaching the first decompression stop can be ignored.
- **Delay Greater Than 1 Minute, Deeper Than 50 fsw:**
  If the delay exceeds one minute and occurs at a depth greater than 50 fsw:
  1. Round up the delay time to the next whole minute and add it to the bottom time.
  2. Recompute the decompression schedule.
  3. If no change in schedule is required, continue with the planned decompression.
  4. If a change in schedule is required and the new schedule calls for a decompression stop deeper than the diver's current depth, perform any missed deeper stops at the diver's current depth. Do not descend to a deeper depth.

  Example:
  Divers make a dive to 115 fsw with a stage depth of 113 fsw and a bottom time of 55 minutes. According to the 120 fsw / 55 min decompression schedule, the first decompression stop is at 30 fsw. During ascent, the divers are delayed at 100 fsw for 3 minutes 27 seconds and take 6 minutes 13 seconds to reach the 30-fsw decompression stop. The total delay is rounded up to 4 minutes, which is then added to the bottom time, resulting in a new bottom time of 59 minutes. The new decompression schedule should be calculated using a 60-minute bottom time.

- **Delay Greater Than 1 Minute, Shallower Than 50 fsw:**
  If a delay greater than one minute occurs at a depth shallower than 50 fsw, round the delay time up to the next whole minute and add it to the first decompression stop time.

  Example:
  Divers make a dive to 113 fsw with a bottom time of 60 minutes. According to the Air Decompression Table, the first decompression stop is at 30 fsw. During ascent, the divers are delayed at 40 fsw, taking 6 minutes 20 seconds to reach the 30-fsw stop instead of the expected 2 minutes 46 seconds. The delay of 3 minutes 34 seconds (rounded to 4 minutes) should be

added to the 30-fsw decompression stop time, increasing it from 14 minutes to 18 minutes on oxygen.

9.4.5 Delays Leaving or Between Air Stops

- **Delay Less Than 1 Minute Leaving an Air Stop:**
  If the delay in leaving an air stop is less than 1 minute, it can be disregarded. Resume normal decompression once the delay is over.
- **Delay Less Than 1 Minute Between Air Stops:**
  If the delay between stops is less than 1 minute, disregard the delay and continue as planned.
- **Delay Greater Than 1 Minute Leaving an Air Stop or Between Air Stops Deeper Than 50 fsw:**
  Add the delay to the bottom time and recalculate the required decompression. If a new schedule is required, continue with the new schedule from the present stop or subsequent stop if the delay occurs between stops. Ignore any missed stops or time deeper than the depth at which the delay occurred.
- **Delay Greater Than 1 Minute Leaving an Air Stop or Between Air Stops Shallower Than 50 fsw:**
  Ignore the delay. Resume the normal schedule upon completion of the delay.

9.4.6 Delays Involving Oxygen Stops

- **Delay Leaving an Oxygen Stop at 30 fsw or Between Oxygen Stops at 30 and 20 fsw:**
  Subtract any delay in leaving the 30-fsw oxygen stop or any delay during travel from 30 to 20 fsw from the subsequent 20-fsw oxygen stop time. If the delay causes the total time on oxygen deeper than 20 fsw to exceed 30 minutes, shift the diver to air at the 30-minute mark. Once the issue is resolved, switch the diver back to oxygen and resume decompression. Any time spent on air is disregarded.

  Example:
  A diver's decompression schedule includes a 20-minute stop on oxygen at 30 fsw and a 40-minute stop on oxygen at 20 fsw. A 15-minute delay occurs at the 30-fsw stop due to a stage malfunction. The first 10 minutes of the delay can be spent on oxygen at 30 fsw, but the diver should switch to air for the remaining 5 minutes. After resolving the issue, the diver returns to oxygen at 30 fsw and ascends to 20 fsw to begin the 20-fsw stop, reducing the stop time from 40 to 30 minutes.

- **Delay in Leaving the 20-fsw Oxygen Stop:**
  Delays in leaving the 20-fsw oxygen stop can be ignored, but divers should not remain on oxygen for more than 30 minutes. If necessary, shift the diver to air and remain on air until travel to the surface is possible.

9.4.7 Delay in Travel from 40 fsw to the Surface for Surface Decompression

Disregard any delays in travel from 40 fsw to the surface during surface decompression unless the diver exceeds the allowed 5-minute surface interval. If the diver exceeds the 5-minute surface interval, follow the emergency procedures guidance.

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9.5 Decompression Special Procedures

9.5.1 Surface Interval Greater Than 5 Minutes

If the time from leaving 40 fsw in the water to the time of arrival at 50 fsw in the chamber during surface decompression exceeds 5 minutes, take the following actions:

- **Surface Interval More Than 5 Minutes but Less Than or Equal to 7 Minutes:**
  Increase the time on oxygen at 50 fsw from 15 to 30 minutes by adding one-half oxygen period to the 50 fsw chamber stop. Ascend to 40 fsw during the subsequent air break. The 15-minute penalty is considered part of the normal surface decompression procedure, not an emergency procedure.

  Example:
  Divers are decompressing on a SurDO2 schedule that requires 1.5 oxygen breathing periods. It took 6 minutes and 20 seconds to travel from 40 fsw to the surface, undress the diver, and recompress to 50 fsw in the chamber. The divers are placed on oxygen at 50 fsw in the chamber. They will breathe oxygen at 50 fsw for the 15 minutes required by the original schedule, plus an additional 15 minutes to compensate for exceeding the normal 5-minute surface interval. Upon completion of 30 minutes on oxygen at 50 fsw, they will remove the BIBS, initiate a 5-minute air break, and ascend from 50 fsw to 40 fsw at 30 fsw/min while breathing air. After 5 minutes on air, the divers will breathe oxygen for 30 minutes to complete the oxygen time required at 40 fsw on the original schedule. The total number of oxygen periods is increased from 1.5 to 2.0 due to the extended surface interval.

- **Surface Interval Greater Than 7 Minutes:**
  If the surface interval is greater than 7 minutes, continue compression to a depth of 60 fsw and proceed as follows:
  1. **Treatment Table 5:**
     Treat the divers on Treatment Table 5 (refer to the U.S. Navy Dive Manual) if the original schedule required 2 or fewer oxygen periods in the chamber.
  2. **Treatment Table 6:**
     Treat the divers on Treatment Table 6 (refer to the U.S. Navy Dive Manual) if the original schedule required 2.5 or more oxygen periods in the chamber.
- **Difficulty Equalizing Middle Ear Pressure:**
  On rare occasions, a diver may not be able to reach 50 fsw in the chamber due to difficulty equalizing middle ear pressure. In this situation, an alternative procedure for surface decompression on oxygen may be used:
  1. **Compress to the Deepest Attainable Depth:**
     Compress the diver to the deepest depth he can initially attain, usually less than 20 fsw, and begin oxygen breathing at that depth.
  2. **Continue Attempts to Compress Deeper:**
     Continue attempts to gradually compress the diver deeper. If the in-water air or air/oxygen decompression schedule required only a 20-fsw water stop, attempt to compress the diver to 20 fsw. If the schedule required a 30-fsw water stop, attempt to compress the diver to 30 fsw.

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3. **Double Oxygen Periods:**
   Double the number of chamber oxygen periods indicated in the table and have the diver take these periods at the depth he is able to attain. Oxygen time starts when the diver initially goes on oxygen. Interrupt oxygen breathing every 60 minutes with a 15-minute air break, which does not count toward the total oxygen time.
4. **Surface and Monitor:**
   Upon completion of the oxygen breathing periods, surface the diver at 30 fsw/min. Carefully observe the diver post-dive for the onset of decompression sickness.

   Note: The "safe way out" procedure is not intended to replace normal surface decompression procedures. Repetitive diving is not allowed following a dive in which the "safe way out" procedure is used.

9.5.2 Decompression Sickness During the Surface Interval

If symptoms of Type I decompression sickness occur during travel from 40 fsw to the surface or during the surface undress phase, take the following actions:

- **Compress to 50 fsw:**
  Compress the diver to 50 fsw following normal surface decompression procedures. Delay the neurological exam until the diver reaches the 50-fsw stop and is on oxygen.
- **Type I Symptoms Resolve at 50 fsw:**
  If Type I symptoms resolve during the 15-minute 50-fsw stop, the surface interval was 5 minutes or less, and no neurological signs are found, increase the 50 fsw oxygen time from 15 to 30 minutes as outlined above. Then, continue normal decompression for the dive schedule and ascend from 50 to 40 fsw during the subsequent air break.
- **Type I Symptoms Persist or Surface Interval Exceeds 5 Minutes:**
  If Type I symptoms do not resolve during the 15-minute 50-fsw stop or the surface interval was greater than 5 minutes, compress the diver to 60 fsw on oxygen. Treat the diver as follows:
  1. **Treatment Table 5:**
     Use Treatment Table 5 (refer to the U.S. Navy Dive Manual) if the original schedule required 2 or fewer oxygen periods in the chamber.
  2. **Treatment Table 6:**
     Use Treatment Table 6 (refer to the U.S. Navy Dive Manual) if the original schedule required 2.5 or more oxygen periods in the chamber.

     Note: Treatment table time starts upon arrival at 60 fsw. Follow the guidelines for treatment of decompression sickness given in Chapter 20, Volume 5, U.S. Navy Dive Manual.

- **Type II Symptoms:**
  If symptoms of Type II decompression sickness occur during travel from 40 fsw to the surface, during the surface undress phase, or the neurological examination at 50 fsw is abnormal, compress the diver to 60 fsw on oxygen and treat the diver on Treatment Table 6. Treatment table time starts upon arrival at 60 fsw. Follow the guidelines for treatment of decompression sickness as outlined in Chapter 20, Volume 5, U.S. Navy Dive Manual.

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Example:
A SurDO2 schedule calls for two 30-minute oxygen periods in the chamber. The chamber oxygen supply is lost permanently after 28 minutes on oxygen at 50 and 40 fsw, with chamber air as the only gas available. The remaining oxygen time is calculated as follows:

- **Remaining oxygen time:** (2 × 30) – 28 = 32 minutes.
- **The original decompression schedule calls for:** 52 and 140 minutes of in-water air decompression stops at 30 and 20 fsw, totaling 192 minutes.
- **The corresponding oxygen stop times are:** 13 and 34 minutes, totaling 47 minutes.
- **The ratio of air stop time to oxygen stop time is:** 192/47 = 4.08.
- **The remaining chamber air time is:** 32 × 4.08 = 131 minutes, allocated as follows:
  - 13 minutes at 40 fsw (131 × 0.1)
  - 26 minutes at 30 fsw (131 × 0.2)
  - 92 minutes at 20 fsw (131 × 0.7)

This calculation ensures that the diver completes the required decompression using available resources, following established procedures for managing decompression in the absence of oxygen.

9.5.3 CNS Oxygen Toxicity in the Chamber

At the first sign of CNS oxygen toxicity, the diver should be removed from oxygen and allowed to breathe chamber air. Fifteen minutes after all symptoms have completely subsided, resume oxygen breathing at the point of interruption. If symptoms develop again, or if the first symptom is a convulsion, take the following action:

- **Remove the Mask:**
  Immediately remove the diver's oxygen mask.
- **Decompress by 10 Feet:**
  After all symptoms have completely subsided, decompress 10 feet at a rate of 1 fsw/min. For a convulsion, begin the travel when the patient is fully relaxed and breathing normally.
- **Resume Oxygen Breathing:**
  Resume oxygen breathing at the shallower depth at the point of schedule interruption.
- **Complete Decompression on Air if Symptoms Persist:**
  If another oxygen symptom occurs after ascending 10 fsw, complete decompression on chamber air. Compute the remaining chamber time on air as follows:
  - **At 40 fsw:** Allocate 10% of the remaining air time to the 40-fsw stop, 20% to the 30-fsw stop, and 70% to the 20-fsw stop.
  - **At 30 fsw:** Allocate 30% of the remaining time to the 30-fsw stop and 70% to the 20-fsw stop.
  - **Round Stop Times:** Round the stop times to the nearest whole minute. Surface the divers upon completion of the 20-fsw stop.

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9.5.4 Asymptomatic Omitted Decompression

Certain emergencies, such as uncontrolled ascents, an exhausted air supply, or bodily injury may interrupt or prevent required decompression. If the diver shows symptoms of decompression sickness or arterial gas embolism, immediate treatment using the appropriate recompression treatment table is essential. Even if the diver shows no symptoms, omitted decompression must be addressed in some manner to avert later difficulty.

- **Planned Omitted Decompression:**
  This occurs when a condition develops at depth that requires the diver to surface before completing all of the decompression stops. Time is available to consider options, prepare the recompression chamber, and alert personnel.
- **Unplanned Omitted Decompression:**
  This occurs when the diver suddenly appears on the surface without warning or misses decompression for an unforeseen reason.

9.5.5 No-Decompression Stops Required

If a diver makes an uncontrolled ascent to the surface at a rate greater than 30 fsw/min but the dive itself is within no-decompression limits, the diver should be observed on the surface for one hour to ensure that symptoms of decompression sickness or arterial gas embolism do not develop. Recompression is not necessary unless symptoms develop.

9.5.6 Omitted Decompression Stops at 30 and 20 fsw

If the diver omits some or all of the decompression time at 30 and/or 20 fsw, take the following actions:

- **Surface for Less Than One Minute:**
  If the diver is on the surface for less than one minute, return the diver to the depth of the stop from which he came. Increase that stop time by one minute. Resume decompression according to the original schedule.
- **Surface for 1 to 5 Minutes (Chamber Available):**
  If the diver is on the surface for 1 to 5 minutes and a recompression chamber is available on the dive station, place the diver in the recompression chamber and complete the decompression using surface decompression.
    - **Oxygen Time Calculation:**
      If the diver was on oxygen at the time of the omission, compute the number of chamber oxygen periods required by multiplying the remaining oxygen time at the stops by 1.1, dividing the total by 30 minutes, then rounding the result up to the next highest half period.
    - **Air Time Calculation:**
      If the diver was on air at the time of the omission, first compute the equivalent remaining oxygen time at the stop as per the U.S. Navy Dive Manual. Use this time to compute the number of oxygen periods required.
    - **Minimum Requirement:**
      One half period (15 minutes at 50 fsw) is the minimum requirement.

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- **Surface for 5 to 7 Minutes (Chamber Available):**
  If the diver is on the surface for more than 5 minutes but less than or equal to 7 minutes and a recompression chamber is available on the dive station, place the diver in the recompression chamber and complete the decompression using surface decompression as outlined in step 2. Increase the time on oxygen at 50 fsw from 15 to 30 minutes.
- **Surface for More Than 7 Minutes (Chamber Available):**
  If the diver is on the surface for more than 7 minutes and a recompression chamber is available on site, treat the diver with Treatment Table 5 (U.S. Navy Dive Manual) if the surface decompression schedule for that dive required two or fewer oxygen periods in the chamber. Use Treatment Table 6 if the surface decompression schedule required 2.5 or more oxygen periods in the chamber.
- **Surface for More Than 1 Minute (No Chamber Available):**
  If a recompression chamber is not available, return the diver to the depth of the omitted stop. Complete decompression in the water by multiplying the 30- and/or 20-fsw air or oxygen stops by 1.5.

9.5.7 Diver Remaining in the Water

If the diver indicates that he has decompression sickness but feels he can remain in the water:

- **Dispatch Standby Diver:**
  Send a standby diver to assist. Continue to decompress the other divers according to the original schedule.
- **Switch to 100% Oxygen:**
  If the diver is decompressing on air at 30 or 20 fsw, switch the diver to 100% oxygen if available.
- **Descend 10 fsw:**
  Have the diver descend 10 fsw. If significant relief of symptoms is not obtained, have the diver descend an additional 10 fsw, but no deeper than 40 fsw if the diver is on oxygen.
- **Remain at Treatment Depth:**
  Remain at treatment depth for at least 30 minutes.
- **Resume Decompression:**
  If the diver is on air, resume decompression from the treatment depth by multiplying subsequent air or oxygen stop times by 1.5. Insert intervening stops in 10-fsw increments if recompression went deeper than the depth of the first stop on the original schedule.
- **Return to Surface on Oxygen:**
  If the diver is undergoing treatment on oxygen at 40 fsw, return to the surface by multiplying the 30- and 20-fsw oxygen stop times by 1.5. If the original schedule did not call for a 30-fsw oxygen stop, insert a 30-fsw oxygen stop with a time equal to the 20-fsw stop time.
- **Surface Monitoring:**
  If the diver is symptom-free upon surfacing, place the diver on oxygen, transport to the nearest recompression chamber, and treat on Treatment Table 5 (U.S. Navy Dive Manual). If not symptom-free, treat on Treatment Table 6.
- **Surface Interval:**
  If the diving supervisor elects to surface the diver for chamber treatment, ensure the surface interval is 5 minutes or less. Treat the diver as having Type II decompression sickness, even if the symptoms are Type I.

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9.5.8 Diver Leaving the Water

If the diver indicates that he has decompression sickness and feels he cannot safely remain in the water:

- **Surface the Diver:**
  Surface the diver at a moderate rate (not to exceed 30 fsw/min).
- **Recompress Immediately:**
  If a recompression chamber is on site, recompress the diver immediately. Follow the U.S. Navy Dive Manual for treatment table selection and use.
- **No Chamber On Site:**
  If a recompression chamber is not available on site, follow the management guidance provided in the U.S. Navy Dive Manual.

9.5.9 Decompression Sickness in the Water

In rare instances, decompression sickness may develop in the water during prolonged decompression on air or air/oxygen. The predominant symptom will usually be joint pain, but more serious symptoms such as numbness, weakness, hearing loss, and vertigo may also occur. Decompression sickness is most likely to appear at the shallow stops just before surfacing but may occur during ascent to the first stop or shortly thereafter.

Management Considerations:
Managing decompression sickness in the water is challenging. Only general guidance can be presented here, and management decisions must be made on-site, taking into account all known factors. Whenever possible, seek the advice of a diving medical officer.

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SPM ❖ CH.10 | US Navy Air Diving and Treatment Tables

10.1 USN Rev.7 NDL Air Diving and RNT Tables

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
3.0m	10	Unlimited	57	101	158	245	426	*										
4.5m	15	Unlimited	36	60	88	121	163	217	297	449	*							
6.0m	20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
7.6m	25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
9.1m	30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
10.6m	35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
12.1m	40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
13.7m	45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
15.2m	50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
16.7m	55	74	8	14	19	25	31	37	43	50	56	63	71	74				
18.2m	60	63	7	12	17	22	28	33	39	45	51	57	63					
21.3m	70	48	6	10	14	19	23	28	32	37	42	47	48					
24.3m	80	39	5	9	12	16	20	24	28	32	36	39						
27.4m	90	33	4	7	11	14	17	21	24	28	31	33						
30.4m	100	25	4	6	9	12	15	18	21	25								
33.5m	110	20	3	6	8	11	14	16	19	20								
36.5m	120	15	3	5	7	10	12	15										
39.6m	130	12	2	4	6	9	11	12										
42.6m	140	10	2	4	6	8	10											
45.7m	150	8		3	5	7	8											
48.7m	160	7		3	5	6	7											
51.8m	170	6			4	6												
54.8m	180	6			4	5	6											
57.9m	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.

Repetitive Group at Beginning of Surface Interval

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
A	:10 2:20 *															
B	10 1:16	1:17 3:36 *														
C	:10 :55	56 2:11	2:12 4:31 *													
D	:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *												
E	:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *											
F	10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *										
G	:10 :52	53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *									
H	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	6:33 6:32	8:52 *								
I	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:14	6:09 6:08	7:25 7:24	9:44 *							
J	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:14	6:07 6:06	7:01 7:00	8:17 8:16	10:36 *						
K	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *					
L	10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *				
M	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *			
N	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *		
O	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *	
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

Repetitive Group at the End of the Surface Interval

Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
3.0m 10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
4.5m 15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
6.0m 20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
7.6m 25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
9.1m 30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
10.6m 35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
12.1m 40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
13.7m 45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
15.2m 50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
16.7m 55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
18.2m 60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
21.3m 70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
24.3m 80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
27.4m 90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
30.4m 100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
33.5m 110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
36.5m 120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
39.6m 130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
42.6m 140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
45.7m 150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
48.7m 160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
51.8m 170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
54.8m 180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
57.9m 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.

10.2 USN Rev.7 Air Diving Tables

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 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
30 FSW / 9.1 MSW														
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 / 10.6 MSW														
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		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
40 FSW / 12.1 MSW														
163	1:20	AIR									0	1:20	0	O
		AIR/O_2									**0**	1:20		
170	0:40	AIR									6	7:20	0.5	O
		AIR/O_2									**2**	3:20		
180	0:40	AIR									14	15:20	0.5	Z
		AIR/O_2									**5**	6:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
190	0:40	AIR									21	22:20	0.5	Z
		AIR/O_2									**7**	8:20		
200	0:40	AIR									27	28:20	0.5	Z
		AIR/O_2									**9**	10:20		
210	0:40	AIR									39	40:20	0.5	Z
		AIR/O_2									**11**	12:20		
220	0:40	AIR									52	53:20	0.5	Z
		AIR/O_2									**12**	13:20		
230	0:40	AIR									64	65:20	1	Z
		AIR/O_2									**16**	17:20		
240	0:40	AIR									75	76:20	1	Z
		AIR/O_2									**19**	20:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
270	0:40	AIR									101	102:20	1	Z
		AIR/O_2									**26**	27:20		
300	0:40	AIR									128	129:20	1.5	
		AIR/O_2									**33**	34:20		
330	0:40	AIR									160	161:20	1.5	
		AIR/O_2									**38**	44:20		
360	0:40	AIR									184	185:20	2	
		AIR/O_2									**44**	50:20		
420	0:40	AIR									248	249:20	2.5	
		AIR/O_2									**56**	62:20		
480	0:40	AIR									321	322:20	2.5	
		AIR/O_2									**68**	79:20		
Exceptional Exposure: In-Water Air/O_2 Decompression ---------- SurDO_2 Required----------														
540	0:40	AIR									372	373:20	3	
		AIR/O_2									**80**	91:20		
600	0:40	AIR									410	411:20	3.5	
		AIR/O_2									**93**	104:20		
660	0:40	AIR									439	440:20	4	
		AIR/O_2									**103**	119:20		
Exceptional Exposure: SurDO_2 ----------														
720	0:40	AIR									461	462:20	4.5	
		AIR/O_2									**112**	128:20		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
45 FSW / 13.7 MSW														
125	1:30	AIR									0	1:30	0	N
		AIR/O_2									**0**	1:30		
130	0:50	AIR									2	3:30	0.5	O
		AIR/O_2									**1**	2:30		
140	0:50	AIR									14	15:30	0.5	O
		AIR/O_2									**5**	6:30		
In-Water Air/O_2 Decompression or $SurDO_2$ Recommended ----------														
150	0:50	AIR									25	26:30	0.5	Z
		AIR/O_2									**8**	9:30		
160	0:50	AIR									34	35:30	0.5	Z
		AIR/O_2									**11**	12:30		
170	0:50	AIR									41	42:30	1	Z
		AIR/O_2									**14**	15:30		
180	0:50	AIR									59	60:30	1	Z
		AIR/O_2									**17**	18:30		
190	0:50	AIR									75	76:30	1	Z
		AIR/O_2									**19**	20:30		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or $SurDO_2$ Required ----------														
200	0:50	AIR									89	90:30	1	Z
		AIR/O_2									**23**	24:30		
210	0:50	AIR									101	102:30	1	Z
		AIR/O_2									**27**	28:30		
220	0:50	AIR									112	113:30	1.5	Z
		AIR/O_2									**30**	31:30		
230	0:50	AIR									121	122:30	1.5	Z
		AIR/O_2									**33**	34:30		
240	0:50	AIR									130	131:30	1.5	Z
		AIR/O_2									**37**	43:30		
270	0:50	AIR									173	174:30	2	
		AIR/O_2									**45**	51:30		
300	0:50	AIR									206	207:30	2	
		AIR/O_2									**51**	57:30		
330	0:50	AIR									243	244:30	2.5	
		AIR/O_2									**61**	67:30		
360	0:50	AIR									288	289:30	3	
		AIR/O_2									**69**	80:30		
Exceptional Exposure: In-Water $Air/0_2$ Decompression ---------- $SurDO_2$ Required----------														
420	0:50	AIR									373	374:30	3.5	
		AIR/O_2									**84**	95:30		
480	0:50	AIR									431	432:30	4	
		AIR/O_2									**101**	117:30		
Exceptional Exposure: $SurDO_2$ ----------														
540	0:50	AIR									473	474:30	4.5	
		AIR/O_2									**117**	133:30		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
50 FSW / 15.2 MSW														
92	1:40	AIR									0	1:40	0	M
		AIR/O_2									**0**	1:40		
95	1:00	AIR									2	3:40	0.5	M
		AIR/O_2									**1**	2:40		
100	1:00	AIR									4	5:40	0.5	N
		AIR/O_2									**2**	3:40		
110	1:00	AIR									8	9:40	0.5	O
		AIR/O_2									**4**	5:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
120	1:00	AIR									21	22:40	0.5	O
		AIR/O_2									**7**	8:40		
130	1:00	AIR									34	35:40	0.5	Z
		AIR/O_2									**12**	13:40		
140	1:00	AIR									45	46:40	1	Z
		AIR/O_2									**16**	17:40		
150	1:00	AIR									56	57:40	1	Z
		AIR/O_2									**19**	20:40		
160	1:00	AIR									78	79:40	1	Z
		AIR/O_2									**23**	24:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
170	1:00	AIR									96	97:40	1	Z
		AIR/O_2									**26**	27:40		
180	1:00	AIR									111	112:40	1.5	Z
		AIR/O_2									**30**	31:40		
190	1:00	AIR									125	126:40	1.5	Z
		AIR/O_2									**35**	36:40		
200	1:00	AIR									136	137:40	1.5	Z
		AIR/O_2									**39**	45:40		
210	1:00	AIR									147	148:40	2	
		AIR/O_2									**43**	49:40		
220	1:00	AIR									166	167:40	2	
		AIR/O_2									**47**	53:40		
230	1:00	AIR									183	184:40	2	
		AIR/O_2									**50**	56:40		
240	1:00	AIR									198	199:40	2	
		AIR/O_2									**53**	59:40		
270	1:00	AIR									236	237:40	2.5	
		AIR/O_2									**62**	68:40		
300	1:00	AIR									285	286:40	3	
		AIR/O_2									**74**	85:40		
Exceptional Exposure: In-Water Air/O_2 Decompression ---------- SurDO_2 Required----------														
330	1:00	AIR									345	346:40	3.5	
		AIR/O_2									**83**	94:40		
360	1:00	AIR									393	394:40	3.5	
		AIR/O_2									**92**	103:40		
Exceptional Exposure: SurDO_2 ----------														
420	1:00	AIR									464	465:40	4.5	
		AIR/O_2									**113**	129:40		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
55 FSW / 16.7 MSW														
74	1:50	AIR									0	1:50	0	L
		AIR/O_2									**0**	1:50		
75	1:10	AIR									1	2:50	0.5	L
		AIR/O_2									**1**	2:50		
80	1:10	AIR									4	5:50	0.5	M
		AIR/O_2									**2**	3:50		
90	1:10	AIR									10	11:50	0.5	N
		AIR/O_2									**5**	6:50		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
100	1:10	AIR									17	18:50	0.5	O
		AIR/O_2									**8**	9:50		
110	1:10	AIR									34	35:50	0.5	O
		AIR/O_2									**12**	13:50		
120	1:10	AIR									48	49:50	1	Z
		AIR/O_2									**17**	18:50		
130	1:10	AIR									59	60:50	1	Z
		AIR/O_2									**22**	23:50		
140	1:10	AIR									84	85:50	1	Z
		AIR/O_2									**26**	27:50		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
150	1:10	AIR									105	106:50	1.5	Z
		AIR/O_2									**30**	31:50		
160	1:10	AIR									123	124:50	1.5	Z
		AIR/O_2									**34**	35:50		
170	1:10	AIR									138	139:50	1.5	Z
		AIR/O_2									**40**	46:50		
180	1:10	AIR									151	152:50	2	Z
		AIR/O_2									**45**	51:50		
190	1:10	AIR									169	170:50	2	
		AIR/O_2									**50**	56:50		
200	1:10	AIR									190	191:50	2	
		AIR/O_2									**54**	60:50		
210	1:10	AIR									208	209:50	2.5	
		AIR/O_2									**58**	64:50		
220	1:10	AIR									224	225:50	2.5	
		AIR/O_2									**62**	68:50		
230	1:10	AIR									239	240:50	2.5	
		AIR/O_2									**66**	77:50		
240	1:10	AIR									254	255:50	3	
		AIR/O_2									**69**	80:50		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO_2 Required----------														
270	1:10	AIR									313	314:50	3.5	
		AIR/O_2									**83**	94:50		
300	1:10	AIR									380	381:50	3.5	
		AIR/O_2									**94**	105:50		
330	1:10	AIR									432	433:50	4	
		AIR/O_2									**106**	122:50		
Exceptional Exposure: SurDO_2 ----------														
360	1:10	AIR									474	475:50	4.5	
		AIR/O_2									**118**	134:50		

Table 9-9. Air Decompression Table (Continued).

(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 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
60 FSW / 18.2 MSW														
63	2:00	AIR									0	2:00	0	K
		AIR/O_2									**0**	2:00		
65	1:20	AIR									2	4:00	0.5	L
		AIR/O_2									**1**	3:00		
70	1:20	AIR									7	9:00	0.5	L
		AIR/O_2									**4**	6:00		
80	1:20	AIR									14	16:00	0.5	N
		AIR/O_2									**7**	9:00		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
90	1:20	AIR									23	25:00	0.5	O
		AIR/O_2									**10**	12:00		
100	1:20	AIR									42	44:00	1	Z
		AIR/O_2									**15**	17:00		
110	1:20	AIR									57	59:00	1	Z
		AIR/O_2									**21**	23:00		
120	1:20	AIR									75	77:00	1	Z
		AIR/O_2									**26**	28:00		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
130	1:20	AIR									102	104:00	1.5	Z
		AIR/O_2									**31**	33:00		
140	1:20	AIR									124	126:00	1.5	Z
		AIR/O_2									**35**	37:00		
150	1:20	AIR									143	145:00	2	Z
		AIR/O_2									**41**	48:00		
160	1:20	AIR									158	160:00	2	Z
		AIR/O_2									**48**	55:00		
170	1:20	AIR									178	180:00	2	
		AIR/O_2									**53**	60:00		
180	1:20	AIR									201	203:00	2.5	
		AIR/O_2									**59**	66:00		
190	1:20	AIR									222	224:00	2.5	
		AIR/O_2									**64**	71:00		
200	1:20	AIR									240	242:00	2.5	
		AIR/O_2									**68**	80:00		
210	1:20	AIR									256	258:00	3	
		AIR/O_2									**73**	85:00		
220	1:20	AIR									278	280:00	3	
		AIR/O_2									**77**	89:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
230	1:20	AIR									300	302:00	3.5	
		AIR/O_2									**82**	94:00		
240	1:20	AIR									321	323:00	3.5	
		AIR/O_2									**88**	100:00		
270	1:20	AIR									398	400:00	4	
		AIR/O_2									**102**	119:00		
Exceptional Exposure: SurDO$_2$ ----------														
300	1:20	AIR									456	458:00	4.5	
		AIR/O_2									**115**	132:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
70 FSW / 21.3 MSW														
48	2:20	AIR									0	2:20	0	K
		AIR/O_2									**0**	2:20		
50	1:40	AIR									2	4:20	0.5	K
		AIR/O_2									**1**	3:20		
55	1:40	AIR									9	11:20	0.5	L
		AIR/O_2									**5**	7:20		
60	1:40	AIR									14	16:20	0.5	M
		AIR/O_2									**8**	10:20		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
70	1:40	AIR									24	26:20	0.5	N
		AIR/O_2									**13**	15:20		
80	1:40	AIR									44	46:20	1	O
		AIR/O_2									**17**	19:20		
90	1:40	AIR									64	66:20	1	Z
		AIR/O_2									**24**	26:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
100	1:40	AIR									88	90:20	1.5	Z
		AIR/O_2									**31**	33:20		
110	1:40	AIR									120	122:20	1.5	Z
		AIR/O_2									**38**	45:20		
120	1:40	AIR									145	147:20	2	Z
		AIR/O_2									**44**	51:20		
130	1:40	AIR									167	169:20	2	Z
		AIR/O_2									**51**	58:20		
140	1:40	AIR									189	191:20	2.5	
		AIR/O_2									**59**	66:20		
150	1:40	AIR									219	221:20	2.5	
		AIR/O_2									**66**	78:20		
160	1:20	AIR								1	244	247:00	3	
		AIR/O_2								**1**	**72**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
170	1:20	AIR								2	265	269:00	3	
		AIR/O_2								**1**	**78**	91:00		
180	1:20	AIR								4	289	295:00	3.5	
		AIR/O_2								**2**	**83**	97:00		
190	1:20	AIR								5	316	323:00	3.5	
		AIR/O_2								**3**	**88**	103:00		
200	1:20	AIR								9	345	356:00	4	
		AIR/O_2								**5**	**93**	115:00		
210	1:20	AIR								13	378	393:00	4	
		AIR/O_2								**7**	**98**	122:00		
Exceptional Exposure: SurDO$_2$ ----------														
240	1:20	AIR								25	454	481:00	5	
		AIR/O_2								**13**	**110**	140:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
80 FSW / 24.3 MSW														
39	2:40	AIR									0	2:40	0	J
		AIR/O_2									**0**	2:40		
40	2:00	AIR									1	3:40	0.5	J
		AIR/O_2									**1**	3:40		
45	2:00	AIR									10	12:40	0.5	K
		AIR/O_2									**5**	7:40		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
50	2:00	AIR									17	19:40	0.5	M
		AIR/O_2									**9**	11:40		
55	2:00	AIR									24	26:40	0.5	M
		AIR/O_2									**13**	15:40		
60	2:00	AIR									30	32:40	1	N
		AIR/O_2									**16**	18:40		
70	2:00	AIR									54	56:40	1	O
		AIR/O_2									**22**	24:40		
80	2:00	AIR									77	79:40	1.5	Z
		AIR/O_2									**30**	32:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
90	2:00	AIR									114	116:40	1.5	Z
		AIR/O_2									**39**	46:40		
100	1:40	AIR								1	147	150:20	2	Z
		AIR/O_2								**1**	**46**	54:20		
110	1:40	AIR								6	171	179:20	2	Z
		AIR/O_2								**3**	**51**	61:20		
120	1:40	AIR								10	200	212:20	2.5	
		AIR/O_2								**5**	**59**	71:20		
130	1:40	AIR								14	232	248:20	3	
		AIR/O_2								**7**	**67**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
140	1:40	AIR								17	258	277:20	3.5	
		AIR/O_2								**9**	**73**	94:20		
150	1:40	AIR								19	285	306:20	3.5	
		AIR/O_2								**10**	**80**	102:20		
160	1:40	AIR								21	318	341:20	4	
		AIR/O_2								**11**	**86**	114:20		
170	1:40	AIR								27	354	383:20	4	
		AIR/O_2								**14**	**90**	121:20		
Exceptional Exposure: SurDO$_2$ ----------														
180	1:40	AIR								33	391	426:20	4.5	
		AIR/O_2								**17**	**96**	130:20		
210	1:40	AIR								51	473	526:20	5	
		AIR/O_2								**26**	**110**	158:20		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
90 FSW / 27.4 MSW														
33	3:00	AIR									0	3:00	0	J
		AIR/O_2									**0**	3:00		
35	2:20	AIR									4	7:00	0.5	J
		AIR/O_2									**2**	5:00		
40	2:20	AIR									14	17:00	0.5	L
		AIR/O_2									**7**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
45	2:20	AIR									23	26:00	0.5	M
		AIR/O_2									**12**	15:00		
50	2:20	AIR									31	34:00	1	N
		AIR/O_2									**17**	20:00		
55	2:20	AIR									39	42:00	1	O
		AIR/O_2									**21**	24:00		
60	2:20	AIR									56	59:00	1	O
		AIR/O_2									**24**	27:00		
70	2:20	AIR									83	86:00	1.5	Z
		AIR/O_2									**32**	35:00		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
80	2:00	AIR								5	125	132:40	2	Z
		AIR/O_2								**3**	**40**	50:40		
90	2:00	AIR								13	158	173:40	2	Z
		AIR/O_2								**7**	**46**	60:40		
100	2:00	AIR								19	185	206:40	2.5	
		AIR/O_2								**10**	**53**	70:40		
110	2:00	AIR								25	224	251:40	3	
		AIR/O_2								**13**	**61**	86:40		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ---------- SurDO_2 Required----------														
120	1:40	AIR							2	28	256	288:20	3.5	
		AIR/O_2							2	**14**	**70**	98:40		
130	1:40	AIR							5	28	291	326:20	3.5	
		AIR/O_2							5	**14**	**79**	110:40		
140	1:40	AIR							8	28	330	368:20	4	
		AIR/O_2							8	**14**	**87**	126:40		
Exceptional Exposure: SurDO_2 ----------														
150	1:40	AIR							11	34	378	425:20	4.5	
		AIR/O_2							11	**17**	**94**	139:40		
160	1:40	AIR							13	40	418	473:20	4.5	
		AIR/O_2							13	**20**	**101**	151:40		
170	1:40	AIR							15	45	451	513:20	5	
		AIR/O_2							15	**23**	**106**	166:40		
180	1:40	AIR							16	51	479	548:20	5.5	
		AIR/O_2							16	**26**	**112**	176:40		
240	1:40	AIR							42	68	592	704:20	7.5	
		AIR/O_2							42	**34**	**159**	267:40		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
100 FSW / 30.4 MSW														
25	3:20	AIR									0	3:20	0	H
		AIR/O_2									**0**	3:20		
30	2:40	AIR									3	6:20	0.5	J
		AIR/O_2									**2**	5:20		
35	2:40	AIR									15	18:20	0.5	L
		AIR/O_2									**8**	11:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
40	2:40	AIR									26	29:20	1	M
		AIR/O_2									**14**	17:20		
45	2:40	AIR									36	39:20	1	N
		AIR/O_2									**19**	22:20		
50	2:40	AIR									47	50:20	1	O
		AIR/O_2									**24**	27:20		
55	2:40	AIR									65	68:20	1.5	Z
		AIR/O_2									**28**	31:20		
60	2:40	AIR									81	84:20	1.5	Z
		AIR/O_2									**33**	36:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
70	2:20	AIR								11	124	138:00	2	Z
		AIR/O_2								**6**	**39**	53:00		
80	2:20	AIR								21	160	184:00	2.5	Z
		AIR/O_2								**11**	**45**	64:00		
90	2:00	AIR							2	28	196	228:40	2.5	
		AIR/O_2							2	**14**	**53**	82:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO_2 Required----------														
100	2:00	AIR							9	28	241	280:40	3	
		AIR/O_2							9	**14**	**66**	102:00		
110	2:00	AIR							14	28	278	322:40	3.5	
		AIR/O_2							14	**14**	**76**	117:00		
120	2:00	AIR							19	28	324	373:40	4	
		AIR/O_2							19	**14**	**85**	136:00		
Exceptional Exposure: SurDO_2 ----------														
150	1:40	AIR						3	26	46	461	538:20	5	
		AIR/O_2						3	26	**23**	**109**	183:40		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
110 FSW / 33.5 MSW														
20	3:40	AIR									0	3:40	0	H
		AIR/O_2									**0**	3:40		
25	3:00	AIR									5	8:40	0.5	I
		AIR/O_2									**3**	6:40		
30	3:00	AIR									14	17:40	0.5	K
		AIR/O_2									**7**	10:40		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
35	3:00	AIR									27	30:40	1	M
		AIR/O_2									**14**	17:40		
40	3:00	AIR									39	42:40	1	N
		AIR/O_2									**20**	23:40		
45	3:00	AIR									50	53:40	1	O
		AIR/O_2									**26**	29:40		
50	3:00	AIR									71	74:40	1.5	Z
		AIR/O_2									**32**	35:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
55	2:40	AIR								5	85	93:20	1.5	Z
		AIR/O_2								**3**	**33**	44:20		
60	2:40	AIR								13	111	127:20	2	Z
		AIR/O_2								**7**	**36**	51:20		
70	2:40	AIR								26	155	184:20	2.5	Z
		AIR/O_2								**14**	**42**	64:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
80	2:20	AIR							9	28	200	240:00	2.5	
		AIR/O_2							9	**14**	**54**	90:20		
90	2:20	AIR							18	28	249	298:00	3.5	
		AIR/O_2							18	**14**	**68**	113:20		
100	2:20	AIR							25	28	295	351:00	3.5	
		AIR/O_2							25	**14**	**79**	131:20		
110	2:00	AIR						5	26	28	353	414:40	4	
		AIR/O_2						5	26	**14**	**91**	154:00		
Exceptional Exposure: SurDO$_2$ ----------														
120	2:00	AIR						10	26	35	413	486:40	4.5	
		AIR/O_2						10	26	**18**	**101**	173:00		
180	1:40	AIR					3	23	47	68	593	736:20	7.5	
		AIR/O_2					3	23	47	**34**	**159**	298:40		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
120 FSW / 36.5 MSW														
15	4:00	AIR									0	4:00	0	F
		AIR/O_2									**0**	4:00		
20	3:20	AIR									4	8:00	0.5	H
		AIR/O_2									**2**	6:00		
25	3:20	AIR									9	13:00	0.5	J
		AIR/O_2									**5**	9:00		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
30	3:20	AIR									24	28:00	0.5	L
		AIR/O_2									**13**	17:00		
35	3:20	AIR									38	42:00	1	N
		AIR/O_2									**20**	24:00		
40	3:00	AIR								2	49	54:40	1	O
		AIR/O_2								**1**	**26**	30:40		
45	3:00	AIR								3	71	77:40	1.5	Z
		AIR/O_2								**2**	**31**	36:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
50	3:00	AIR								10	85	98:40	1.5	Z
		AIR/O_2								**5**	**33**	46:40		
55	3:00	AIR								19	116	138:40	2	Z
		AIR/O_2								**10**	**35**	53:40		
60	3:00	AIR								27	142	172:40	2	Z
		AIR/O_2								**14**	**39**	61:40		
70	2:40	AIR							13	28	190	234:20	2.5	
		AIR/O_2							13	**14**	**51**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
80	2:40	AIR							24	28	246	301:20	3	
		AIR/O_2							24	**14**	**67**	118:40		
90	2:20	AIR						7	26	28	303	367:00	3.5	
		AIR/O_2						7	26	**14**	**80**	140:20		
100	2:20	AIR						15	25	28	372	443:00	4	
		AIR/O_2						15	25	**14**	**95**	167:20		
Exceptional Exposure: SurDO$_2$ ----------														
110	2:20	AIR						21	25	38	433	520:00	5	
		AIR/O_2						21	25	**19**	**105**	188:20		
120	2:00	AIR					3	23	25	47	480	580:40	5.5	
		AIR/O_2					3	23	25	**24**	**113**	211:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
130 FSW / 39.6 MSW														
12	4:20	AIR									0	4:20	0	F
		AIR/O_2									**0**	4:20		
15	3:40	AIR									3	7:20	0.5	G
		AIR/O_2									**2**	6:20		
20	3:40	AIR									8	12:20	0.5	I
		AIR/O_2									**5**	9:20		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
25	3:40	AIR									17	21:20	0.5	K
		AIR/O_2									**9**	13:20		
30	3:20	AIR								2	32	38:00	1	M
		AIR/O_2								1	**17**	22:00		
35	3:20	AIR								5	44	53:00	1	O
		AIR/O_2								**3**	**23**	30:00		
40	3:20	AIR								6	66	76:00	1.5	Z
		AIR/O_2								**3**	**30**	37:00		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
45	3:00	AIR							1	11	84	99:40	1.5	Z
		AIR/O_2							1	**6**	**33**	49:00		
50	3:00	AIR							2	20	118	143:40	2	Z
		AIR/O_2							2	**10**	**36**	57:00		
55	3:00	AIR							4	28	146	181:40	2	Z
		AIR/O_2							4	**14**	**40**	67:00		
60	3:00	AIR							12	28	170	213:40	2.5	Z
		AIR/O_2							12	**14**	**46**	81:00		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ---------- SurDO$_2$ Required----------														
70	2:40	AIR						1	26	28	235	293:20	3	
		AIR/O_2						1	26	**14**	**63**	117:40		
80	2:40	AIR						12	26	28	297	366:20	3.5	
		AIR/O_2						12	26	**14**	**79**	144:40		
90	2:40	AIR						22	25	28	375	453:20	4	
		AIR/O_2						22	25	**14**	**95**	174:40		
Exceptional Exposure: SurDO$_2$ ----------														
100	2:20	AIR					6	23	26	38	444	540:00	5	
		AIR/O_2					6	23	26	**20**	**106**	204:20		
120	2:20	AIR					17	24	27	57	534	662:00	6	
		AIR/O_2					17	24	27	**29**	**130**	255:20		
180	2:00	AIR				13	21	45	57	94	658	890:40	9	
		AIR/O_2				13	21	45	57	**46**	**198**	418:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
140 FSW / 42.6 MSW														
10	4:40	AIR									0	4:40	0	E
		AIR/O_2									**0**	4:40		
15	4:00	AIR									5	9:40	0.5	H
		AIR/O_2									**3**	7:40		
20	4:00	AIR									13	17:40	0.5	J
		AIR/O_2									**7**	11:40		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended														
25	3:40	AIR								3	24	31:20	1	L
		AIR/O_2								**2**	**12**	18:20		
30	3:40	AIR								7	37	48:20	1	N
		AIR/O_2								**4**	**19**	27:20		
35	3:20	AIR							2	7	58	71:00	1.5	O
		AIR/O_2							2	**4**	**26**	36:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
40	3:20	AIR							4	7	82	97:00	1.5	Z
		AIR/O_2							4	**4**	**33**	50:20		
45	3:20	AIR							5	18	114	141:00	2	Z
		AIR/O_2							5	**9**	**36**	59:20		
50	3:20	AIR							8	27	145	184:00	2	Z
		AIR/O_2							8	**14**	**39**	70:20		
55	3:00	AIR						1	15	29	171	219:40	2.5	Z
		AIR/O_2						1	15	**15**	**45**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
60	3:00	AIR						2	23	28	209	265:40	3	
		AIR/O_2						2	23	**14**	**56**	109:00		
70	3:00	AIR						14	25	29	276	347:40	3.5	
		AIR/O_2						14	25	**15**	**74**	142:00		
80	2:40	AIR					2	24	25	29	362	445:20	4	
		AIR/O_2					2	24	25	**15**	**91**	175:40		
Exceptional Exposure: SurDO$_2$ ----------														
90	2:40	AIR					12	23	26	38	443	545:20	5	
		AIR/O_2					12	23	26	**19**	**107**	210:40		

Table 9-9. Air Decompression Table (Continued).

(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 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
150 FSW / 45.7 MSW														
8	5:00	AIR									0	5:00	0	E
		AIR/O_2									**0**	5:00		
10	4:20	AIR									2	7:00	0.5	F
		AIR/O_2									**1**	6:00		
15	4:20	AIR									8	13:00	0.5	H
		AIR/O_2									**5**	10:00		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended														
20	4:00	AIR								2	15	21:40	0.5	K
		AIR/O_2								1	**8**	13:40		
25	4:00	AIR								7	29	40:40	1	M
		AIR/O_2								**4**	**14**	22:40		
30	3:40	AIR							4	7	45	60:20	1.5	O
		AIR/O_2							4	**4**	**22**	34:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
35	3:40	AIR							6	7	74	91:20	1.5	Z
		AIR/O_2							6	**4**	**30**	44:40		
40	3:20	AIR						2	6	14	106	132:00	2	Z
		AIR/O_2						2	6	**7**	**35**	59:20		
45	3:20	AIR						3	8	24	142	181:00	2	Z
		AIR/O_2						3	8	**12**	**40**	72:20		
50	3:20	AIR						4	14	28	170	220:00	2.5	Z
		AIR/O_2						4	14	**14**	**46**	87:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
55	3:20	AIR						7	21	28	212	272:00	3	
		AIR/O_2						7	21	**14**	**57**	113:20		
60	3:20	AIR						11	26	28	248	317:00	3	
		AIR/O_2						11	26	**14**	**67**	132:20		
70	3:00	AIR					3	24	25	28	330	413:40	4	
		AIR/O_2					3	24	25	**14**	**85**	170:00		
Exceptional Exposure: SurDO$_2$ ----------														
80	3:00	AIR					15	23	26	35	430	532:40	4.5	
		AIR/O_2					15	23	26	**18**	**104**	205:00		
90	2:40	AIR				3	22	23	26	47	496	620:20	5.5	
		AIR/O_2				3	22	23	26	**24**	**118**	239:40		
120	2:20	AIR			3	20	22	23	50	75	608	804:00	8	
		AIR/O_2			3	20	22	23	50	**37**	**168**	356:20		
180	2:00	AIR		2	19	20	42	48	79	121	694	1027:40	10.5	
		AIR/O_2		2	19	20	42	48	79	**58**	**222**	538:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
160 FSW / 48.7 MSW														
7	5:20	AIR									0	5:20	0	E
		AIR/O_2									**0**	5:20		
10	4:40	AIR									4	9:20	0.5	F
		AIR/O_2									**2**	7:20		
15	4:20	AIR								2	10	17:00	0.5	I
		AIR/O_2								**1**	**6**	12:00		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended ----------														
20	4:00	AIR							1	4	19	28:40	0.5	L
		AIR/O_2							1	**2**	**10**	18:00		
25	4:00	AIR							4	7	35	50:40	1	N
		AIR/O_2							4	**4**	**17**	30:00		
30	3:40	AIR						2	6	7	62	81:20	1.5	Z
		AIR/O_2						2	6	**4**	**26**	42:40		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required ----------														
35	3:40	AIR						4	6	8	89	111:20	1.5	Z
		AIR/O_2						4	6	**4**	**34**	57:40		
40	3:40	AIR						6	6	21	134	171:20	2	Z
		AIR/O_2						6	6	**11**	**38**	70:40		
45	3:20	AIR					2	5	11	28	166	216:00	2.5	Z
		AIR/O_2					2	5	11	**14**	**45**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required----------														
50	3:20	AIR					2	8	19	28	207	268:00	3	
		AIR/O_2					2	8	19	**15**	**55**	113:20		
55	3:20	AIR					3	11	26	28	248	320:00	3	
		AIR/O_2					3	11	26	**14**	**67**	135:20		
60	3:20	AIR					6	17	25	29	291	372:00	3.5	
		AIR/O_2					6	17	25	**15**	**77**	154:20		
Exceptional Exposure: SurDO$_2$ ----------														
70	3:20	AIR					15	23	26	29	399	496:00	4.5	
		AIR/O_2					15	23	26	**15**	**99**	197:20		
80	3:00	AIR				6	21	24	25	44	482	605:40	5.5	
		AIR/O_2				6	21	24	25	**23**	**114**	237:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
170 FSW / 51.8 MSW														
6	5:40	AIR									0	5:40	0	D
		AIR/O_2									**0**	5:40		
10	5:00	AIR									6	11:40	0.5	G
		AIR/O_2									**3**	8:40		
In-Water Air/O_2 Decompression or SurDO$_2$ Recommended														
15	4:40	AIR								3	13	21:20	0.5	J
		AIR/O_2								2	**6**	13:20		
20	4:20	AIR							3	6	24	38:00	1	M
		AIR/O_2							3	**3**	**12**	23:20		
25	4:00	AIR						1	7	7	41	60:40	1	O
		AIR/O_2						1	7	**4**	**20**	37:00		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO$_2$ Required														
30	4:00	AIR						5	7	7	77	100:40	1.5	Z
		AIR/O_2						5	7	**3**	**30**	50:00		
35	3:40	AIR					2	6	6	15	120	153:20	2	Z
		AIR/O_2					2	6	6	**8**	**37**	68:40		
40	3:40	AIR					4	6	9	25	158	206:20	2.5	Z
		AIR/O_2					4	6	9	**12**	**44**	84:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO$_2$ Required														
45	3:40	AIR					5	7	16	28	197	257:20	2.5	Z
		AIR/O_2					5	7	16	**14**	**53**	109:40		
50	3:20	AIR				1	5	11	23	28	244	316:00	3	
		AIR/O_2				1	5	11	23	**14**	**66**	134:20		
55	3:20	AIR				2	7	16	26	28	289	372:00	3.5	
		AIR/O_2				2	7	16	26	**14**	**77**	156:20		
60	3:20	AIR				2	11	21	26	28	344	436:00	4	
		AIR/O_2				2	11	21	26	**14**	**88**	181:20		
Exceptional Exposure: SurDO$_2$														
70	3:20	AIR				7	19	24	25	39	454	572:00	5	
		AIR/O_2				7	19	24	25	**20**	**109**	228:20		
80	3:20	AIR				17	22	23	26	53	525	670:00	6	
		AIR/O_2				17	22	23	26	**27**	**128**	267:20		
90	3:00	AIR			8	19	22	23	37	66	574	752:40	7	
		AIR/O_2			8	19	22	23	37	**33**	**148**	319:00		
120	2:40	AIR		9	19	20	22	42	60	94	659	928:20	9	
		AIR/O_2		9	19	20	22	42	60	**46**	**198**	454:40		
180	2:20	AIR	10	18	19	40	43	70	97	156	703	1159:00	11.5	
		AIR/O_2	10	18	19	40	43	70	97	**74**	**229**	648:00		

Table 9-9. Air Decompression Table (Continued).

(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** 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
180 FSW / 54.8 MSW														
6	6:00	AIR									0	6:00	0	E
		AIR/O_2									**0**	6:00		
10	5:20	AIR									8	14:00	0.5	G
		AIR/O_2									**4**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ----------														
15	4:40	AIR							2	3	14	24:20	0.5	K
		AIR/O_2							2	**2**	**7**	16:40		
20	4:20	AIR						1	5	7	29	47:00	1	M
		AIR/O_2						1	5	**3**	**15**	29:20		
25	4:20	AIR						5	6	7	57	80:00	1.5	O
		AIR/O_2						5	6	**4**	**24**	44:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or SurDO_2 Required ----------														
30	4:00	AIR					3	6	6	7	95	121:40	1.5	Z
		AIR/O_2					3	6	6	**4**	**34**	63:00		
35	3:40	AIR				1	5	6	6	22	144	188:20	2	Z
		AIR/O_2				1	5	6	6	**11**	**41**	79:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ---------- SurDO_2 Required----------														
40	3:40	AIR				2	6	5	13	28	178	236:20	2.5	
		AIR/O_2				2	6	5	13	**14**	**48**	97:40		
45	3:40	AIR				4	5	10	20	28	235	306:20	3	
		AIR/O_2				4	5	10	20	**14**	**63**	130:40		
50	3:40	AIR				4	8	13	25	29	277	360:20	3.5	
		AIR/O_2				4	8	13	25	**15**	**75**	154:40		
55	3:40	AIR				5	11	19	26	28	336	429:20	4	
		AIR/O_2				5	11	19	26	**14**	**87**	181:40		
Exceptional Exposure: SurDO_2 ----------														
60	3:20	AIR		1	8	13	23	25	31	406		511:00	4.5	
		AIR/O_2		1	8	13	23	25	**16**	**100**		205:20		
70	3:20	AIR	4	12	21	24	25	48	499			637:00	5.5	
		AIR/O_2	4	12	21	24	25	**24**	**119**			253:20		

Table 9-9. Air Decompression Table (Continued).

(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 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
190 FSW / 57.9 MSW														
5	6:20	AIR									0	6:20	0	D
		AIR/O_2									**0**	6:20		
10	5:20	AIR								2	8	16:00	0.5	H
		AIR/O_2								1	**4**	11:00		
In-Water Air/O_2 Decompression or $SurDO_2$ Recommended ----------														
15	4:40	AIR						1	3	3	16	28:20	0.5	K
		AIR/O_2						1	3	**2**	**8**	19:40		
20	4:20	AIR					1	2	6	7	34	55:00	1	N
		AIR/O_2					1	2	6	**4**	**17**	35:20		
Exceptional Exposure: In-Water Air Decompression ---------- In-Water Air/O_2 Decompression or $SurDO_2$ Required ----------														
25	4:20	AIR					2	6	7	7	72	99:00	1.5	Z
		AIR/O_2					2	6	7	**3**	**28**	51:20		
30	4:00	AIR				1	6	5	7	13	122	158:40	2	Z
		AIR/O_2				1	6	5	7	**7**	**38**	74:00		
Exceptional Exposure: In-Water $Air/0_2$ Decompression ---------- $SurDO_2$ Required----------														
35	4:00	AIR				4	5	6	8	26	165	218:40	2.5	Z
		AIR/O_2				4	5	6	8	**13**	**45**	91:00		
40	3:40	AIR			1	5	5	8	17	28	217	285:20	3	
		AIR/O_2			1	5	5	8	17	**15**	**58**	123:40		
45	3:40	AIR			2	5	6	12	24	29	264	346:20	3.5	
		AIR/O_2			2	5	6	12	24	**15**	**71**	149:40		
50	3:40	AIR			3	5	10	17	26	28	324	417:20	4	
		AIR/O_2			3	5	10	17	26	**14**	**85**	179:40		
Exceptional Exposure: SurDO2 ----------														
55	3:40	AIR			4	8	10	24	25	30	397	502:20	4.5	
		AIR/O_2			4	8	10	24	25	**15**	**99**	204:40		
60	3:40	AIR			5	10	16	24	25	40	454	578:20	5	
		AIR/O_2			5	10	16	24	25	**20**	**109**	233:40		
90	3:20	AIR		11	19	20	21	28	51	83	626	863:00	8.5	
		AIR/O_2		11	19	20	21	28	51	**41**	**178**	408:20		
120	3:00	AIR	15	17	19	20	37	46	79	113	691	1040:40	10.5	
		AIR/O_2	15	17	19	20	37	46	79	**55**	**219**	551:00		

Table 9-9. Air Decompression Table (Continued).

(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 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
200 FSW / 60.9 MSW														
Exceptional Exposure ----------														
5	6:40	AIR									0	6:40	0	E
		AIR/O_2									**0**	6:40		
10	5:40	AIR								3	8	17:20	0.5	H
		AIR/O_2								**2**	**4**	12:20		
15	5:00	AIR						2	3	5	19	34:40	0.5	L
		AIR/O_2						2	3	**3**	**9**	23:00		
20	4:40	AIR					2	4	6	7	43	67:20	1	O
		AIR/O_2					2	4	6	**4**	**20**	41:40		
25	4:20	AIR				1	5	6	6	7	85	115:00	1.5	Z
		AIR/O_2				1	5	6	6	**4**	**32**	64:20		
30	4:20	AIR				4	6	5	7	19	145	191:00	2	Z
		AIR/O_2				4	6	5	7	**10**	**42**	84:20		
35	4:00	AIR			2	5	5	6	13	28	188	251:40	2.5	
		AIR/O_2			2	5	5	6	13	**14**	**51**	106:00		
40	4:00	AIR			4	5	5	11	21	28	249	327:40	3.5	
		AIR/O_2			4	5	5	11	21	**14**	**68**	143:00		
45	3:40	AIR		1	4	5	10	14	25	28	306	397:20	3.5	
		AIR/O_2		1	4	5	10	14	25	**14**	**81**	168:40		
50	3:40	AIR		2	4	8	10	21	26	28	382	485:20	4.5	
		AIR/O_2		2	4	8	10	21	26	**14**	**97**	201:40		
210 FSW / 64.0 MSW														
Exceptional Exposure ----------														
4	7:00	AIR									0	7:00	0	D
		AIR/O_2									**0**	7:00		
5	6:20	AIR									2	9:00	0.5	E
		AIR/O_2									**1**	8:00		
10	5:40	AIR							2	3	9	20:20	0.5	I
		AIR/O_2							2	**2**	**4**	14:40		
15	5:00	AIR					1	3	3	6	24	42:40	1	M
		AIR/O_2					1	3	3	**3**	**12**	28:00		
20	4:40	AIR				1	3	5	6	7	57	84:20	1	O
		AIR/O_2				1	3	5	6	**4**	**23**	47:40		
25	4:40	AIR				3	6	5	7	8	110	144:20	2	Z
		AIR/O_2				3	6	5	7	**4**	**38**	73:40		
30	4:20	AIR			2	5	6	6	6	26	163	219:00	2.5	Z
		AIR/O_2			2	5	6	6	6	**13**	**45**	93:20		
35	4:00	AIR		1	4	5	6	7	18	28	223	296:40	3	
		AIR/O_2		1	4	5	6	7	18	**14**	**60**	130:00		
40	4:00	AIR		2	5	5	7	11	26	28	278	366:40	3.5	
		AIR/O_2		2	5	5	7	11	26	**14**	**76**	161:00		
45	4:00	AIR		4	4	6	11	18	26	28	355	456:40	4	
		AIR/O_2		4	4	6	11	18	26	**14**	**91**	194:00		
50	3:40	AIR	1	4	5	10	12	23	26	36	432	553:20	5	
		AIR/O_2	1	4	5	10	12	23	26	**18**	**105**	223:40		

Table 9-9. Air Decompression Table (Continued).
(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 130	120	110	100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
220 FSW / 67.0 MSW																	
Exceptional Exposure																	
4	7:20	AIR												0	7:20	0	E
		AIR/O_2												**0**	7:20		
5	6:40	AIR												3	10:20	0.5	E
		AIR/O_2												**2**	9:20		
10	6:00	AIR										3	4	10	23:40	0.5	J
		AIR/O_2										3	**2**	**5**	17:00		
15	5:20	AIR								3	2	4	7	28	50:00	1	N
		AIR/O_2								3	2	4	**4**	**14**	33:20		
20	5:00	AIR							2	4	6	6	7	70	100:40	1.5	Z
		AIR/O_2							2	4	6	6	**4**	**26**	54:00		
25	4:40	AIR						1	5	6	6	6	14	133	176:20	2	Z
		AIR/O_2						1	5	6	6	6	**7**	**41**	82:40		
30	4:20	AIR					1	4	5	6	6	10	28	183	248:00	2.5	
		AIR/O_2					1	4	5	6	6	10	**14**	**50**	106:20		
35	4:20	AIR					3	5	5	5	10	22	28	251	334:00	3.5	
		AIR/O_2					3	5	5	5	10	22	**14**	**68**	147:20		
40	4:00	AIR				1	4	5	5	9	15	26	28	319	416:40	4	
		AIR/O_2				1	4	5	5	9	15	26	**14**	**84**	183:00		
250 FSW / 76.2 MSW																	
Exceptional Exposure																	
4	7:40	AIR												4	12:20	0.5	F
		AIR/O_2												**2**	10:20		
5	7:40	AIR												7	15:20	0.5	G
		AIR/O_2												**4**	12:20		
10	6:20	AIR								2	2	4	3	15	33:00	0.5	L
		AIR/O_2								2	2	4	**2**	**7**	24:20		
15	5:40	AIR						2	2	3	4	6	7	53	83:20	1	O
		AIR/O_2						2	2	3	4	6	**4**	**22**	49:40		
20	5:20	AIR					2	2	4	6	6	6	11	125	168:00	2	Z
		AIR/O_2					2	2	4	6	6	6	**6**	**39**	82:20		
25	5:00	AIR				1	4	4	5	6	6	10	28	189	258:40	2.5	
		AIR/O_2				1	4	4	5	6	6	10	**14**	**51**	112:00		
30	4:40	AIR			1	4	4	4	5	6	9	25	28	267	358:20	3.5	
		AIR/O_2			1	4	4	4	5	6	9	25	**15**	**72**	160:40		
35	4:40	AIR			3	4	4	5	5	10	19	26	28	363	472:20	4	
		AIR/O_2			3	4	4	5	5	10	19	26	**14**	**93**	203:40		

10.3 US Navy Treatment Flowcharts

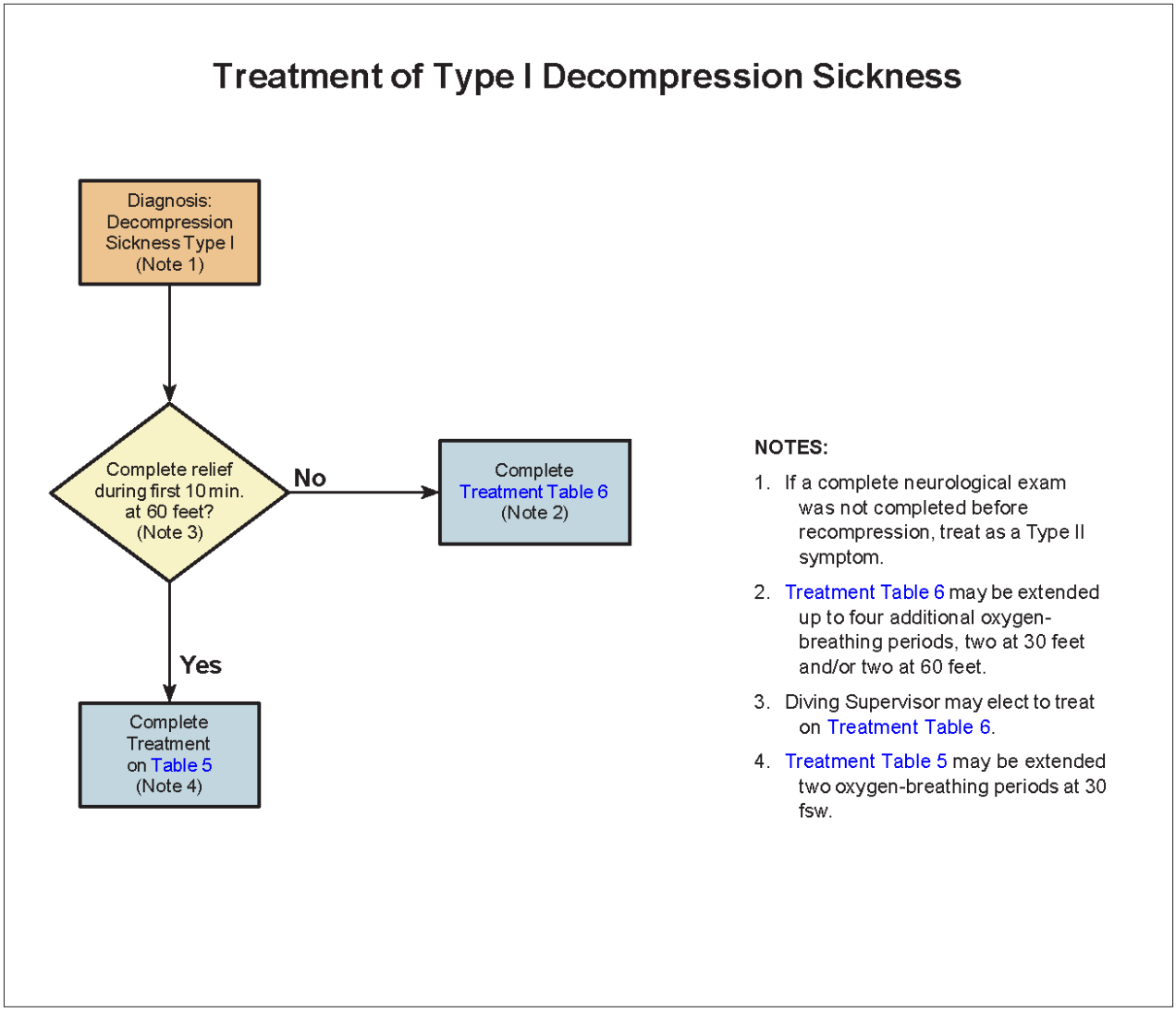


Figure 17-2. Treatment of Type I Decompression Sickness.

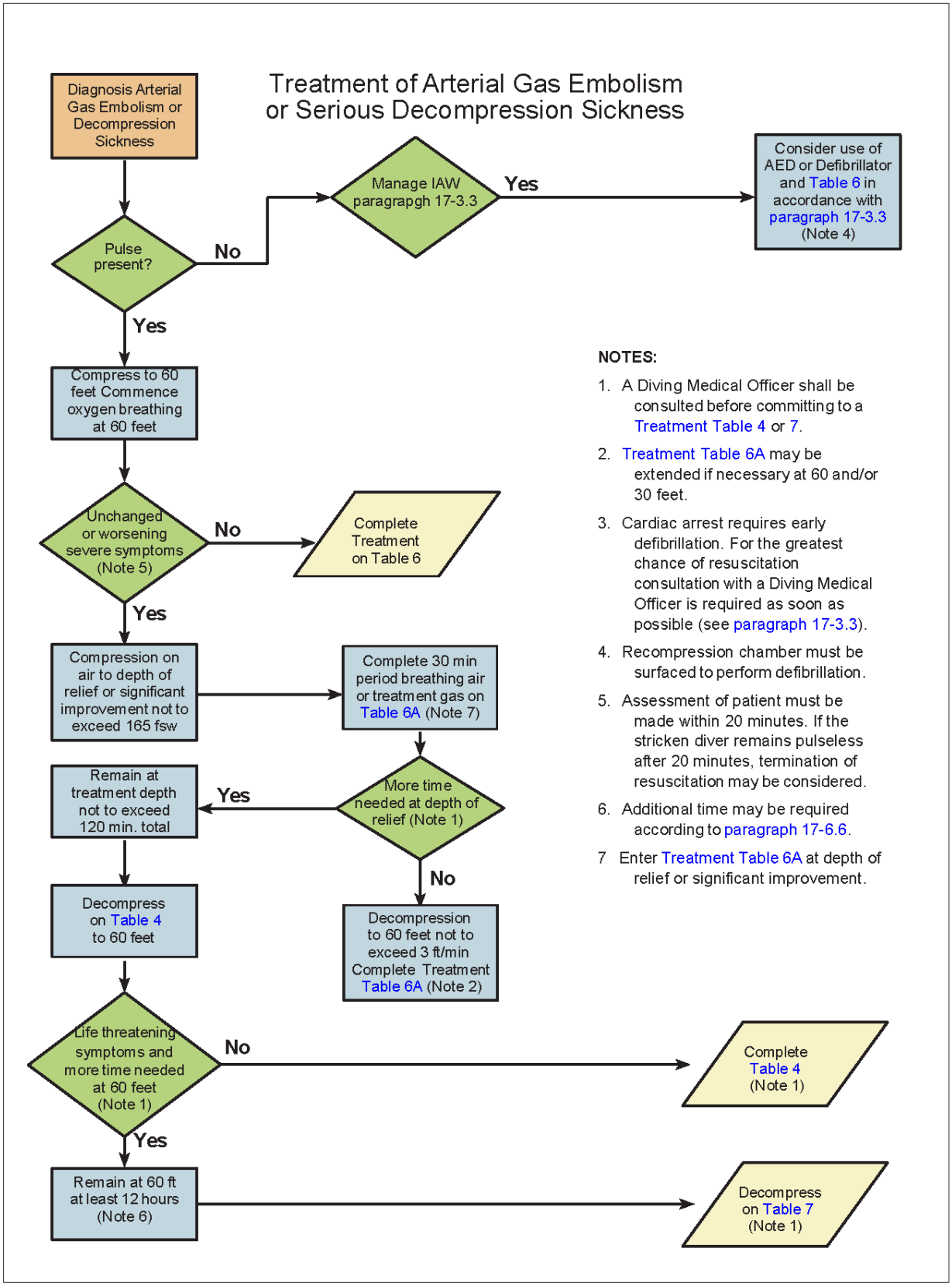


Figure 17-1. Treatment of Arterial Gas Embolism or Serious Decompression Sickness.

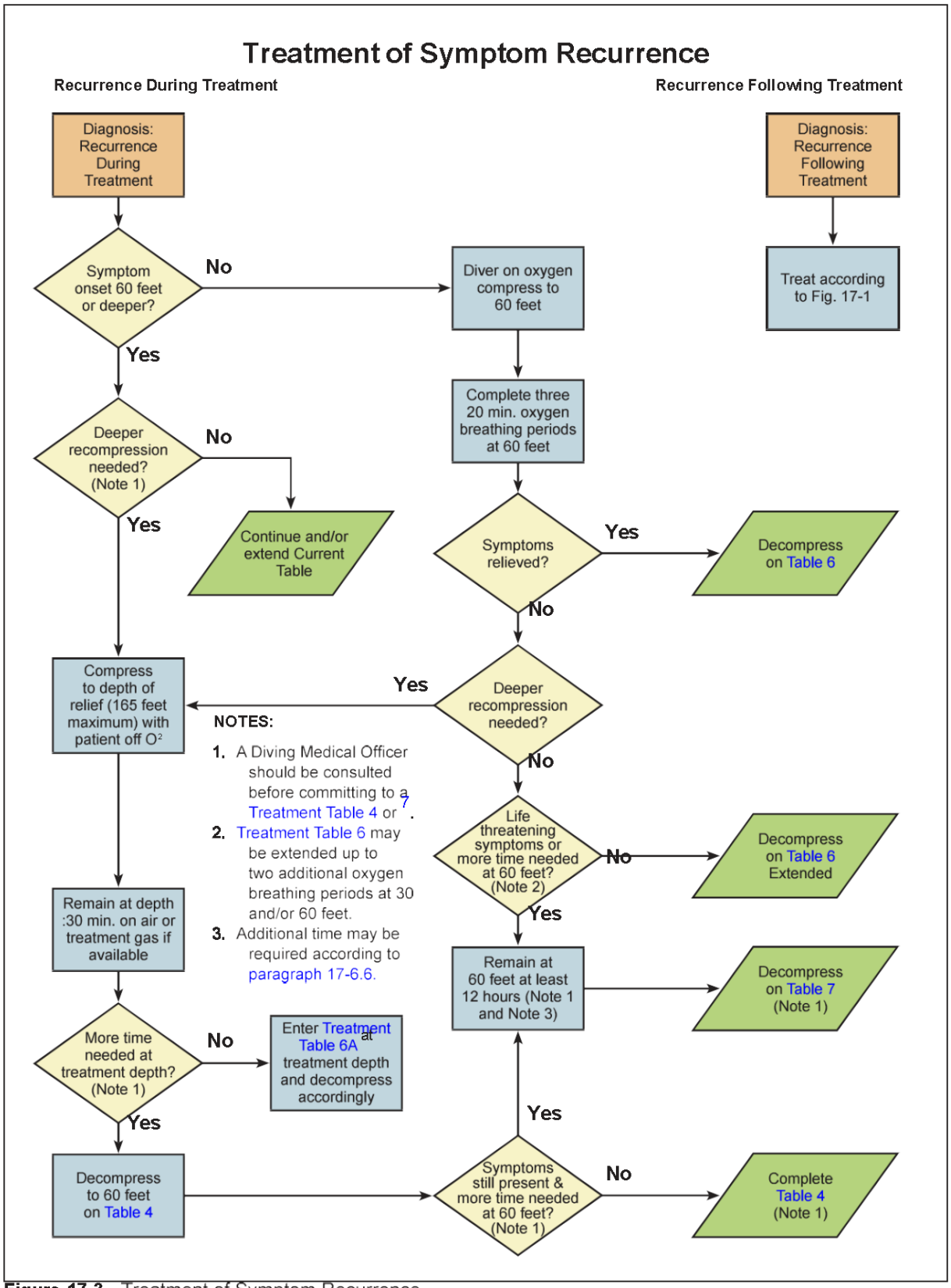


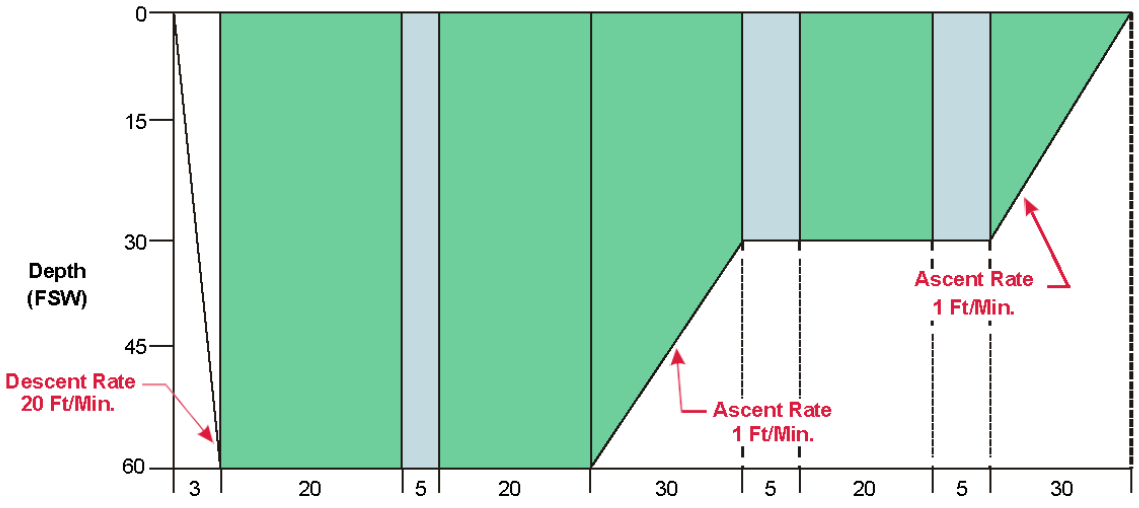
Figure 17-3. Treatment of Symptom Recurrence.

10.4 US Navy Treatment Tables

Treatment Table 5

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1)
5. Treatment Table may be extended two oxygen-breathing periods at the 30-foot stop. No air break required between oxygen-breathing periods or prior to ascent.
6. Tender breathes 100 percent O_2 during ascent from the 30-foot stop to the surface. If the tender had a previous hyperbaric exposure in the previous 18 hours, an additional 20 minutes of oxygen breathing is required prior to ascent.

Treatment Table 5 Depth/Time Profile

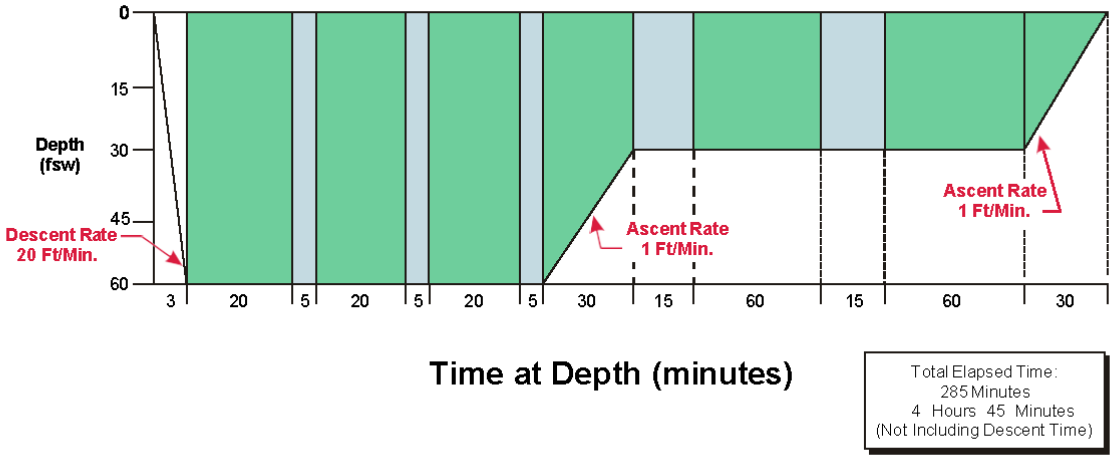


Total Elapsed Time:
135 Minutes
2 Hours 15 Minutes
(Not Including Descent Time)

Treatment Table 6

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1).
5. Table 6 can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (15 minutes on air and 60 minutes on oxygen), or both.
6. Tender breathes 100 percent O_2 during the last 30 min. at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 feet. If there has been more than one extension, the O_2 breathing at 30 feet is increased to 60 minutes. If the tender had a hyperbaric exposure within the past 18 hours an additional 60-minute O_2 period is taken at 30 feet.

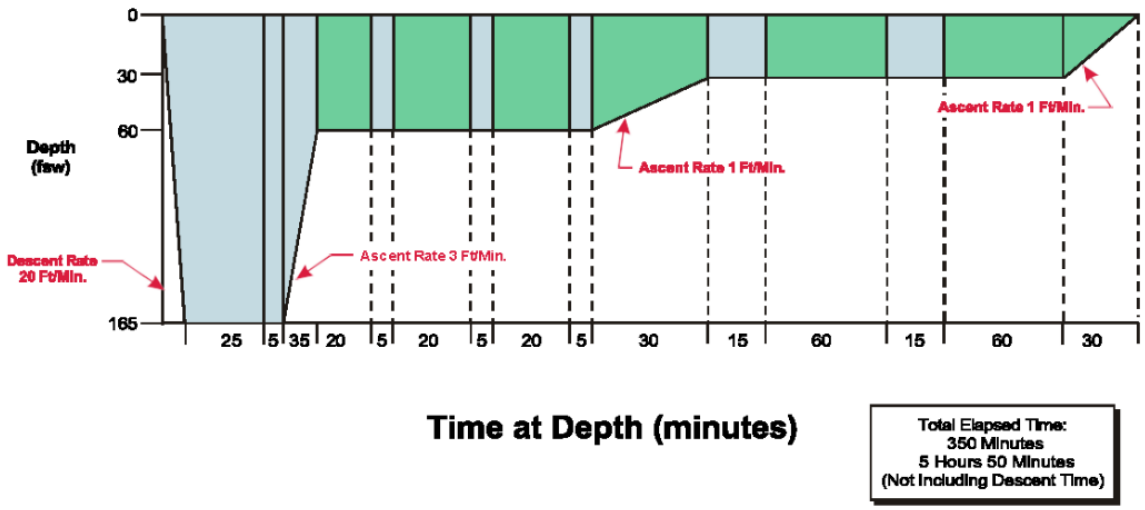
Treatment Table 6 Depth/Time Profile



Treatment Table 6A

1. Descent rate - 20 ft/min.
2. Ascent rate - 165 fsw to 60 fsw not to exceed 3 ft/min, 60 fsw and shallower, not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time at treatment depth does not include compression time.
4. Table begins with initial compression to depth of 60 fsw. If initial treatment was at 60 feet, up to 20 minutes may be spent at 60 feet before compression to 165 fsw. Contact a Diving Medical Officer.
5. If a chamber is equipped with a high-O_2 treatment gas, it may be administered at 165 fsw and shallower, not to exceed 3.0 ata O_2 in accordance with paragraph 17-8.9. Treatment gas is administered for 25 minutes interrupted by 5 minutes of air. Treatment gas is breathed during ascent from the treatment depth to 60 fsw.
6. Deeper than 60 feet, if treatment gas must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided before resuming treatment gas. The time off treatment gas is counted as part of the time at treatment depth. If at 60 feet or shallower and oxygen breathing must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1).
7. Table 6A can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (60 minutes on oxygen and 15 minutes on air), or both.
8. Tender breathes 100 percent O_2 during the last 60 minutes at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 fsw. If there has been more than one extension, the O_2 breathing at 30 fsw is increased to 90 minutes. If the tender had a hyperbaric exposure within the past 18 hours, an additional 60 minute O_2 breathing period is taken at 30 fsw.
9. If significant improvement is not obtained within 30 minutes at 165 feet, consult with a Diving Medical Officer before switching to Treatment Table 4.

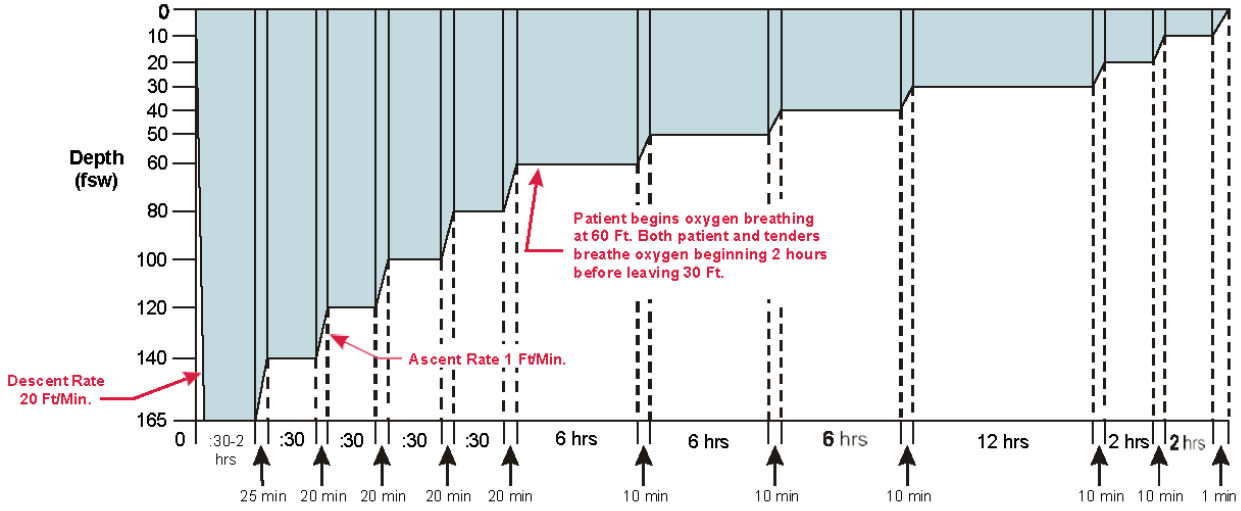
Treatment Table 6A Depth/Time Profile



Treatment Table 4

1. Descent rate - 20 ft/min.
2. Ascent rate - 1 ft/min.
3. Time at 165 feet includes compression.
4. If only air is available, decompress on air. If oxygen is available, patient begins oxygen breathing upon arrival at 60 feet with appropriate air breaks. Both tender and patient breathe oxygen beginning 2 hours before leaving 30 feet. (see paragraph 17-6.5).
5. Ensure life-support considerations can be met before committing to a Table 4. (see paragraph 17-8.10.1.1) Internal chamber temperature should be below 85° F.
6. If oxygen breathing is interrupted, no compensatory lengthening of the table is required.
7. If switching from Treatment Table 6A or 3 at 165 feet, stay a maximum of 2 hours at 165 feet before decompressing.
8. If the chamber is equipped with a high-O_2 treatment gas, it may be administered at 165 fsw, not to exceed 3.0 ata O_2. Treatment gas is administered for 25 minutes interrupted by 5 minutes of air.

Treatment Table 4 Depth/Time Profile

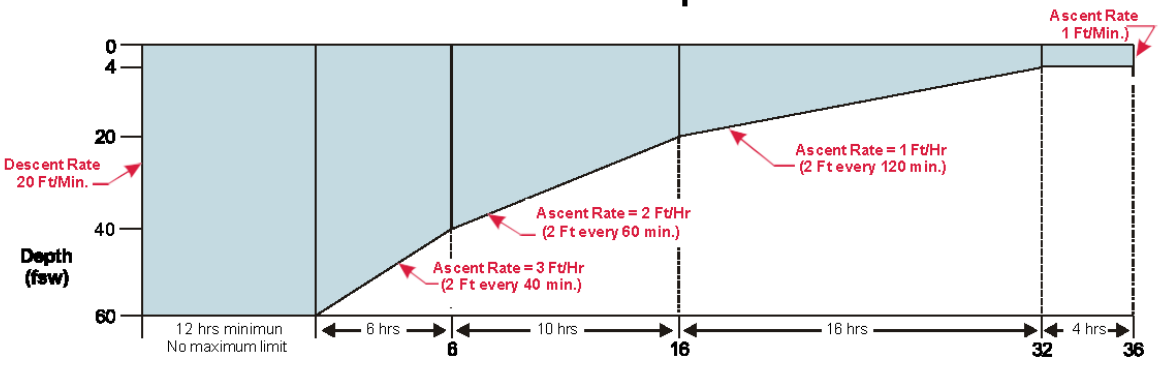


Total Elapsed Time:
39 Hours 6 Minutes
(30 Minutes at 165 fsw) to
40 Hours 36 Minutes
(2 Hours at 165 fsw)

Treatment Table 7

1. Table begins upon arrival at 60 feet. Arrival at 60 feet is accomplished by initial treatment on Table 6, 6A or 4. If initial treatment has progressed to a depth shallower than 60 feet, compress to 60 feet at 20 ft/min to begin Table 7.
2. Maximum duration at 60 feet is unlimited. Remain at 60 feet a minimum of 12 hours unless overriding circumstances dictate earlier decompression.
3. Patient begins oxygen breathing periods at 60 feet. Tender need breathe only chamber atmosphere throughout. If oxygen breathing is interrupted, no lengthening of the table is required.
4. Minimum chamber O_2 concentration is 19 percent. Maximum CO_2 concentration is 1.5 percent SEV (11.4 mmHg). Maximum chamber internal temperature is 85°F (paragraph 17-6.5).
5. Decompression starts with a 2-foot upward excursion from 60 to 58 feet. Decompress with stops every 2 feet for times shown in profile below. Ascent time between stops is approximately 30 seconds. Stop time begins with ascent from deeper to next shallower step. Stop at 4 feet for 4 hours and then ascend to the surface at 1 ft/min.
6. Ensure chamber life-support requirements can be met before committing to a Treatment Table 7.
7. A Diving Medical Officer should be consulted before committing to this treatment table.

Treatment Table 7 Depth/Time Profile



Time at Depth (hours)

10.5 Spare US Navy NDL and RNT Tables

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
3.0m	10	Unlimited	57	101	158	245	426	*										
4.5m	15	Unlimited	36	60	88	121	163	217	297	449	*							
6.0m	20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
7.6m	25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
9.1m	30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
10.6m	35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
12.1m	40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
13.7m	45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
15.2m	50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
16.7m	55	74	8	14	19	25	31	37	43	50	56	63	71	74				
18.2m	60	63	7	12	17	22	28	33	39	45	51	57	63					
21.3m	70	48	6	10	14	19	23	28	32	37	42	47	48					
24.3m	80	39	5	9	12	16	20	24	28	32	36	39						
27.4m	90	33	4	7	11	14	17	21	24	28	31	33						
30.4m	100	25	4	6	9	12	15	18	21	25								
33.5m	110	20	3	6	8	11	14	16	19	20								
36.5m	120	15	3	5	7	10	12	15										
39.6m	130	12	2	4	6	9	11	12										
42.6m	140	10	2	4	6	8	10											
45.7m	150	8		3	5	7	8											
48.7m	160	7		3	5	6	7											
51.8m	170	6			4	6												
54.8m	180	6			4	5	6											
57.9m	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.

Repetitive Group at Beginning of Surface Interval

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
A	:10	2:20 *															
B	10	1:17	3:36 *														
C	:10	56	2:12	4:31 *													
D	:10	:53	1:48	3:04	5:23 *												
E	:10	:53	1:45	2:40	3:56	6:15 *											
F	10	:53	1:45	2:38	3:32	4:49	7:08 *										
G	:10	53	1:45	2:38	3:30	4:24	5:41	8:00 *									
H	:10	:53	1:45	2:37	3:30	4:22	5:17	6:33	8:52 *								
I	:10	:53	1:45	2:38	3:30	4:22	5:14	6:09	7:25	9:44 *							
J	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	7:01	8:17	10:36 *						
K	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:53	9:10	11:29 *					
L	10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:45	10:02	12:21 *				
M	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:38	10:54	13:13 *			
N	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:30	11:46	14:05 *		
O	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:28	11:22	12:38	14:58 *	
Z	:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:28	11:20	12:14	13:31	15:50 *

Dive Depth	Repetitive Group at the End of the Surface Interval: Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
3.0m 10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
4.5m 15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
6.0m 20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
7.6m 25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
9.1m 30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
10.6m 35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
12.1m 40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
13.7m 45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
15.2m 50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
16.7m 55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
18.2m 60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
21.3m 70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
24.3m 80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
27.4m 90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
30.4m 100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
33.5m 110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
36.5m 120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
39.6m 130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
42.6m 140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
45.7m 150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
48.7m 160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
51.8m 170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
54.8m 180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
57.9m 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.