Appendix P – Conductor Casing

Narrative for HDD / Conductor Casing Pipe Construction at Stony Point

Terrestrial side of HDD – Stony Point

1. Notify all appropriate parties in accordance with approved EM&CP.
2. Mobilize to site.
3. Establish soil erosion and sediment controls.
4. Prepare drill pad.
5. Layout drill entry points.
6. Set up drill and ancillary equipment.

Marine side of HDD – Stony Point

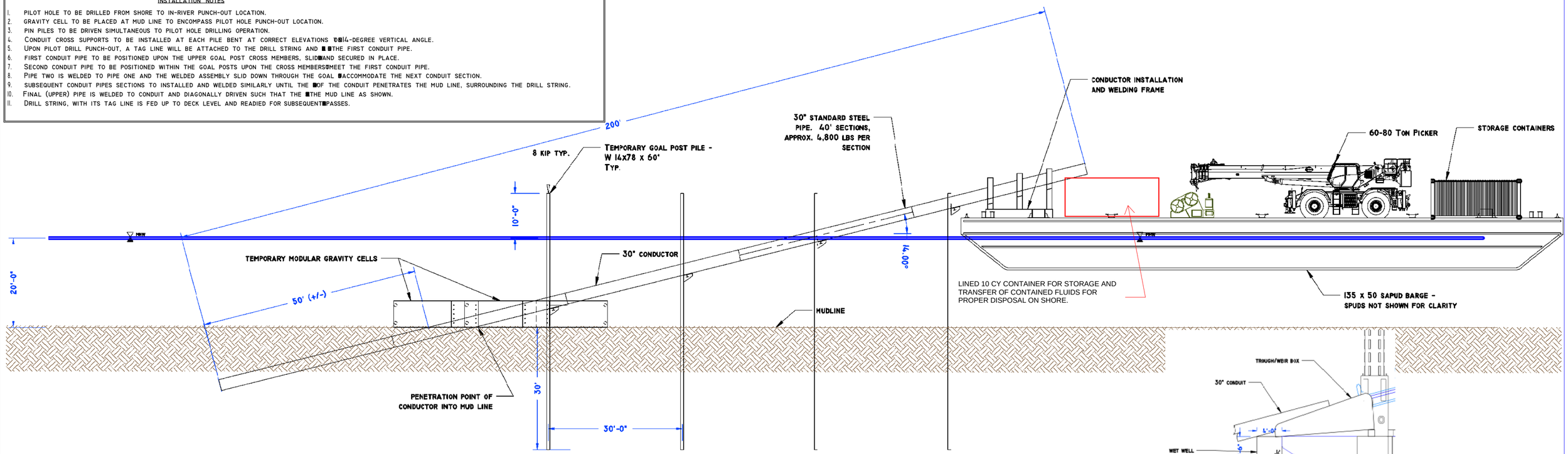
1. Issue Local Notice to Mariners notification to the US Coast Guard.
2. Notify all appropriate parties in accordance with approved EM&CP.
3. Mobilize marine assets.
4. Establish containment areas on deck of barge where steel riser pipe conductor casing is to exit.

Work sequence

1. Rig up, begin 10” diameter pilot hole followed by 5-inch drill stem. Drill direction is from land towards water. Utilize drilling fluids contained in Appendix Q of this manual or approved equal.
2. Using guidance on drill, as the drill head nears penetrating the river bottom, switch from drilling fluids from Note 1 above to clean water. This will keep the drill fluid escaping on river bottom.
3. Complete pilot hole penetration of river bottom. See Section 6.2.5.3 of Installation Plan.
4. Locate drill exit hole.
5. Set gravity cell on river bottom using divers.
6. Layout/install “temporary goal post” support steel.
7. Layout/install steel conductor casing riser pipe to 14-degree slope onto support barge.
8. Advance the drill steel onto barge and remove pilot tool cutting head.
9. Push steel conductor casing riser pipe concentrically over 8” dia. pilot hole and into the river bottom. Divers to assist.
10. The steel conductor riser pipe now provides a closed system.
11. Install reaming tool on land side and begin forward reaming process. See Section 6.2.5.4 of Installation Plan.
12. Follow Appendix F and Appendix G for fraction mitigation and drilling fluid containment.
13. As the ream pass approaches the sea bed/steel riser casing pipe, divers to monitor gravity cell for Inadvertent Returns (IR).
14. In event of IR in gravity cell, divers to utilize submersible pump with flexible hose to transfer drilling fluids to containment system on barge deck.
15. During the forward ream, drilling fluids will be recycled on land side. Process and stockpile cuttings on land side for future disposal.
16. Contain drilling fluids on deck of barge. Collect in holding tank. Transfer captured drilling fluids to truck to be properly disposed of.
17. During instances of harsh winters and freezing conditions, additional H-pile used for "temporary goal post supports" will be driven in a pattern up river from the marine assets and conductor casing to serve as ice breakers and protect the HDD entry/exit location.

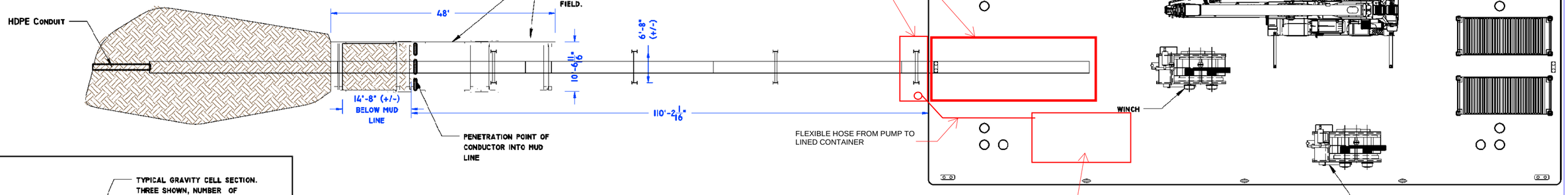
INSTALLATION NOTES

1. PILOT HOLE TO BE DRILLED FROM SHORE TO IN-RIVER PUNCH-OUT LOCATION.
2. GRAVITY CELL TO BE PLACED AT MUD LINE TO ENCOMPASS PILOT HOLE PUNCH-OUT LOCATION.
3. PIN PILES TO BE DRIVEN SIMULTANEOUS TO PILOT HOLE DRILLING OPERATION.
4. CONDUIT CROSS SUPPORTS TO BE INSTALLED AT EACH PILE BENT AT CORRECT ELEVATIONS TO 14-DEGREE VERTICAL ANGLE.
5. UPON PILOT DRILL PUNCH-OUT, A TAG LINE WILL BE ATTACHED TO THE DRILL STRING AND TO THE FIRST CONDUIT PIPE.
6. FIRST CONDUIT PIPE TO BE POSITIONED UPON THE UPPER GOAL POST CROSS MEMBERS, SLID AND SECURED IN PLACE.
7. SECOND CONDUIT PIPE TO BE POSITIONED WITHIN THE GOAL POSTS UPON THE CROSS MEMBERS TO MEET THE FIRST CONDUIT PIPE.
8. PIPE TWO IS WELDED TO PIPE ONE AND THE WELDED ASSEMBLY SLID DOWN THROUGH THE GOAL TO ACCOMMODATE THE NEXT CONDUIT SECTION.
9. SUBSEQUENT CONDUIT PIPES SECTIONS TO INSTALLED AND WELDED SIMILARLY UNTIL THE END OF THE CONDUIT PENETRATES THE MUD LINE, SURROUNDING THE DRILL STRING.
10. FINAL (UPPER) PIPE IS WELDED TO CONDUIT AND DIAGONALLY DRIVEN SUCH THAT THE END THE MUD LINE AS SHOWN.
11. DRILL STRING, WITH ITS TAG LINE IS FED UP TO DECK LEVEL AND READIED FOR SUBSEQUENT PASSES.

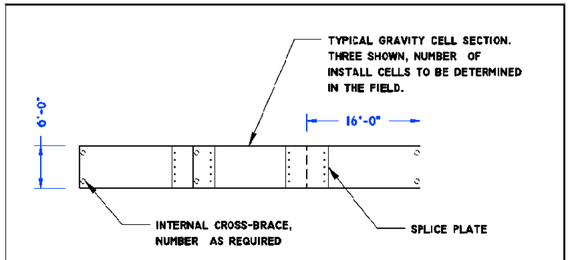


PROFILE
30" CONDUCTOR PIPE AND SUPPORTS

ELEVATION VIEW - DRILL FLUID COLLECTOR SYSTEM (PIPING AND HOSES NOT SHOWN) N.T.S.



PLAN VIEW
30" CONDUCTOR PIPE AND SUPPORTS



ELEVATION
TEMPORARY GRAVITY CELL ASSEMBLY

No.	REVISION	DATE	BY

Caldwell
Marine International, LLC.
1333 Campus Parkway
Wall Township, N.J. 07727
(732) 557-6100

Project: CHANMPLAIN-HUDSON EXPRESS
Drawing Name: 14 DEGREE CONDUCTOR PIPE/GOAL INSTALLATION
Client: HTS
Drawn By: WHP — Date Drawn: 6/02/22
Approved By: BP — Date Approved: 6/03/22
Scale: 3/32" = 1'-0"
Project No.: 1229
Sheet No.: 1 — Rev.: 0

Appendix Q – Drilling Fluids Data

BORE-GEL®

Boring Fluid System – U.S. Patent Number 5,723,416

Description

BORE-GEL□ sin□le-sac□ □orin□ fluid s□ste□ is s□eciall□ for□ ulated for use in hori□ontal directional drillin□ (HDD □a□□lications. BORE-GEL fluid s□ste□ is a □ro□rietar□ □lended □roduct usin□ hi□h-□ualit□ W□o□in□ sodiu□ □entonite. When BORE-GEL fluid s□ste□ is □i□ed with fresh water, it develo□s an eas□-to-□u□ □ slurr□ with desira□le fluid □ro□erties for HDD.

Applications/Functions

The use of BORE-GEL fluid system promotes the following:

- O□ti□u□ □el stren□th for cuttin□s sus□ension and trans□ort
- Pu□ □a□le slurr□ with □ini□al viscosit□
- Hi□h reactive solids concentration for i□ □roved □orehole sta□ilit□ in □oorl□ consolidated/ce□ented sands and □ravel for□ations
- Reduced filtration via a thin filter ca□e with low □er□ ea□ilit□
- Lu□rication of □i□e in □icrotunnelin□ o□erations

Advantages

- Mini□i□es the nu□ □er of □orin□ fluid □roducts re□uired
- Eas□ to □i□ and fast to □ield
- Low viscosit□ □ ini□i□es □u□ □ □ressures
- Provides lu□ricit□ for □ullin□ □roduct line
- Can □e used in Water Wells in unconsolidated for□ations or when additional □el stren□ths are re□uired to co□ □ensate for low annular velocit□
- NSF/ANSI Standard 60 certified

Typical Properties

• A□□earance	Tan to □ra□ □owder
• □H (4□ slurr□ or 15 l□/□□l□	10.2
• Bul□ densit□, l□/ft^3	68 to 72 (co□ □acted□

Rev. 2/24/2011 · IDP 032

Recommended Treatment

Add slowl□and unifor□l□throu□h a hi□h-shear, □et-t□□e □i□er over one or □ore c□cles of the volu□e of slurr□. Continue to circulate and a□itate the slurr□until all un□ielded □entonite is dis□ersed.

Approximate amounts of BORE-GEL® fluid system added to fresh water		
Boring Application	**lb/100 gal**	**kg/m³**
Nor□al □orin□conditions	25 □35	30 □42
Poorl□consolidated sand/□ravel	35 □60	42 □72
Lu□rication fluid for □icrotunnelin□	50 □60	60 □72

Packaging

BORE-GEL □orin□fluid s□ste□ is □ac□a□ed in a 50-l□(23-□□□□ultiwall □a□er □a□.

Availability

BORE-GEL □orin□fluid s□ste□ can □e □urchased throu□h an□Baroid Industrial Drillin□Products Retailer. To locate the Baroid IDP retailer nearest □ou contact the Custo□er Service De□art□ent in Houston or □our area IDP Sales Re□resentative.

Baroid Industrial Drilling Products
Product Service Line, Halliburton
3000 N. Sa□ Houston P□w□ E.
Houston, TX 77032

Customer Service	(800□735-6075 Toll Free	(281□871-4612
Technical Service	(877□379-7412 Toll Free	(281□871-4613

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BORE-GEL®**

Revision Date: 20-Mar-2015

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BORE-GEL®
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Stewardship
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT (w/w)	ACGIH TLV-TWA	OSHA PEL-TWA
Bentonite	1302-78-9	60 - 100%	TWA: 1 mg/m^3	Not applicable
Crystalline silica, quartz	14808-60-7	1 - 5%	TWA: 0.025 mg/m^3	$\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, cristobalite	14464-46-1	0.1 - 1%	TWA: 0.025 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$
Crystalline silica, tridymite	15468-32-3	0.1 - 1%	0.05 mg/m^3	1/2 x $\frac{10\ mg/m^3}{\%SiO2 + 2}$

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, AS/NZS 1715, or equivalent respirator when using this product. Review the Safety Data Sheet (SDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Physical Hazard 0 , PPE: At

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption	Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions	This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Storage Information	Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.
Personal Protective Equipment	If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (N95, P2/P3)
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Light brown or Gray
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.5
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	53 - 80
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined

Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Slightly soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data: Stable

Hazardous Polymerization: Will Not Occur

Conditions to Avoid None anticipated

Incompatibility (Materials to Avoid) Hydrofluoric acid.

Hazardous Decomposition Products Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

Additional Guidelines Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Sympotoms related to exposure

Acute Toxicity

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause eye irritation.

Skin Contact May cause mechanical skin irritation.

Ingestion None known

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Bentonite	1302-78-9	> 5000 mg/kg (Rat) > 2000 mg/kg (Rat)	No data available	> 5.27 mg/L (Rat)
Crystalline silica, quartz	14808-60-7	500 mg/kg (Rat) >15,000 mg/kg (Human)	No data available	No data available
Crystalline silica, cristobalite	14464-46-1	> 5000 mg/kg (Rat)	No data available	No data available
Crystalline silica, tridymite	15468-32-3	> 5000 mg/kg (Rat)	No data available	No data available

12. ECOLOGICAL INFORMATION

Ecotoxicological Information

Ecotoxicity Product

Acute Fish Toxicity: TLM96: 10000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Ecotoxicity Substance

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Bentonite	1302-78-9	EC50(72h): > 100 mg/L (freshwater algae)	TLM96 10,000 ppm (Oncorhynchus mykiss) LC50 (96h) 16,000 - 19,000 mg/L (Oncorhynchus mykiss) LC50 (24h) 2800 – 3200 mg/L (black bass, warmouth bass, blue gill and sunfish)	No information available	EC50 (96h) 81.6 mg/L (Metacarcinus magister) EC50 (96h) 24.8 mg/L (Pandalus danae) EC50 (48h) > 100 mg/L (Daphnia magna)
Crystalline silica, quartz	14808-60-7	No information available	LL0 (96h) 10,000 mg/L (Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)
Crystalline silica, cristobalite	14464-46-1	No information available	LL0 (96h) 10,000 mg/L (Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)

Crystalline silica, tridymite	15468-32-3	No information available	LL0 (96h) 10,000 mg/L(Danio rerio) (similar substance)	No information available	LL50 (24h) > 10,000 mg/L (Daphnia magna) (similar substance)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Bentonite	1302-78-9	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, cristobalite	14464-46-1	The methods for determining biodegradability are not applicable to inorganic substances.
Crystalline silica, tridymite	15468-32-3	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Bentonite	1302-78-9	No information available
Crystalline silica, quartz	14808-60-7	No information available
Crystalline silica, cristobalite	14464-46-1	No information available
Crystalline silica, tridymite	15468-32-3	No information available

12.4. Mobility in soil
No information available

12.5. Results of PBT and vPvB assessment
No information available.

Substances	PBT and vPvB assessment
Bentonite	No data available
Crystalline silica, quartz	Not PBT/vPvB
Crystalline silica, cristobalite	No data available
Crystalline silica, tridymite	No data available

12.6. Other adverse effects
No information available

13. DISPOSAL CONSIDERATIONS

Disposal Method If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

US DOT

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable

US DOT Bulk

DOT (Bulk) Not applicable

Canadian TDG

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable

IMDG/IMO

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable

IATA/ICAO

UN Number: Not restricted
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable
Special Precautions for User: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory — All components listed on inventory or are exempt.

EPA SARA Title III Extremely Hazardous Substances — Not applicable

EPA SARA (311,312) Hazard Class — Acute Health Hazard
Chronic Health Hazard

EPA SARA (313) Chemicals — This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).

EPA CERCLA/Superfund Reportable Spill Quantity — Not applicable.

EPA RCRA Hazardous Waste Classification — If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

California Proposition 65 — The California Proposition 65 regulations apply to this product.

MA Right-to-Know Law — One or more components listed.

NJ Right-to-Know Law — One or more components listed.

PA Right-to-Know Law — One or more components listed.

Canadian Regulations

Canadian DSL Inventory — All components listed on inventory or are exempt.

WHMIS Hazard Class — D2A Very Toxic Materials
Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this SDS
Not applicable

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

QUIK-GEL®

Viscosifier

Description

QUIK-GEL□ viscosifier is an eas□-to-□i□, finel□ □round (200-□esh□, □re□iu□-□rade, hi□h-□eldin□ W□o□in□sodiu□ □entonite. QUIK-GEL viscosifier i□ □arts viscosit□, fluid loss control and □ellin□ characteristics to freshwater-□ased drillin□ fluids.

Applications/Functions

The use of QUIK-GEL viscosifier promotes or assists the following:

- Mi□with fresh water to for□ a low-solids drillin□ fluid for □eneral drillin□ a□□lications
- Viscosif□ water-□ased drillin□ fluids
- Reduce filtration □□for□in□a thin filter ca□e with low □er□ea□ilit□
- I□ □rove hole-cleanin□ ca□a□ilit□ of drillin□ fluids
- Mi□with foa□in□a□ents to □a□e "□el/foa□" drillin□ fluids for air/foa□ drillin□ a□□lications

Advantages

- NSF/ANSI Standard 60 certified
- Sin□le-sac□ □roduct and cost effective
- Can □rovide lu□ricit□ for drillin□ fluids
- Can □i□easil□ and □uic□□reaches □a□i□u□ viscosit□
- Can □ield □ore than twice as □uch □ud of the sa□e viscosit□ as an e□ual wei□ht of API oilfield □rades of □entonite

Typical Properties

A□□earance	Gre□to tan □owder
Bul□densit□, l□/ft^3	68 to 72 (co□□acted□
□H (3□ solution□	8.9

Recommended Treatment

Mi□slowl□throu□h a □et □i□er or sift slowl□into the vorte□of a hi□h-s□eed stirrer.

Approximate Amounts of QUIK-GEL viscosifier Added to Freshwater			
Application/Desired Result	**lb/100 gal**	**lb/bbl**	**kg/m^3**
Normal Drilling Conditions	15-25	6-10	18-30
Unconsolidated Formations	35-50	15-21	42-60
Make-Up For Gel/Foam Systems	12-15	5-7	14-18

- 1 □□l □42 U.S. □allons

Rev. 03/2011 · IDP 009

Additional Information

Note:

- For o□ti□u□ □ield, □re-treat □a□e-u□water with 1-2 □ounds of soda ash □er 100 □allons of water (1.2-2.4 □□/□^{3}□.

Packaging

QUIK-GEL viscosifier is □ac□a□ed in 50-l□(22.7-□□□□ultiwall □a□er □a□s.

Availability

QUIK-GEL viscosifier can □e □urchased throu□h an□Baroid Industrial Products Retailer. To locate the Baroid IDP retailer nearest □ou contact the Custo□er Service De□art□ent in Houston or □our area IDP Sales Re□resentative.

Baroid Industrial Drilling Products

Product Service Line, Halliburton

3000 N. Sa□ Houston P□w□ E.

Houston, TX 77032

Customer Service	(800□735-6075 Toll Free	(281□871-4612
Technical Service	(877□379-7412 Toll Free	(281□871-4613

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **QUIK-GEL®**

Revision Date: 14-Aug-2017 **Revision Number:** 20

1. Identification

1.1. Product Identifier

Product Trade Name: QUIK-GEL®
Synonyms None
Chemical Family: Mineral
Internal ID Code HM003747

1.2 Recommended use and restrictions on use

Application: Viscosifier
Uses advised against No information available

1.3 Manufacturer's Name and Contact Details

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000

Halliburton Energy Services, Inc.
645 - 7th Ave SW Suite 1800
Calgary, AB
T2P 4G8
Canada

Prepared By Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

1.4. Emergency telephone number:

Emergency Telephone Number 1-866-519-4752 or 1-760-476-3962
Global Incident Response Access Code: 334305
Contract Number: 14012

2. Hazards Identification

2.1 Classification in accordance with paragraph (d) of §1910.1200

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

2.2. Label Elements

Hazard Pictograms

Signal Word: Danger

Hazard Statements
H350 - May cause cancer by inhalation
H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

Precautionary Statements

Prevention
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P280 - Wear protective gloves/protective clothing/eye protection/face protection

Response
P308 + P313 - IF exposed or concerned: Get medical advice/attention
P314 - Get medical attention/advice if you feel unwell

Storage
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

2.3 Hazards not otherwise classified

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface. Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz. A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer. In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - US
Crystalline silica, quartz	14808-60-7	1 - 5%	Carc. 1A (H350) STOT RE 1 (H372)

The exact percentage (concentration) of the composition has been withheld as proprietary.

4. First Aid Measures

4.1. Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Rinse mouth with water many times.

4.2 Most important symptoms/effects, acute and delayed

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. Fire-fighting measures

5.1. Extinguishing media

Suitable Extinguishing Media

All standard fire fighting media

Extinguishing media which must not be used for safety reasons

None known.

5.2 Specific hazards arising from the substance or mixture

Special exposure hazards in a fire

None anticipated

5.3 Special protective equipment and precautions for fire-fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

See Section 8 for additional information

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet. Use appropriate protective equipment.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Keep from excessive heat. Do not reuse empty container. Product has a shelf life of 36 months.

8. Exposure Controls/Personal Protection

8.1 Occupational Exposure Limits

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA
Crystalline silica, quartz	14808-60-7	TWA: 50 µg/m³	TWA: 0.025 mg/m³

Exposures to crystalline silica that result from bentonite or other sorptive clays are exempt from the PEL in §1910.1053. The PEL in §1910.1000 Table Z–3 (i.e., the formula that is approximately equivalent to 100 µg/m³) applies to occupational exposures to respirable crystalline silica from sorptive clays.

8.2 Appropriate engineering controls

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

8.3 Individual protection measures, such as personal protective equipment

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (N95, P2/P3)

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Powder
Odor: Mild earthy
Color Various
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	8-10
Freezing Point / Range	No data available
Melting Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Flammability (solid, gas)	No data available
Upper flammability limit	No data available
Lower flammability limit	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	2.6
Water Solubility	Partly soluble
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.

10.2. Chemical stability
Stable

10.3. Possibility of hazardous reactions
Will Not Occur

10.4. Conditions to avoid
None anticipated

10.5. Incompatible materials
Hydrofluoric acid.

10.6. Hazardous decomposition products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. Toxicological Information

11.1 Information on likely routes of exposure

Principle Route of Exposure Eye or skin contact, inhalation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics

Acute Toxicity

Inhalation Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause mechanical irritation to eye.

Skin Contact None known.

Ingestion None known.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology

Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface (Wendlandt et al., 2007; Hochella and Muryama, 2010; SMI, 2014). Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz (Geh et al., 2006; Creutzenberg et al., 2008). A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer (Waxweiler et al., 1988; ACGIH, 1991; USEPA, 1996; IARC, 2005). In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

11.3 Toxicity data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, quartz	14808-60-7	> 15000 mg/kg (human)	No data available	No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the eye

Substances	CAS Number	Skin Sensitization
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, quartz	14808-60-7	Not applicable

12. Ecological Information

12.1. Toxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, quartz	14808-60-7	EC50 (72 h) =440 mg/L (Selenastrum capricornutum)(similar substance)	LL0 (96 h) =10000 mg/L (Danio rerio)(similar substance)	No information available	LL50 (24 h) >10000 mg/L (Daphnia magna)(similar substance)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Crystalline silica, quartz	14808-60-7	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Crystalline silica, quartz	14808-60-7	No information available

12.5 Other adverse effects

No information available

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. Transport Information

US DOT

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Canadian TDG

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable
Special Precautions for User None

15. Regulatory Information

US Regulations

US TSCA Inventory All components listed on inventory or are exempt.

TSCA Significant New Use Rules - S5A2

Substances	CAS Number	TSCA Significant New Use Rules - S5A2
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA Title III Extremely Hazardous Substances

Substances	CAS Number	EPA SARA Title III Extremely Hazardous Substances
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA (311,312) Hazard Class
Chronic Health Hazard

EPA SARA (313) Chemicals

Substances	CAS Number	Toxic Release Inventory (TRI) - Group I	Toxic Release Inventory (TRI) - Group II
Crystalline silica, quartz	14808-60-7	Not applicable	Not applicable

EPA CERCLA/Superfund Reportable Spill Quantity

Substances	CAS Number	CERCLA RQ
Crystalline silica, quartz	14808-60-7	Not applicable

EPA RCRA Hazardous Waste Classification
If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

California Proposition 65

Substances	CAS Number	California Proposition 65
Crystalline silica, quartz	14808-60-7	carcinogen

U.S. State Right-to-Know Regulations

Substances	CAS Number	MA Right-to-Know Law	NJ Right-to-Know Law	PA Right-to-Know Law
Crystalline silica, quartz	14808-60-7	Carcinogen Extraordinarily hazardous	1660	Present

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Physical Hazard 0 , PPE: E

Canadian Regulations

Canadian Domestic Substances List (DSL) All components listed on inventory or are exempt.

16. Other information

Preparation Information

Prepared By
Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

Revision Date: 14-Aug-2017

Reason for Revision SDS sections updated:
2
8
11

Additional information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
d - day
EC50 – Effective Concentration 50%
ErC50 – Effective Concentration growth rate 50%
h - hour
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
NIOSH – National Institute for Occupational Safety and Health
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
UN – United Nations
w/w - weight/weight

Key literature references and sources for data
www.ChemADVISOR.com/

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The

information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Soda Ash

Alkalinity Agent

Description

Soda Ash al□alinit□a□ent is a □ranular □owder for□ of sodiu□ car□onate □ri□aril□used to condition and soften □a□e-u□water and to raise □H.

Applications/Functions

- Treat out calciu□ hardness in □a□e-u□water
- Raise □H

Advantages

- Can eli□inate calciu□ ions □□convertin□to insolu□le car□onate
- Can □a□i□i□e the □erfor□ance of □entonite and □ol□□er □roducts

Typical Properties

A□□earance	Varia□le-colored □owder (white to □ra□□
□H of 5□ solution	11.5
Bul□densit□, l□/ft^3	57-65

Recommended Treatment

- Hardness and □H levels of □a□e-u□water should □e chec□ed □rior to addition of Soda Ash.
- When treatin□□a□e-u□water, □H ran□es should □e □aintained □etween 8.5 □9.5
- Addition of Soda Ash should alwa□s □e done □rior to addition of □entonite or □ol□□er to the fluid s□ste□.
- Soda Ash al□alinit□a□ent should not □e added at the sa□e ti□e as other drillin□fluid co□□onents.

General Treatment:

- 1-2 □ounds of Soda Ash al□alinit□a□ent □er 100 □allons of □a□e-u□ water or 1.2-2.4 □ilo□ra□s □er cu□ic □eter of □a□e-u□water.
- Use as re□uired to re□ove calciu□ ions □ut do not add in e□cess as overtreat□ent can lead to detri□ental effects and reduced □erfor□ance of the drillin□fluid co□□onents and/or s□ste□.
- Mi□slowl□throu□h a □et □i□er or sift slowl□into the vorte□of a hi□h-s□eed stirrer.

Rev. 08/18/2011

Packaging

Soda Ash is □ac□a□ed in 50-l□ (22.7 □□□or 100-l□ (45.4 □□□□ ultiwall □a□er □a□s.

Availability

Soda Ash can □e □urchased throu□h an□Baroid Industrial Drillin□ Products Retailer. To locate the Baroid IDP retailer nearest □ou contact the Custo□er Service De□art□ent in Houston or □our area IDP Sales Re□resentative.

Baroid Industrial Drilling Products
Product Service Line, Halliburton
3000 N. Sa□ Houston P□w□. E.
Houston, TX 77032

Customer Service	(800□735-6075 Toll Free	(281□871-4612
Technical Service	(877□379-7412 Toll Free	(281□871-4613

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **SODA ASH**

Revision Date: 24-Apr-2017 **Revision Number:** 42

1. Identification

1.1. Product Identifier

Product Trade Name: SODA ASH
Synonyms None
Chemical Family: Carbonate
Internal ID Code HM001822

1.2 Recommended use and restrictions on use

Application: Buffer
Uses advised against No information available

1.3 Manufacturer's Name and Contact Details

Manufacturer/Supplier

Halliburton Energy Services, Inc.
P.O. Box 1431
Duncan, Oklahoma 73536-0431
Telephone: 1-281-871-6107

Halliburton Energy Services, Inc.
645 - 7th Ave SW Suite 1800
Calgary, AB
T2P 4G8
Canada

Prepared By Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

1.4. Emergency telephone number

Emergency Telephone Number: 1-866-519-4752 or 1-760-476-3962
Global Incident Response Access Code: 334305
Contract Number: 14012

2. Hazards Identification

2.1 Classification in accordance with paragraph (d) of §1910.1200

Serious Eye Damage/Irritation	Category 2 - H319

2.2. Label Elements

Hazard Pictograms

Signal Word: Warning

Hazard Statements H319 - Causes serious eye irritation

Precautionary Statements

Prevention P264 - Wash face, hands and any exposed skin thoroughly after handling
P280 - Wear eye protection/face protection

Response P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P337 + P313 - If eye irritation persists: Get medical advice/attention

Storage None

Disposal None

2.3 Hazards not otherwise classified

None known

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - US
Sodium carbonate	497-19-8	60 - 100%	Eye Irrit. 2 (H319)

The exact percentage (concentration) of the composition has been withheld as proprietary.

4. First Aid Measures

4.1. Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

4.2 Most important symptoms/effects, acute and delayed

Causes eye irritation

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. Fire-fighting measures

5.1. Extinguishing media

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

5.2 Specific hazards arising from the substance or mixture

Special exposure hazards in a fire
Decomposition in fire may produce harmful gases.

5.3 Special protective equipment and precautions for fire-fighters

Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Avoid contact with skin, eyes and clothing. Ensure adequate ventilation.
See Section 8 for additional information

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Scoop up and remove.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions
Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information
Store away from acids. Store in a cool, dry location. Product has a shelf life of 60 months.

8. Exposure Controls/Personal Protection

8.1 Occupational Exposure Limits

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA
Sodium carbonate	497-19-8	Not applicable	Not applicable

8.2 Appropriate engineering controls

Engineering Controls Use in a well ventilated area. Localized ventilation should be used to control dust levels.

8.3 Individual protection measures, such as personal protective equipment

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective

equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	None known.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Powder	**Color**	White
Odor:	Odorless	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	11.5
Freezing Point / Range	No data available
Melting Point / Range	851 °C
Boiling Point / Range	No data available
Flash Point	No data available
Flammability (solid, gas)	No data available
Upper flammability limit	No data available
Lower flammability limit	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	2.5
Water Solubility	Partly soluble
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

Molecular Weight	105.99 g/mole
VOC Content (%)	No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.

10.2. Chemical stability
Stable

10.3. Possibility of hazardous reactions
Will Not Occur

10.4. Conditions to avoid
None anticipated

10.5. Incompatible materials

Strong acids.

10.6. Hazardous decomposition products

Carbon monoxide and carbon dioxide.

11. Toxicological Information

11.1 Information on likely routes of exposure

Principle Route of Exposure Eye or skin contact, inhalation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics

Acute Toxicity

Inhalation May cause mild respiratory irritation.

Eye Contact Causes eye irritation.

Skin Contact Not irritating to skin in rabbits.

Ingestion Irritation of the mouth, throat, and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

11.3 Toxicity data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sodium carbonate	497-19-8	4090 mg/kg (Rat) 2800 mg/kg (Rat)	2210 mg/kg (Mouse) > 2000 mg/kg (Rabbit)	2.3 mg/L (Rat) 2h

Substances	CAS Number	Skin corrosion/irritation
Sodium carbonate	497-19-8	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Sodium carbonate	497-19-8	Irritating to eyes

Substances	CAS Number	Skin Sensitization
Sodium carbonate	497-19-8	Not classified

Substances	CAS Number	Respiratory Sensitization
Sodium carbonate	497-19-8	No information available

Substances	CAS Number	Mutagenic Effects
Sodium carbonate	497-19-8	In vivo tests did not show mutagenic effects.

Substances	CAS Number	Carcinogenic Effects
Sodium carbonate	497-19-8	No information available

Substances	CAS Number	Reproductive toxicity
Sodium carbonate	497-19-8	Did not show teratogenic effects in animal experiments.

Substances	CAS Number	STOT - single exposure
Sodium carbonate	497-19-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Sodium carbonate	497-19-8	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	Aspiration hazard
Sodium carbonate	497-19-8	Not applicable

12. Ecological Information

12.1. Toxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Sodium carbonate	497-19-8	EC50 242 mg/L (Nitzschia)	TLM24 385 mg/L (Lepomis macrochirus) LC50 310-1220 mg/L (Pimephales promelas) LC50 (96h) 300 mg/L (Lepomis macrochirus)	No information available	EC50 265 mg/L (Daphnia magna) EC50 (48h) 200 – 227 mg/L (Ceriodaphnia sp.)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Sodium carbonate	497-19-8	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Sodium carbonate	497-19-8	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Sodium carbonate	497-19-8	No information available

12.5 Other adverse effects

No information available

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. Transport Information

US DOT

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Canadian TDG

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable

Packing Group: Not applicable
Environmental Hazards: Not applicable

IATA/ICAO

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable
Special Precautions for User None

15. Regulatory Information

US Regulations

US TSCA Inventory All components listed on inventory or are exempt.

TSCA Significant New Use Rules - S5A2

Substances	CAS Number	TSCA Significant New Use Rules - S5A2
Sodium carbonate	497-19-8	Not applicable

EPA SARA Title III Extremely Hazardous Substances

Substances	CAS Number	EPA SARA Title III Extremely Hazardous Substances
Sodium carbonate	497-19-8	Not applicable

EPA SARA (311,312) Hazard Class
Acute Health Hazard

EPA SARA (313) Chemicals

Substances	CAS Number	Toxic Release Inventory (TRI) - Group I	Toxic Release Inventory (TRI) - Group II
Sodium carbonate	497-19-8	Not applicable	Not applicable

EPA CERCLA/Superfund Reportable Spill Quantity

Substances	CAS Number	CERCLA RQ
Sodium carbonate	497-19-8	Not applicable

EPA RCRA Hazardous Waste Classification
If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

California Proposition 65

Substances	CAS Number	California Proposition 65
Sodium carbonate	497-19-8	Not applicable

U.S. State Right-to-Know Regulations

Substances	CAS Number	MA Right-to-Know Law	NJ Right-to-Know Law	PA Right-to-Know Law
Sodium carbonate	497-19-8	Not applicable	Not applicable	Not applicable

NFPA Ratings: Health 2, Flammability 0, Reactivity 0
HMIS Ratings: Health 2, Flammability 0, Physical Hazard 0 , PPE: B

Canadian Regulations

Canadian Domestic Substances List (DSL) All components listed on inventory or are exempt.

16. Other information

Preparation Information

Prepared By
Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

Revision Date: 24-Apr-2017

Reason for Revision SDS sections updated:
2

Additional information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
d - day
EC50 – Effective Concentration 50%
ErC50 – Effective Concentration growth rate 50%
h - hour
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
NIOSH – National Institute for Occupational Safety and Health
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
UN – United Nations
w/w - weight/weight

Key literature references and sources for data
www.ChemADVISOR.com/

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Appendix R– Diving Procedures and Safe Practices Manual

DIVING PROCEDURES & SAFE PRACTICES MANUAL

REVISION TABLE			
REV. #	**DESCRIPTION**	**DATE**	**APPROVED**
00	Creation	06/20/08	AB AG
01	Revised after review	10/17/17	LA DC
02	Revised after revew	12/17/21	LA EP DC
03	Revised after reveiw	05/18/22	LA EP DC
04	Revised after reveiw	06/17/22	LA EP

*This manual references the current 29 CFR 1910 standards for Commercial Diving Operations and the US Navy Diver's Handbook – Revision 7

1. General Information

1.1 Introduction

The procedures and requirements outlined in this manual are founded on the regulations that have been established by the U. S. Coast Guard, the Association of Diving Contractors (ADC), and the Occupational Safety and Health Administration (OSHA), and the US Navy Diver's Handbook – Revision 7

When diving operations occur that are not covered in this manual, local regulations must be determined. Should differences between local regulations and this manual occur the more conservative guidance shall be used. If a direct conflict exists between this manual and local regulations, Caldwell Marine International *(CMI*) management must be consulted for guidance.

This manual applies to all types of diving operations conducted by *Caldwell Marine International* divers and contractors. It provides guidance and detailed procedures to be followed when conducting air diving, both surface supplied and SCUBA. As changes to regulations governing commercial diving occur this manual will be updated

1.2. Diving Personnel Responsibilities

Each dive team member shall have the experience or training necessary to perform assigned tasks in a safe and healthful manner. All dive team members shall be trained in cardiopulmonary resuscitation and first aid (American Red Cross standard course or equivalent) and in the use of a manual bag-type resuscitator. Dive team members who are exposed to or control the exposure of others to hyperbaric conditions shall be trained in diving-related physics and physiology and fully understand emergency procedures.

1.2.1 Diving Supervisor

The Diving Supervisor is the on-scene-representative of *Caldwell Marine International* management and is directly responsible for the safe conduct of all phases of diving operations. The diving supervisor shall be designated in writing and given to the Person-in-Charge prior to any diving operation**. THE NUMBER ONE PRIORITY OF THE DIVING SUPERVISOR IS THE SAFETY OF THE DIVE TEAM UNDER THEIR AUTHORITY.** The Diving Supervisor has the final word concerning diving operations, shall exercise caution when dealing with matters not covered by company policy, and must understand and comply with all government regulations and company policies that apply to the diving operation.

The responsibilities of the Diving Supervisor include:

- The Supervisor shall be in immediate control of the diving operation and available to implement emergency procedures.
- The Supervisor is not permitted to dive unless there is another qualified supervisor designated in writing and is available to take over the divingoperation.
- The Diving Supervisor shall coordinate with the Person-in-Charge, Craft Masters, Customer Representative, all persons responsible for any thing that may affect the safety of the divers and the efficient completion of the divingoperation.
- Personally verify that all personnel in the dive team are qualified and physically able to perform tasks assigned. He must make an assessment of the physical condition of the divers prior to each dive to determine if any physical impairment is present which would be harmful to their health and safety ether in the water or in a chamber.
- The Diving Supervisor will perform Job Hazard Analysis (JHA) for each task undertaken.
- The supervisor will establish a dive plan ensuring that enough trained personnel, supplies, and proper equipment are available for the safe and timely completion of the diving operation.
- The Diving supervisor shall personally verify the emergency assistance checklist to ensure a two-way communication system is available to reach emergency assistance if required.
- The Diving supervisor shall ensure that diving operations are conducted from a safe dive platform.
- The Supervisor shall verify that the Safety Procedures Checklist, Equipment Procedures Checklist, and the Recompression Chamber Checklist, if chamber is on location, have been performed properly and ensure that all diving equipment designated for use is suitable for the planned operation and is in good working order.
- Ensure that all manuals, instructions, decompression and recompression tables and regulatory publications are available at the dive location. Provide the Customer Representative a copy of the dive manual and a dive plan outlining the diving operation.
- The Diving Supervisor shall brief the dive team on the details to the task, safety precautions and emergency procedures. After the dive he will assess the diver condition and instruct to report any physical problems that may occur as soon as possible.
- The Diving Supervisor will immediately activate emergency procedures at the first sign of a problem with the dive. As soon as the situation stabilizes he will inform the Person-in-Charge, and Customer Representative.
- Report all accidents or incidents required by law to the company. Insure that all reports required are promptly filled out sent to the proper authorities.

1.2.2 Diver

Assigned by the Diving Supervisor, the diver should be at least 18 years old, and medically certified "fit to dive". The diver shall be qualified to dive the equipment in use, and be in possession of an up to date diver's logbook. The Diver must have a current certification in First Aid and CPR.

- Understand and comply with company policies and this document.
- Follow safe diving practice at all times.
- Ensure diver-worn equipment is properly maintained, complete, and ready for use. Asrequired, assist in the maintenance and repair of all diving equipment.
- Immediately obey all commands or instructions form the diving supervisor to return the surface or first decompression stop.
- Act as standby diver when directed to do so.
- Act as a chamber operator as required.
- Report any recent medical treatment or illness to the diving supervisor.
- Report all symptoms after a dive to the diving supervisor immediately and as accurately as possible.
- Report all equipment problems to the diving supervisor.
- Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site.
- Remain in the vicinity of the recompression chamber if required.
- Be ready to assume the responsibilities of the Diving Supervisor where one is not required.

1.2.3 Standby Diver

The Standby Diver is that individual possessing the required training and experience to enter the water at the diving station in order to render assistance to a stricken diver.

- The Standby's helmet or mask will be fitted to the standby umbilical in a wrench tight status. The flow to the helmet or mask will be verified, and a communications check will be conducted to ensure three-way communications between the standby diver, topside, and the stricken diver.
- The Standby will remain in the immediate vicinity of the diving control station, receives the same briefings and instructions as the working diver, monitors the progress of the dive, and be fully prepared to respond if called upon for assistance i.e.. Standby diver is at the dive station with his diving helmet, harness, bail-out bottle and weight belt and available to render immediate assistance when called apon.The standby diver shall also be equipped with an octopus rig.

1.2.4 Tender

The tender is assigned by the diving supervisor to continuously tend a diver. He must have a basic understanding of diving acquired through a special school or equivalent experience He shall not be assigned any other task while the diver is under the water. The Tender must have a current certification in First Aid and CPR. The Tender must:

- Set up and operate all equipment as directed by the lead tender, Diving supervisor.

Assist in topside work connected with the diving operations or other topside work as required or directed.

- Stay alert to what is going on with the dive. Be aware of the divers location and the

divers depth. Once the diver is in the water, the tender constantly tends the lines to eliminate excess slack or tension. The tender exchanges line-pull signals with the diver, keeps the Diving Supervisor informed of the line-pull signals and amount of diving hose/tending line over the side and remains alert for any signs of an emergency.

- Immediately report any conditions, which may be hazardous or unsafe.
- If qualified, operate the recompression chamber when directed by the diving supervisor.
- If qualified to act as an inside tender he must be medically certified, "fit to dive."
- If acting as an inside tender he must be familiar with and alert for any symptoms of oxygen toxicity.

1.3 Medical Requirements

1.3.1 General

For persons engaged as divers or otherwise subjected to hyperbaric conditions the following medical examinations are required.

- An initial medical examination
- Periodic re-examination recommended annually but as minimum on an annual basis.

1. A re-examination is required after a diving related injury or illness to determine fitness to return to diving duty. For the purposes of these medical requirements all examinations are to be performed only by licensed physicians qualified to perform commercial diver medical examinations. Must have licensed physician signature to be legible and/or stamped, with their medigal designation clearly indicated. Non-physicians are not recognized by the ADCI as being qualified to perform commercial diver medical examinations

1.3.2 Physical Examination

The initial examination and subsequent periodic re-examination include the following:

- Work History
- The test required in table 1-1
- Any test deemed necessary to establish the presence of any disqualifying conditions
- Any test the physician needs to prepare the written report.

If with in one year the individual has had a comprehensive medical examination comparable to the initial diving physical and no disqualifying conditions are present, the examination can be use in place of the initial examination.

1.3.3 Re-examination After Diving Injury or Illness

Any person exposed to hyperbaric conditions who has a diving related injury or illness that requires hospitalization of more 72 hours or known AGE or decompression sickness with central nervous system dysfunction will require a re-examination and be released by a qualified physician before they can return to diving duty.
The examining physician should determine the scope of the examination in light of the nature of the diving injury or illness.

1.3.4 Physician's Written Report

With respect to the initial examination or any re-examination, the diver must obtain a written report from the examining physician that contains the following information:

- Results of the examination and tests given on accordance with this section.
- The physician's opinion as to the fitness of the person to perform as a diver based on his medical history and the results of the test required in table 1-1 in particular to the following:
- Stress to the pulmonary, muscular, cardiac and skeletal systems.
- Interference with effective external communication of the gas-containing organs of the body.
- Condition if the central and peripheral nervous system.
- Any other factor that indicates material impairment of the employee's health.
- The physician's opinion as to whether there exist any disqualifying conditions.
- Any recommended limitations placed on the persons activities as a diver or exposure to hyperbaric conditions.
- A statement by the examining physician the individual has been informed of the results of the physical any and conditions that require further examination or treatment.

1.3.5 Disqualifying Conditions

A person having any of the following conditions, as determined by a qualified physician shall be disqualified from engaging in diving or other hyperbaric activities:

- History of seizure disorders other than childhood febrile convulsions.
- Cystic or cavity disease of the lungs, significant obstructive or restrictive lung disease, or recurrent pneumothorax.
- Chronic inability to equalize sinus and middle ear cavities.
- Significant central peripheral nervous system disease.
- Significant cardiac abnormalities.
- Chronic alcoholism, drug abuse, or history of psychosis.
- Significant hemoglobinopathies.
- Significant malignancies.
- Grossly impaired hearing.
- Pregnancy.
- Chronic obstruction of the Eustachian tubes.
- Chronic gastrointestinal disease.
- Hernia
- Severe head injury, cranial surgery.

- Severe visual defects.
- Excessive obesity.
- Diabetes.
- Gross abnormality of the renal tract.
- Severe Stammering.
- Any acute condition while undergoing treatment for that condition

Below are the current Disqualifying Conditions Listed on the ADCI current edition:

- History of seizure disorder other than early childhood febrile conditions.
- Cystic, bullous or cavitary disease of the lungs, significant obstructive or restrictive lung disease and/or spontaneous pneumothorax.
- Chronic inability to equalize sinus and middle ear pressure.
- Significant central or peripheral nervous system disease or impairment.
- Chronic alcoholism, drug abuse or dependence or history of psychosis.
- Hemoglobinpathies associated with comorbidities.
- Any person engaged as a diver, or otherwise exposed to hyperbaric conditions, will have a medical evaluation following any non-diving injury or illness that requires any prescription medication, any surgical procedure or any hospitalization.
- Untreated or persistent/metastatic or other significant malignancies including those that require chemotherapy and/or radiation therapy unless five years after treatment with no evidence of recurrence.
- Hearing impairment in the better ear should be at least 40 dB average in the 500, 1000, and 2000 Hz frequencies.
- Justa-articular osteonecrosis is disqualifying. Chronic conditions requiring continuous control by medication that increases risks in diving.
- Pregnancy.

The above current list does not mean that all other conditions are acceptable such as excessive obesity. For example previously listed diabetes. Current gudielines suggest that DM with a stable HBA1c and no medications is not disqualifying.

1.3.6 Withdrawal from Hyperbaric Conditions

Withdrawal from hyperbaric conditions shall be determined by a physician examination whether a person's health will be at risk by continued hyperbaric exposure.

1.3.7 Medical Record Keeping

An accurate medical record for each person subject to the medical specifications of this section should be maintained. The record should include the employees current dive physical and be maintained for at least 5 years after the last hyperbaric exposure.

Medical Test for Diving			
Test	**Initial**	**Annual Per ADCI current table 2.3.4 tble 1**	**Comments**
History and Physical	X	X	Include predisposition to unconsciousness, vomiting cardiac arrest, impairment of oxygen transport, serious blood loss, or anything that in the opinion of the examining physician will interfere with effective underwater work.
Chest X-Ray	X	X	PA (Projection: 14" x 17" min.)
Bone and Joint X-Ray Survey	X		Required initially and as medically indicated.
EKG: Stress			Required only as medically indicated.
Pulmonary Function	X	X	Required initially and as medically indicated
Audiogram	X	X	Threshold audiogram by pure tone audiometry; bone conduction audiogram as medically indicated.
Visual Acuity	X	X	Required initially and as medically indicated.
Color Blindness	X		Required initially
Hematocrit, Hemoglobin, WBC Count	X	X	
EEG			Required only as medically indicated
Routine Urinalysis	X	X	
EKG Standard (12l)	X		Required initially to establish baseline, annually after age 35, and as medically indicated
Comprehensive Metabolic profile.	X	X	Optional including cholesteraol and triglucerides required for diversd over 40
Lipid Panel	X	X	Required annualy afterage 35
Framingham Risk Score	X	X	Required annualy after age of 35

1.4 Record Keeping

1.4.1 Diving Logs

During each diving operation, an operation log shall be maintained covering the entire operation. The Diving Supervisor will ensure that the master operations log is properly updated.

Operations logbook will be maintain at the dive control center. This logbook will be a chronological record of all events that directly affect the diving operation. The diving supervisor will sign all entries. The logbook shall include the following:

- Date, time, and location at the start and completion of each dive operation.
- Approximate underwater and surface conditions (weather, visibility, temperatures, and currents).
- Names of dive team members including diving supervisor.
- General nature of work performed.
- Repetitive dive designation or elapsed time since last hyperbaric exposure if less than 24 hours for each diver.
- Diving modes used.
- Maximum depth and bottom time for each diver.
- Name of person-in-charge
- For each dive outside the no-de-compression limits, deeper than 130 fsw, or using mixed-gas, the breathing gases and decompression table designations used.
- When decompression sickness or gas embolism is suspected or symptoms are evident:
- The name of the diver; and a description and results of treatment
- For each fatality or any diving related injury or illness that results in incapacitation of more than 72 hours or requires any dive team member to be hospitalized for more than 24 hours—The date, Time, Circumstances; and Extent of any injury or illness.
- The diving supervisor shall insure that the following is recorded in the logbook for each diving operation deviating from the requirements of this manual:
- A description of the circumstances leading to the situation.
- The deviations made.
- The corrective action taken, if appropriate, to reduce the possibility of recurrence.

1.4.2 Maintenance Logs

Caldwell Marine International shall insure that the equipment identified below will be maintained, inspected/tested, and tagged at the appropriate intervals and documented:

- The date and results of each check of the medical kits.
- The date and results of each test of the air compressor.
- The date and results of each check of breathing mixtures.
- The date and results of each check of each breathing supply system.
- The date, equipment cleaned, general cleaning procedure, and names of persons cleaning the diving equipment for oxygen service.
- The date and results of each test of the breathing supply hoses and sys-tem.

- The date and results of each inspection of the breathing gas supply system.
- The date and results of each test of depth gages and timekeeping de-vices.
- The date and results of each test and inspection of each PVHO.
- The date and results of each inspection of the diving equipment.
- The date and results of each test and inspection of pressure piping.
- The date and results of each test and inspection of volume tanks and cylinders. (see addendum 3-4)

1.5 Limits/Prohibitions

This section will establish limits for the use of the various types of diving equipment and breathing gases for *Caldwell Marine International* divers and contractors. These limits are in accordance with accepted safe diving practices. **THEY ARE CONSIDERED FIRM DO NOT EXCEED THEM WITHOUT EXPRESS PERMISSION FROM *Caldwell Marine International* MANAGEMENT**. The limits established in this section are to govern all diving operations regardless of the geographical location, unless they are in conflict with regulations established by the local government. In this case the limits that are more conservative shall be used, and the area of difference will be brought to the attention of *Caldwell Marine International* management.

1.5.1 General Limits

The limits presented in Table 1-2 are to govern all diving operations conducted by *Caldwell Marine International* divers and contractors.

Table 1-2 *Caldwell Marine International Diving* Limits

Depth: Feet	Meters	Type of Diving Activity
0 fsw	0 m	CMI requires a bail out bottle at all times regardless of depth. (USCG)
60 fsw	18.2 m	Recompression chamber required at the dive site for any dives deeper than this depth or any dives requiring decompression. (ADC)
130 fsw	39.6	Stage or open bell required for dives deeper than this depth or for any for any dives requiring decompression (USCG)
100 fsw	39.6	Maximum permissible depth for SCUBA (USCG)
170 fsw	51.8	Normal working limit for surface supplied air diving. Dives deeper than this depth will not be conducted without the permission of *Caldwell Marine International* management (*Caldwell Marine International*)
190 fsw	57.9 m	Air dives deeper than this depth will be limited to dives with a maximum bottom time of 30 minutes. (USCG)
220 fsw	67 m	Maximum limit for live boating. (USCG) – not permitted
220 fsw	67 m	Maximum limit for surface supplied air diving. Maximum bottom time – 30 minutes. (USCG)

2. Operation Planning

2.1 General Planning Considerations

Planning of a diving operation shall include a Job Hazard Analysis. A successful diving project is the direct outcome of careful, thorough planning. The nature of each operation determines the scope of the planning effort, but certain general considerations apply to every operation.

- **Bottom Time**: Bottom time is always at a premium. Developing measures to conserve bottom time or increase diver effectiveness is critical for success.
- **Preplanning:** An operation that is delayed due to unanticipated problems may fail. Preplanning the use of the time available to accomplish specific objectives is a prerequisite to success.
- **Equipment:** Selecting the correct equipment for the job is critical to success.
- **Environmental Conditions:** Diving operational planners must plan for safely mitigating extreme environmental conditions. Personnel and support facility safety shall be given the highest priority.
- **Diver Protection:** It is critical to protect divers from shipping hazards, temperature extremes, and dangerous pollution during all operations.
- **Emergency Assistance:** It is critical to coordinate emergency assistance from outside sources before the operation begins.
- **Weather:** Because diving operations are weather dependent, dive planning should factor in delays due to weather.

2.2 Define Project Objective

A clear and concise statement of the project objective shall be established. This includes an in-depth breakdown of all task required to complete the job, the location and the time frame in which it is to be accomplished. All parties involved in the project, diving and non-diving should work together to define the scope of work. Once the diving objectives have been outlined planning can begin.

2.3 Information Gathering

The size of the operation, the diving site location, bottom conditions, and the prevailing environmental conditions influence the extent and type of information that must be gathered when planning an operation. Some operations are of a recurring nature; so much of the required information is readily available. However, even for a standard operation, procedures may have been modified or special environmental conditions may exist, requiring a change in the plan or special tools. Potential changes in task requirements affecting work procedures should not be overlooked during planning. Areas, which should be considered when planning an operation, include government regulations affecting diving, resources, both logistical and emergency that are available locally to support the operation.

2.3.1 Surface Conditions

Surface conditions in the operating area affect both the divers and the topside team members. Surface conditions are influenced by location, time of year, wind, waves, tides, current, cloud cover, temperature, visibility, and the presence of other ships. Completing the Environmental Assessment Work-sheet can help ensure that environmental factors are not overlooked during planning. Weather reports and long-range weather forecasts shall be studied to determine if conditions will be acceptable for diving. Weather reports shall be continually monitored while an operation is in progress.

NOTE: Diving should be discontinued if sudden squalls, electrical storms, heavy seas, unusual tide or any other condition exists that, in the opinion of the Diving Supervisor, jeopardizes the safety of the divers or topside personnel.

2.3.2 Sea State

A significant factor is the sea state. Wave action can affect everything from the stability of the moor to the vulnerability of the crew to seasickness or injury. Unless properly moored, a ship or boat drifts or swings around an anchor, fouling lines and dragging divers. Wave action will cause the vessel to pitch and roll, resulting in a potentially hazardous surge on lines and hoses to the diver and equipment such as a jet sled or bell, on or near the bottom. Divers are not particularly affected by the action of surface waves unless operating in surf or shallow waters, or if the waves are exceptionally large. Surface waves may become a serious problem when the diver enters or leaves the water and during decompression stops near the surface.

2.3.3 Tender Safety

Effective dive planning shall provide for extreme temperatures that may be encountered on the surface. Normally, such conditions are a greater problem for tending personnel than for a diver. Any reduction in the effectiveness of the topside personnel may endanger the safety of a diver. Tending personnel shall guard against:

- Sunburn
- Windburn
- Hypothermia
- Frostbite
- Dehydration
- Heat exhaustion

2.3.4 Surface Visibility

Variations in surface visibility are important. Reduced visibility may seriously hinder or force postponement of diving operations. For operations to be conducted in a known fog belt, the diving schedule should allow for delays because of low visibility. Diver and support crew safety is the prime consideration when determining whether surface visibility is adequate. Proper flags signaling devices shall be use during the day and at the proper lighting shall be use to warn other vessels in the area.

2.3.5 Depth

Depth is a major factor in selecting both diving personnel and apparatus and influences the decompression profile for any dive. Depth must be carefully measured and plotted over the general area of the operation to get an accurate depth profile of the dive site. Operations in deep waters may also call for special support equipment such as underwater lights, cameras, ROV, etc.

2.3.6 River or Major Ocean Currents

The direction and velocity of normal river, ocean, and tidal currents will vary with time of the year, phase of the tide, con-figuration of the bottom, water depth, and weather. Tide and current tables show the conditions at the surface only and should be used with caution when planning diving operations. The direction and velocity of the current beneath the surface may be quite different than that observed on the surface.

2.3.7 Underwater Visibility

Underwater visibility varies with depth and turbidity. Visibility is poorest in harbor areas because of river silt, sewage, and industrial wastes flowing into the harbor. Agitation of the bottom caused by strong currents and the passage of large ships can also affect visibility. Divers are frequently required to dive at night or in an enclosed space where visibility very limited. Generally good visibility can be considered a luxury, and should be accounted for.

2.3.8 Type of Bottom

The type of bottom may have a significant effect upon a diver's ability to move and work efficiently and safely. Advance knowledge of bottom conditions is important in scheduling work, selecting dive technique and equipment, and anticipating possible hazards. The type of bottom is often noted on the chart for the area, but conditions can change within just a few feet.

2.4 Logistics

The initial task to be planned for is getting all equipment, supplies and personnel on site at the proper time. Once on the scene and operating the problem becomes one of maintaining an adequate supply required materials to meet anticipated requirements.

- Consultation with the Person-in-Charge of the platform from which operations are to be conducted is necessary. He must fully understand all of the demands that will be placed on his vessel so he has time to make the preparations required to ensure that his craft is ready on time. Arrangements must also be made for the placement of diving and support equipment on board in a manner that will not affect the stability and operability of the craft.
- Complying with regulations established by the government whose waters diving operations are being conducted is essential. It is not uncommon for a government to require written permission, submit copies of intended diving procedures, to have procedures that are more conservative than this manual. Governments may require environmental impact statements. The cost of not complying with governmental regulations can be enormous.

- Arrangements for personnel must not be over looked. This not only includes arranging for a sufficient quantity of qualified personnel at all levels, but also arranging backups in the event that personnel scheduled for a job are unable to make it, and making sure that personnel know when and where they are supposed to be, and any special equipment they are to bring.

2.5 Chart and Checklists

The charts and checklists are provided to assist the project planner complete the Job Hazard Analysis. (see addendum #1)

3. Safety

3.1 General

This section is intended to cover general safety rules and regulations relating to operations and equipment not dealt with in other sections. *Caldwell Marine International* divers and contractors should become intimately familiar with this section. **SAFETY IS A FULL-TIME JOB**. The more conscientious each employee becomes regarding safety, the safer and cost effective each job becomes.

- No standards will ever exist which can substitute for common sense, sound judgment, and a continuing concern for operation risk management.
- The procedures contained in this manual represent the minimum acceptable diving safety procedures to be employed in commercial diving operations.
- It is recommended that deviation from these procedures should only be undertaken when, in the opinion of the diving supervisor that a emergency situation exists and these procedures would do harm.
- Decompression procedures established in the US Navy Diving Manual Revision 6 will be used as a guideline and it will be the responsibility of all diving personnel to know and understand them so as to establish a safe and healthful working environment fir the diver.

3.2 Emergency Services

At all times while diving operations are being carried out, emergency services must be available and be able to proceed by the fastest means of transport to the location of the diving operations in the event of an life threatening emergency.

3.3 Diving Operations

- Water craft of any kind shall not come alongside a vessel from which diving operation are being conducted while a diver is in the water. The only exception to this rule is when the diver is working out of a stage or diving bell and the diving supervisor has giving his permission.
- Precaution shall be taken to ensure that the divers umbilical does not be come fowled in the propellers of the diving support vessel.
- Prior to lifting heavy objects from the bottom the diver should leave thewater.
- Appropriate signals, accordance with figure 3 –1, shall be displayed when

conducting diving operations. Adendum #XX

- Every precaution must be taken to prevent the divers umbilical from becoming fowled on hazards on the bottom.
- All efforts must be taken to isolate or shutdown any equipment/systems at the work site that present a potential hazard to the diver.
- Diver will not cut any lines until their purpose is known and permission is given from topside.
- The depth of the water, condition of the diver shall determine the length of the dive.
- No diver who shows apparent sings of intoxication, its after-effects (hangover), or is under the influence of drugs will be allowed on any dive station.
- Skylarking, horseplay, or carelessness will not be allowed on any diving station.
- All adjoining work activities shall be informed prior the commencement of diving operations.
- When a diver enters a pipeline, wreck, structure, tunnel, or any other restricted underwater area, another diver shall be available at the point of entry to tend the diver who has entered the enclosed space. **SCUBA DIVING IN ENCLOSED SPACES IS NOT PERMITTED.**
- All tools passed to the diver or recovered from the diver shall be turned off.
- If the diving supervisor does not feel that the divers fully understands all the safety aspects of the task, the diver shall not be used for the job.
- Divers should not dive with colds, sinus or lung congestion.
- The diver shall make sure that he fully understands the task the he is being asked to perform.
- Any diver who is taking medicine for any reason will inform the diving supervisor of the type of medicine and what for. All medicine must be cleared by a diving medical doctor prior to diving.

3.4 Responsibilities of the Diving Supervisor

The Diver Supervisor is on the frontline of this companies construction operation. He is responsible for the safe practices of all diving personnel and non-diving personnel working in his diving station. **SAFETY IS NEVER TO BE JEOPARDIZED TO ACHIEVE A TASK.** To realize this important responsibility the following items are considered the minimum standards.

- Enforce safety procedures and company policy
- Inform employees of safe practices
- See that all practical recommendations are carried out. If there is a conflict with set procedures bring it to the attention of management for the benefit of all employees.
- Ensure the all accidents are fully investigated and all reports are submitted in a timely manner, and that corrective measures are put in place to protect against the accident happing again.
- Stay up to date with new diving techniques, and assist in teaching the new methods to fellow employees.
- Stay current in US Navy techniques for treating Arterial Gas Embolism and Decompression Sickness.

- Maintain an open exchange of information between management and employees.
- Maintain accurate records.
- Establish dive plans with the safety of the dive team first in mind.

3.5 Diving Personnel Responsibilities

As an employee of Caldwell Marine International Group you are our most valued asset.

- Develop and utilize correct and safe working practices at all times.
- Use the proper tool for the task at han.
- If you notice damage on equipment for example, a crack weld or stuck valve bring it up to your supervisor so it can be fixed, more importantly so the equipment does not get put into service during a diving operation and fail while in use by a diver in the water or under pressure in a chamber.
- The proper PPE is worn at all times
- Report all injuries immediately and completely.
- Participate in daily JAG review and safety meetings.
- Correct hazards under your jurisdiction and report those outside your responsibility to your supervisor.
- Practice good house keeping in your work areas
- Only use tools that are cleaned for Oxygen use on an Oxygen system.

3.6 Deck and General Safety

All personnel:

- Stand clear of all lines, hoses, diving equipment, and high-pressure flasks and diver supply hoses.
- Deck Crew:
- Exercise care while loading materials around diving gear and diving equipment. If you should accidentally damage any diving gear or equipment bring it to the attention of the diving supervisor so a proper inspection can be accomplished.
- Do not move any diving equipment without permission of the diving supervisor and unless a member of the dive team is present.
- Do not touch any diving equipment especially do not change any valve configurations, line voltage that is connected as a primary or backup sourced for the diver, without permission of the diving supervisor.

3.7 Deck Crew Directly Assisting the Divers

- Be alert follow instructions carefully.
- Take order only from the diving supervisor.
- Do not wander off from your assigned station unless properly relieved by the diving supervisor.
- Know and be able to identify the meaning of diver line signals.
    - 1 Line Pull - All Stop
    - 2 Line Pulls - Provide Slack on the Divers Hose
    - 3 Line Pulls - Pick-up Slack on Divers Hose

- 4 Line Pull - Pick-up Slack – Diver Surfacing
- Repeated Line Pulls - Emergency, Bring the Diver Up ASAP

3.8 Crane Operators

- When it becomes necessary to move any diving equipment around have a dive team member assist in positioning.
- Should you accident bump into the diving equipment while moving a load notify the diving supervisor
- When assisting in diving operations maintain two-way radio communication with the diving supervisor. Under no circumstances accept any instructions or signals from anyone other than the diving supervisor.
- Understand the task being performed and all hand signals and radio communication expected to be used with the diving supervisor.

3.9 Uses and Storage of Gas Cylinders

NEVER

- Never use cylinders as rollers or supports even when they are empty.
- Never use valve protection caps for lifting cylinders.
- Never use a hammer or wrench to open cylinder valves.
- Never drop or allow any cylinder to fall especially oxygen.
- Never tamper with fuse plugs.

ALWAYS

- Always open cylinder valves slowly to allow the pressure in the system to come up gradually.
- Always keep cylinders far enough away from hot areas so that sparks, slag or flames will not reach them.
- Always store cylinders, both full and empty, so they can not be knocked over.
- Always soap test new connections.
- Always shut valves when finished with them even for a short time.
- Always use the proper “T” wrench to key to open valves on cylinders such acetylene.
- Always replace the cylinder valve cap when the regulator is removed.
- Always tie cylinders down.
- Always store cylinders in a ventilated area.
- Always mark empty cylinders.

3.10 Oxygen Safety Precautions

Oxygen is the most hazardous gas generally handled during diving operations. Oxygen lowers the ignition temperature of flammable substances and accelerates combustion. Hydrocarbons (oil grease ect.) can spontaneously combust in high Oxygen environments. The following rules apply when working with pure or high Oxygen percentages.

- Equipment used with oxygen must be designed for such use.
- Always use a clean oxygen regulator to get oxygen form a cylinder.
- **Never lubricate or allow oil or grease to come in contact with oxygen**

connections, or other oxygen equipment.

- Oxygen systems with pressures greater than 125 psig must have slow opening shut-off valves.
- All lubricants, gaskets, plastics, diaphragms, o-ring materials ect, use in oxygen systems must be O_2 compatible.
- All oxygen system must be assembled free of organic materials and loose particles. All valves, gauges, piping, used in oxygen systems must be Certified "Cleaned for Oxygen Service."
- The Recompression Chamber environment will be maintained at19 to 25 present. Chamber occupants will not be allowed flammable material in with them.
- Clothes, blankets, bedding and other materials used in recompression chamber must be made of fire retardant materials.
- Never use oxygen for compressed air or as a source of pressure.
- The minimum psig in an O_2 cylinder 25psi.

3.11 Operation and use of equipment underwater

Whether it is a screwdriver, specially designed tool, or welding torch, the diver will be thoroughly familiar with and experienced in use of what ever underwater tool is being used at the time.

- Never use a tool is not in good working condition.
- Do not overburden the work site.
- Arrange to have all required gear and tools readily available.
- Power tools shall be off when sent to a diver and when brought to the surface.
- If a hydraulic or pneumatic is available to perform the task required never use a electrically powered tool as a substitute.
- Never lower or drop tools or materials on divers or subsea assets. Always perform any driops next to the diver or assets.

3.12 Underwater Cutting and Welding

Underwater cutting and welding operations involve several hazards, including lethal electrical currents, oxygen and hydrogen rich gases that will explode in the presence of a spark and electrode tip, with temperatures in excess of 10,000°F. It is impossible to anticipate all possible situations that may arise in underwater cutting or welding operations. Consequently, it cannot be assumed that safe operating conditions will exist simply by blindly following the guidelines set forth in this manual. Nonetheless, with a thorough knowledge of cutting and welding fundamentals combined with the use of common sense and sound judgment, the procedures described in this manual can be performed in maximum safety.

3.12.1 Explosive Gases

A. Gases produced by underwater cutting are rich in oxygen and hydrogen and will explode if trapped and ignited. Gases from underwater cutting will collect in closed compartments, open tubular structural members, open piping systems, shaped structural

members and under such members as "H" beams. Before cutting, it is mandatory that provision be made to evacuate existing gases and eliminate the possibility of further gas entrapment. If the presence of trapped explosive gas mixtures is uncertain, it may be necessary to drill holes in suitable locations to allow the gases to escape. This will flood the compartment with seawater. An alternative would be to purge the compartment with a mixture of gases, which will not support combustion. Underwater cutting and welding processes generate explosive gases.

- When cutting with power on or welding, hydrogen and oxygen are dissociated from the water and will travel separately as bubbles. These bubbles can collect in a trapped or confined space overhead. As the hydrogen and oxygen gases combine they will ignite, causing a popping sound.
- Oxygen cutting is about 60 percent efficient, resulting in approximately 40 percent pure oxygen being released into the environment. This gas can become entrapped above the work area, and when combined with a fuel such as hydrocarbons, can easily be ignited by a hydrogen bubble or a spark trapped in the bubble. Any pop is a sign of explosive gases collecting above the underwater work area and is the point when cutting or welding must stop and the cause investigated.
- Prior to the start of any underwater cutting or welding, as built drawings and physical configuration of the work area must be studied to determine all these areas and voids that could contain or trap explosive gases. These areas and voids must be vented or made inert in accordance to prevent possible explosions.
- Care should also be taken when cutting or welding on enclosures that are on or above riverbeds, especially in mud, because trapped methane gas in the proper concentrations can explode.

B. Any one or a combination of the following may produce explosive gases:

- Petroleum products such as gasoline, fuel oil or greases;
- Paint mixing mediums, such as linseed oil or thinners;
- Epoxies, adhesives and solvents;
- Ammunition or bulk explosives;
- Decaying vegetable or animal matter; and
- Unburned gases from cutting torches.
- Every precaution must be taken to prevent an underwater explosion. To minimize the possibility of explosions from trapped gasses, the following procedures are recommended:
- Start cutting at the highest point and work downward.
- When cutting thick material, i.e., propeller shafting, cut from the outside and work around the circumference. By withdrawing the electrode every few seconds to allow water to enter the cut, exceedingly high temperatures can not build up inside the metal.
- Brushing or stroking action in the direction of the intended cut should be used.
- Gases may be vented to the surface with a vent tube (flexible hose) secured in place from the high point where gases would collect to a position above the waterline.

3.12.2 Electricity Underwater

A. Electricity Underwater

Electricity and water are incompatible by nature and the use of electrically powered equipment underwater presents a potential shock danger to both the diver and the tender. When using electrically powered equipment such as cutting, welding or underwater lighting, the diver and tender must be protected from electric shock. All personnel engaged in underwater cutting and welding should be thoroughly trained in CPR and first-aid so they can render immediate assistance in the event of an accident. There are many conditions that contribute to making underwater work difficult. These include adverse currents, unstable footing, poor visibility and low temperatures. A constant source of danger comes from the falling or rolling of cut-away pieces. This is especially true in salvage wrecking. These, combined with the dangers involved in operating an electric arc capable of producing fatal shock, severe burns and explosive gas pockets, create a situation where the diver must be extremely alert.

The following precautions must be observed:

- Careful examination should be made before starting the cut to learn how the cut-away pieces will fall and whether there are any projections, wires or other objects which may foul lines or cause a piece to swing around in an unexpectedmanner.

- Be extremely careful when cutting tightly-bound wire rope e.g., wire wrapped in a ship's propeller. When severed, the wire can backlash with spring-like force.
- Before cutting, ensure that umbilical and diving equipment will not be in the path of slag from the cutting operation.
- Avoid cutting overhead if possible, since the falling molten material will seriously damage the diving helmet, dress and umbilical.
- Never put down or carry an electrode holder while the power is on.
- Never change an electrode while the power is on.
- The diver must never allow any body part or equipment to come in contact with the grounded work when the safety switch is closed.
- Care should be taken with diver-carried large loose metallic items (i.e., wrenches and backpacks) to ensure no contact is made with a live electrode or the work.

B. Power Supply

The power supply used for underwater cutting or welding shall consist of only approved electric welding machines and shall be tested for proper working order prior to use. **Use only DC welding powe**r. Competent, experienced personnel in accordance with approved plans shall install electric welding equipment. This requirement is especially applicable to the installation of primary power lines and outlets intended to supply power to the electric welding machines. The equipment shall only be operated in accordance with the manufacturers recommended operating procedures and the safety precautions outlined in this manual. The following precautions are to be observed during set up and operation of arc cutting or welding equipment:

- Ensure that the welding machine frame and supporting structure are grounded before starting operations.
- Ensure that neither terminal of the welding machine is or becomes short-circuited to the machine frame before starting operations.

- Ensure that all electrical connections are securely made before starting operations.
- d. Stand on dry wood, rubber matting or similar insulating material and not on grounded metal.
- Wear dry rubber or rubberized-canvas gloves that are in good condition when handling energized holders, torches, cables or welding machines.
- Keep the welding machine commutators clean to prevent excessive flashing.
- Keep the welding machine clean and operable, free of oil and grease and (in electrical parts) free of metallic particles that can cause short circuits.

C. Electrode Holders and Cutting Torches

The following are electrode holder and cutting torch precautions that should be observed:

- Use only torches and electrode holders that have been specifically designed for under-water applications. They must have the capacity to handle the maximum rated current required by the electrode being used.
- Inspect the apparatus and ensure that all current-carrying parts are fully insulated with nonconducting material. This material should safely insulate against the maximum voltage encountered to ground. Remember, new does not necessarily

  mean ready for use. Extra insulation may be required, which will provide further diver protection and extend the life of the electrode holder.
- Standard holders designed for surface use shall not be used except in exceptional situations.
- Inspect the electrode holders for worn or damaged parts and insulating material and repair or replace any parts as necessary. Flashback arrestors and monel screens must always be in proper working order.
- Do not lower the welding or cutting torch before the ground clamp is securely attached near the work area.
- Before lowering or raising the electrode holder or ground clamp, ensure that the current is off and the knife switch is open.
- Never attempt to change or tighten an electrode with the current on.
- Never hold the holder so the electrode points toward the body. This can be likened to pointing a loaded pistol at oneself.
- Special care should be taken to avoid touching the metal parts of the diving equipment with the electrode or any uninsulated parts of the electrode holder.

D. Power Cable and Connector Safety

The following are power cable and connector safety precautions that should be observed:

- All parts of the cables that are intended to be submerged shall be fully insulated and watertight. This cannot be overstated.
- Inspect cables and cable connections for damaged insulation before starting operations. Defects in the cable must be repaired or the cable replaced before starting operations.
- All connections shall be made tight and thoroughly insulated by wrapping in rubber tape, applying a layer of scotch cote, then wrapping with electrical tape. This will prevent current loss at the connections. Cables that produce bubbles during

operation should be replaced. The bubbles indicate that current is being lost through the porous insulation.

- Use only welding cables that are a minimum of 2/0 extra flexible. An exception is the electrode holder lead, which can be 1/0. The 1/0 lead is more flexible and will aid the diver in maneuvering the electrode holder. The cable must conform to the applicable requirements of Military Specification MIL-C-915. Cables must be capable of handling the maximum current requirements of the intended work.
- Do not use excessive lengths of cable with large sections stored on deck. When working in deep water, a strain relief should be provided across the connections to support cable weight.
- When connecting lengths of cable, use connectors that have a current carrying capacity that is equivalent to the cable being used.
- Ensure that the 1/0 stinger lead between the electrode holder and the welding lead is defect-free. The cable connection coupling the stinger lead to the 2/0 welding lead should be thoroughly insulated with a layer of scotch cote, wrapped in rubber tape, insulated with an additional layer of scotch cote, then finally wrapped with electrical tape or heat-shrink tubing. This will afford added protection for the diver.

WARNING: The position of the ground in relation to the diver must be such that at no time does the diver or equipment become positioned between the ground and the electrode. The diver must avoid becoming part of the electrical circuit.

- Secure the ground clamp as close to the work-site as possible, preferably in the forward line of vision. The diver must face the ground when welding or cutting. A good rule-of-thumb to remember is: NEVER TURN YOUR BACK TO THE GROUND WHEN THE POWER IS ON.
- Keep additional power cables such as underwater light cables and welding leads separated.
- Cables should be strung overhead if they are to be run for long distances. If this is not practicable and they must be laid on deck, they must be protected and arranged to prevent interference with safe passage of personnel.
- When portable lighting is used, it should be clamped or fully secured in position and not hand held. The portable lighting power cords must be kept clear of the welding leads and work area. Additionally, a ground-fault detector/interrupter (GFD/I) must be incorporated in the circuit.
- Cables in storage should be kept dry and free of grease and oil, which cause premature breakdown of the insulation.

CAUTION: When AC power is required for underwater lighting or operation of hand tools, the AC equipment must be protected by ground-fault detection (GFD) and/or ground-fault interruption (GFI) devices.

D. Safety Switch

A positive-acting, infusible current interrupt switch, rated at 400 amperes must be in the welding circuit. This switch protects the diver by breaking the electric circuit, thereby

stopping the current supply to the electrode holder. The safety switch, more often referred to as a knife switch, is the most important safety item included in the underwater cutting or welding equipment inventory. The diver is fully isolated from electric current when the knife switch is open. The tender (phone talker) should only be instructed to close the switch when the electrode is poised for cutting or welding. It is extremely important to mount the switch correctly. The switch must be positively acting, rigidly mounted and located so that it cannot be accidentally knocked or vibrated closed. Should the switch fall, the circuit would be broken. Both double-pole and single-pole safety switches are authorized, however a double-pole is the most often used because both the working and ground lead are opened or closed simultaneously. To ensure safety switch effectiveness, the following guidelines must be followed:

- When using a single-pole knife switch, it should be located in the welding-lead side of the electric circuit and should be able to handle the maximum welding current.The safety switch must be mounted vertically on a non-conducting (wooden, plastic, etc.) stand. The switch has an open circuit potential of approximately 80 volts across the poles. To prevent accidents, the safety switch should be fitted with a non-conducting slotted cover.
- When reverse polarity is required, the safety switch must be placed in the cutting or welding lead side of the circuit.
- Never operate a knife switch in a combustible atmosphere.
- The knife switch must be in proper working order. Additionally, the switch contact surfaces should be periodically checked for verdigris accumulation.
- The current shall be off (knife switch open) at all times, except when poised for or actually cutting or welding.
- When a single-pole knife switch is used, special care must be taken to ensure that the safety switch is not shunted out between the switch and weldingmachine.
- Wet, bruised or worn cables can be shorted by rubbing against the welding machine frame, hatch combings or by lying on a steel deck. This creates a potential source of danger. Inspect the cable thoroughly and wrap any questionable spots in the insulation with rubber tape, followed by an additional layer of electrical tape or heat shrink.
- Periodic inspection should be made to ensure that the insulation is not damaged.
- The safety switch shall be located in such a position that enables the phone talker or designated tender to operate or oversee the operation of the switch during the entire time the diver is in the water. The switch shall not be closed unless specifically directed by the diver to do so. The phone talker shall confirm each change to the diver via the intercommunications system.

E. Fire and Explosion Prevention

The major causes of fire and explosion are listed as follows:

- Combustibles reached by the arc,
- Flying sparks,
- Hot slag,
- Misuse of compressed gases and cylinders and
- Short circuits.

- It is necessary for the diving supervisor be aware of topside work being conducted in the vicinity of the diving station. Do not allow welding or cutting in an area where there are combustibles. Sparks and slag can fly up to 35 feet. Keep equipment clean and operable, free of oil and grease and free of metallic particles (in electrical parts) that can cause short circuits.
- Hydrocarbons ignite almost spontaneously in the presence of oxygen. **Never allow oxygen-carrying components to come in contact with oil or grease.**

3.13 Hand tools

- Hand tools are often misused simply because the user has never been shown how to use the tool the proper way.
- Wrenches should be inspected frequently to eliminate worn or sprung jaws, broken cages, springs, and bent or cracked handles.
- Frequently inspect driving faces of hammers, chisels, drift pins, bars and similar tools to eliminate mushroomed heads, broken faces, cracked handles and other defects.
- Handles should be sound and securely wedged or fastened to the tools. Painting or taping of handles are prohibited for these practices may cover defects orcracks.
- Keep hand tools clean and in good working order.

3.14 Explosives

Prevention of explosive accidents depends on careful planning and faithful observance of proper blasting practices. The slightest abuse or misdirection of explosives may either kill or cause serious injury to yourself or others. Two general statements may be made about safety and the uses of explosives: (1) a blaster most important responsibility is safety; and (2) the safety of every blasting operation depends on itspeople.

The most important ingredients in a safety program are the quality of it people and the quality of their training. If explosives are to be used on a project a complete Explosive Safety Plan will be completed by the planner covering all aspects of safety and State, Federal, or Governmental regulations. The planner will ensure that the blasting crew is well trained in the blasting technique to be used, and that all safety precautions that can be taken are taken to protect personnel and equipment.

3.15 Confined Space Entry/Tunnel Penetration

Divers are often required to work in an enclosed or confined space. Enclosed space diving shall be supported by a surface-supplied air system.

NOTE Physically Confining Space is any space which would restrict the diver's ability to rotate head to toe, 180 degrees in any plane and/or when the diver has no direct access to the surface or bell for recovery of the diver from the water.

Enclosed Space Hazards: The interior of sunken ships, barges, pipelines, and cofferdams is hazardous due to limited access, poor visibility, and slippery surfaces. Enclosed spaces may be dry or flooded, and dry spaces may contain a contaminated atmosphere.

NOTE: When a diver is working in an enclosed or confined space an additional diver shall be stationed at the underwater point of diver ingress and immediately available to come to the assistance of the diver. In these conditions the dive team must include an additional Tender/Diver, ultimately, the number of tending divers deployed depends on the situation and the good judgment of the Diving Supervisor on the site.

Enclosed Space Safety Precautions:. Because of the hazards involved in enclosed space operations, divers must rigorously adhere to the following warnings.

WARNING: During enclosed space diving, all divers shall be outfitted with a surface supplied rig that includes a diver-to-diver and diver-to-topside communications system and a Bailout Bottle for the diver inside the space.

WARNING: For a dry penetration the divers shall not remove their diving equipment until the atmosphere tests confirm that the atmosphere is safe to breath the air will be tested constantly and the diver must be ready at all times to don his diving rig.

WARNING: If the diving equipment should fail, the diver shall immediately switch to the Bailout Bottle and abort the dive. The Bailout Bottle must have an adequate supply of air to support the diver from the deepest penetration point of the dive. The air requirem.ent for the Bail out Bottle shall be determined during the planning stages of the dive.

Working Around Corners: When working around corners where the umbilical is likely to become fouled or line-pull signals may be dissipated, a second diver (tending diver) may be sent down to tend the lines of the first diver at the obstruction and to pass along any line-pull signals. Line-pull signals are used when audio communications are lost, and are passed on the first diver's lines; the tending diver uses his own lines only for signals directly pertaining to his own situation.

Pre Entry Planning: A site specific HASP is required before entry into a confined space. The plan will cover all aspects of the planned operation; entry and egress form the confined space, health hazards physical chemical biological, emergency response plan. Additionally the HASP will include any permits required by local, state and federal governments.

Training of Personnel: A diving certification is not considered a certification to enter a confined space. The entire crew will be trained in confined space entry and rescue.

4. Equipment Requirements

In order to ensure the safety and wellbeing of the diver, the equipment used in diving operations must be designed to adequately perform the service required, properly maintained in accordance with Governmental regulations, and manufacturers specifications. This section will provide details of the requirements which equipment must meet prior to being used in diving operations conducted by *Caldwell Marine International* divers.

4.1 General System Requirements

To be considered complete, and safe for diving operations a diving system must include the following equipment:

- The equipment must be maintained and certified as per governmental regulations
- The equipment must be capable of supplying the correct gas mixer at the proper standard cubic feet (SCF) and pressure as required for depth.
- A Recompression Chamber is required for any dives deeper than 60 feet or for any dives requiring decompression, or when live-boating at anydepth.
- Voice communications between top side and all divers is required.
- An accurate depth-measuring device is required.
- First aid equipment
- Wet suit, dry suit or hot water suit system which will maintain the diver's body temperature
- A system, which will allow the diver to enter and safely exit the water, is required.

4.2 Diving Supervisor Responsibilities

Prior to the beginning of any diving operation, the diving Supervisor shall ensure that:

- That all equipment with the exception of mobile equipment required for the job is in place, ready for immediate use and secured firmly in place for the duration of the project.
- That the deck recompression chamber is readily accessible to divers returning from underwater operations.

At a minimum every 24 hours the diving Supervisor shall check:

- That all diving systems and equipment being used are in good working order.
- That all diving equipment has been leak tested.
- That all diving systems valve line up configurations have not been tampered with by non-diving personnel.

4.3 Diver Worn Equipment

For the proposes of this manual, diver worn equipment shall include all equipment required for the safety and the wellbeing of the diver, which is worn by or attached to the diver while he is in the water. When required by *Caldwell Marine International*, divers will use equipment specified and provided by *Caldwell Marine International*. No exceptions will be made without the permission of *Caldwell Marine International* management, except in the event of an emergency.

4.3.1 Helmets

The divers' helmet is the most important piece of equipment. Improperly maintained helmets put the diver at an extreme risk. Helmets/masks used by *Caldwell Marine International* divers will:

- Have a non-return check valve located at the attachment point of the umbilical to the helmet.

- Must have an exhaust valve.
- Have reliable two-way communications system

- Must supply the diver with a vent rate of 4.5 (acfm) at any depth the helmet is operated at.
- Dive Superintendent will check helmet certifications and do a visual inspection.

4.3.2 Pre-dive Checks

Immediately prior to each use, a helmet/mask will receive the following checks:

- Visual inspection for obvious signs of damage to the frame, faceplate, breathing system, neck dam, etc.
- Proper operation of the gas system including al regulators and valves.
- A vacuum test performed on the non-return valve.
- A communication check.

4.3.3 Thermal Protection

It is the responsibility of the diver to provide himself with and maintain a wet suit or dry suit, which will provide thermal protection

Suit Selection. Custom wet suits designed for cold-water diving, variable volume dry suits, and hot water suits have all been used effectively for diving in extremely cold water. Each has advantages and disadvantages that must be considered when planning a particular dive mission. All suits must be inspected before use to ensure they are in good condition with no seam separations or fabric cuts.

4.3.4 Wet Suits

Custom wet suits have the advantages of wide availability, simplicity and less danger of catastrophic failure than dry suits. Although the wet suit is not the equipment of choice, if used the following should be considered:

- The wet suit should be maintained in the best possible condition to reduce water flushing in and out of the suit.
- Wearing heavy insulating socks under the boots in a wet suit will help keep feet warm.

CAUTION In very cold water, the wet suit is only a marginally effective thermal protective measure, and its use exposes the diver to hypothermia and restricts available bottom time. The use of alternative thermal protective equipment should be considered in these circumstances.

4.3.5 Variable Volume Dry Suits

Variable volume dry suits provide superior thermal protection to the surface-supplied or scuba diver in the water and on the surface. They are constructed so the entry zipper or seal and all wrist and neck seals are waterproof, keeping the interior dry. They can be inflated orally or from a low-pressure air source via an inlet valve. Air can be exhausted from the

suit via a second valve, allowing excellent buoyancy control. The level of thermal protection can be varied through careful selection of the type and thickness of long underwear. However, too much underwear is bulky and can cause overheating, sweating, and subsequent chilling of the standby diver. Dry suit disadvantages are increased swimmer fatigue due to suit bulk, possible malfunction of inlet and exhaust valves, and the need for additional weights for neutral buoyancy. Further-more, if the diver is horizontal or deployed with the head below the rest of the body, air can migrate into the suit lower extremities, causing over inflation and loss of fins and buoyancy control. A parting seam or zipper could result in a dramatic loss of buoyancy control and thermal shock. Nevertheless, because of its superior thermal protection, the dry suit is an essential component of extremely cold water diving.

4.3.6 Extreme Exposure Suits/Hot Water Suits

Hot water suits provide excellent thermal protection. If their use can be supported logistically, they are an excellent choice whenever bottom times are lengthy. They are impractical for use by standby divers exposed on the surface. A hot water system failure can be catastrophic for a diver in very cold water since the hot water is a life support system under such conditions. Hot water temperature must be carefully monitored to ensure that the water is delivered at the proper temperature. Should dive conditions/durations require the use of a hot water suit system it will be provide by the company.

4.3.7 Pre-dive Checks and Maintenance

The flowing are checks that should be conducted prior to each use.

- Inspect the zipper slides.
- Check foam for gouges, rips or parting of the seams.
- Checks boots and gloves for damages.
- After each dive clean rinse, and dry the suit, boots and gloves with fresh clean water.
- Store in a dry location avoid folding for long periods.

4.3.8 Safety Harness/Bailout bottle

All divers must wear a safety harness. This harness will have a positive buckling device and an attachment ring for the umbilical that distributes the pulling force of the umbilical over the body of the diver, and prevent a direct strain form being placed on the diver helmet. The harness will also have a ring/loop to which a line can be attached for lifting the diver up and over the side in an emergency.

For all surface supplied dives, a bailout bottle will be used. It will be at a minimum equal to or greater than 19 cubic feet. It shall provide the total quantity of breathing mixture available for use by a diver until the standby diver reaches him and they can:

- Return to the surface and carry out the appropriate decompression procedures during the return
- Or standby diver provides the stricken diver with another source of air and than

abort the dive carrying out the appropriate decompression procedures during the return.

4.3.9 Knife

Several types of knives are available. Diving knives should have corrosion-resistant blades and a handle of plastic, hard rubber, or wood. Handles made of wood should be waterproofed with paint, wax, or linseed oil. Handles of cork or bone should be avoided, as these materials deteriorate rapidly when subjected to constant saltwater immersion. Cork may also float the knife away from the diver. Knives may have single-or-double- edged blades with chisel or pointed tips. The most useful knife has one sharp edge and one saw-toothed edge. All knives must be kept sharp. The knife must be carried in a suitable scabbard and worn on the diver's, harness, hip, thigh, or calf. The knife must be readily accessible, must not interfere with body movement, and must be positioned so that it will not become fouled while swimming or working. The scabbard should hold the knife with a positive but easily released lock. **The knife and scabbard must not be secured to the weight bel**t. If the weights are released in an emergency, the knife may be also dropped unintentionally.

4.3.10 Umbilical

The primary link to the divers is the umbilical. It carries breathing gas to the diver, a means of communications, and a method of measuring the diver depth. Also if the time duration and water temperature are a factor the umbilical carries hot water to the diver for thermal protection.

- A divers umbilical must be marked in the following manner: Every (10) foot from 10' to the 100' feet with one blue stripe; every (50) feet a red stripe will be added; and every (100) feet a yellow stripe will be added (USCG).
- It will consist of a least of the following:
  1. Gas hose.
  2. Communication cable.
  3. Pneumofathometer.
  4. Strength member.

4.4 Gas Hose Requirements

The air hose is the most important part of the umbilical. Failure of the air hose can put the diver at extreme risk of drowning. All breathing gas hoses use by Caldwell Marine International will meet the following minimum standards:

- Have a maximum working pressure that is equal to or exceeds the maximum working pressure of system being used, and the pressure equivalent of the maximum depth of the dive relative to the supply source plus 100 psig.
- Have a bursting pressure that is 4 times its maximum working pressure.
- Be made of kink-resistant material
- Have connectors which are corrosion resistant, are resistant accidental disengagement, and have a working pressure at least equal to the hose to which they are attached.

- Be tested in accordance with section 4.7.2

4.5 Breathing Gas Systems

Regardless of the source, the air must meet certain established standards of purity, must be supplied in an adequate volume for breathing, and must have a rate of flow that properly ventilates the helmet or mask. The air must also be provided at sufficient pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves. The air supply requirements depend upon specific factors of each dive such as depth, duration, level of work, number of divers being supported, and type of diving system being used.

4.5.1 Requirements for Air Supply

All surface-supplied diving systems must include a primary and a secondary air supply. The primary supply must be able to support the airflow and pressure requirements for the diving equipment designated. The capacity of the primary supply must meet the consumption rate of the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must be taken into account when sizing the supply. The secondary supply must be sized to be able to support recovery of all divers using the equipment and dive profile of the primary supply if the primary supply sustains a casualty at the worst-case time (for example, immediately prior to completion of planned bottom time of maximum dive depth, when decompression obligation is greatest). Primary and secondary supplies may be either high-pressure (HP) bank-supplied or compressor-supplied

4.5.2 Air Supply Flow Requirements

The required flow from an air supply depends upon the type of diving apparatus being used. The open-circuit air supply system must have a flow capacity (in acfm) that provides sufficient ventilation at depth to maintain acceptable carbon dioxide levels in the mask or helmet. Carbon dioxide levels must be kept within safe limits during normal work, heavy work, and emergencies. The flow requirements for respiration in a demand system are based upon the average rate of airflow demanded by the divers under normal working conditions. The maximum instantaneous (peak) rate of flow under severe work conditions is not a continuous requirement, but rather the highest rate of airflow attained during the inhalation part of the breathing cycle. The diver’s requirement varies with the respiratory demands of the diver’s work level.

4.5.3 Supply Pressure Requirements

In order to supply the diver with an adequate flow of air, the air source must deliver air at sufficient pressure to overcome the bottom seawater pressure and the pressure drop that is introduced as the air flows through the hoses and valves of the system.

4.5.4 Water Vapor Control

A properly operated air supply system should never permit the air supplied to the diver to

reach its dew point. Controlling the amount of water vapor (humidity) in the supplied air is normally accomplished by one or both of the following methods:

- Compression/Expansion. As high-pressure air expands across a pressure reducing valve, the partial pressure of the water vapor in the air is decreased. Since the expansion takes place at essentially a constant temperature (isothermal), the partial pressure of water vapor required to saturate the air remains unchanged. Therefore, the relative humidity of the air is reduced.

- Cooling the air prior to expanding it raises its relative humidity, permitting some of the water to condense. The condensed liquid may then be drained from the system.

4.5.5 Air Compressors

Low pressure air compressors used in diving operations conducted by Caldwell Marine International personnel must have:

- A certified volume tank that meets required specifications.
- A check valve on the inlet side.
- A pressure gauge.
- A drain valve
- An intake, which is located away from areas containing exhaust, fumes from internal combustion engines or other harmful contaminates.
- An efficient filtration system.
- Slow opening relief valves when the system operating pressure exceeds 500 psi.

4.5.6 Gas Purity Standards

Gas used in diving operations conducted by Caldwell Marine International divers will meet the following standards for purity:

- Oxygen Federal Specification BB-O-925a, and be type 1 (gaseous) grade A or B.
- Nitrogen Federal Specification BB-N-411c, and be of type 1 (gaseous) class 1 (oil-free) and of grade A, B, or C.
- Helium grades A, B, or C produced by the U.S. Federal Government, or Equivalent Grade D is oil pumped and will not be used.
- Compressed Air must contain:

Constituent	**Specification**
Oxygen	(percent by volume) 20-22%
Carbon dioxide	(by volume) 1,000 ppm (max)
Carbon monoxide	(by volume) 20 ppm (max)
Total hydrocarbons	(by volume) 25 ppm (max)
Oil, mist, particulates	5 mg/m3 (max)
Odor and taste	not objectionable

4.5.7 Gas Cylinder Color Codes

Color coding systems are not standards and can very significantly. To determine what gas is contained in a cylinder the making on the cylinder must be used not the color the cylinder.

4.6 Deck Chambers

Recompression chambers are used for the treatment of decompression sickness, and for surface decompression procedures. Diving operations to depths greater than 60 fsw, live-boating operations, and any dives requiring decompression, must have a chamber be available at the dive site.

4.6.1 Basic Requirements

Double-lock chambers are used because they permit tending personnel and supplies to enter and leave the chamber during treatment.

4.6.2 Standard Features

Recompression chambers must be equipped with a means for delivering breathing oxygen to the personnel in the chamber. The inner lock should be provided with connections for demand-type oxygen inhalators. Oxygen can be furnished through a high- pressure manifold connected with supply cylinders outside the chamber.

4.6.3 Labeling

All lines should be identified and labeled to indicate function, content and direction of flow.

4.6.4 Inlet and Exhaust Ports

Optimum chamber ventilation requires separation of the inlet and exhaust ports within the chamber. Exhaust ports must be provided with a guard device to prevent accidental injury when they are open.

4.6.5 Pressure Gauges

Chambers must be fitted with appropriate pressure gauges. These gauges, marked to read in feet of seawater (fsw), must be calibrated to ensure accuracy.

4.6.6 Relief Valves

Recompression chambers should be equipped with pressure relief valves in each manned lock. Chambers that do not have latches (dogs) on the doors are not required to have a relief valve on the outer lock. In addition, all chambers shall be equipped with a gag valve, located between the chamber pressure hull and each relief valve. This gag valve shall be a quick acting, ball-type valve, sized to be compatible with the relief valve and its' supply piping. The gag valve shall be safety wired in the openposition

4.6.7 Communications System

Chamber communications are provided through a diver's intercommunication system, with the dual microphone/speaker unit in the chamber and the surface unit outside. The communication system should be arranged so that personnel inside the chamber need not interrupt their activities to operate the system. The backup communications system may be

provided by a set of standard sound-powered telephones. The press-to-talk button on the set inside the chamber can be taped down, thus keeping the circuit open.

4.6.8 Lighting Fixtures

Consideration should be given to installation of a low-level lighting fixture (on a separate circuit), which can be used to relieve the patient of the heat and glare of the main lights. Emergency lights for both locks and an external control station are mandatory.

4.6.9 State of Readiness

Since a recompression chamber is emergency equipment, it must be kept in a state of readiness. The chamber shall be well maintained and equipped with all necessary accessory equipment. A chamber is not to be used as a storage compartment. The chamber and the air and oxygen supply systems shall be checked prior to each use with the Predive Checklist provided at the end of this section. All diving personnel shall be trained in the operation of the recompression chamber equipment and should be able to perform any task required during treatment.

4.6.10 Post dive Checklist

To ensure equipment receives proper post dive maintenance and is returned to operational readiness, perform the equipment checks listed in the Recompression Chamber Post dive Checklist provided at the end of this section.

4.6.11 Diving Craft and Platforms

Regardless of the technique being supported, craft used for diving operations shall:

- Be seaworthy
- Include required lifesaving and other safety gear
- Have a reliable engine (unless it is a moored platform or barge)
- Provide ample room for the divers to dress
- Provide adequate shelter and working area for the support crew
- Be able to carry safely all equipment required for the operation
- Have a well-trained crew

Other support equipment—including barges, tugs, floating cranes or vessels may be needed, depending on the type of operation. The need for additional equipment should be anticipated as far in advance as possible.

4.7 Miscellaneous equipment

4.7.1 Diving Ladders

Diving ladders should be constructed of corrosion resistant material or preserved so as to prevent corrosion. It should be able to support the weight of two divers. It must extend at least 1meter below the surface. The ladder must be fixed firmly in place and have two hand rails extending above the deck of the support craft.

4.7.2 Diving Stages

Diving stages should be constructed of corrosion resistant material or preserved so as to prevent corrosion. It should be able to support the weight of two divers. It must have a open grating platform. A diving stage must be certified for man use.

4.7.3 First Aid Equipment

Each diving operation must have at the dive location and ready for immediate use:

- The Med kits are the responsibility of the diving supervisors when he has custody of the kits of them, but Company safety department will stock maintain the kits.

A medical kit approved by a physician that contains basic and advanced medical supplies necessary for the treatment of illness, minor first aid and trauma related injuries resulting from hyperbaric exposure and non-diving related illness and injuries. The Med kit will be inventoried before and after each job and at six- month intervals:

- Copies of a current emergency first aid handbook
- A bag-type manual resuscitator with mask and tubing.
- A two-way communications system for emergencies.
- A capability to assist an injured diver into the deck recompression chamber.

4.8 Equipment Test Requirements

This section is provided to outline the test requirements for diving system and equipment used by Caldwell Marine International divers.

4.8.1 Chamber Maintenance

Scheduled Maintenance.

Proper care of a recompression chamber requires both routine and periodic maintenance. Every recompression chamber (shall be pressure tested upon installation, at 2-year intervals thereafter, after a major overhaul or repair, and each time it is moved. This test shall be conducted in accordance with the pressure test for recompression chambers contained at the end of this section. The completed test form shall be retained until retest is conducted. Chamber relief valves shall be tested to verify setting. Each tested relief valve shall be tagged to indicate the valve set pressure, date of test, and testing activity. After every use or once a month, whichever comes first, the chamber shall receive routine maintenance in accordance with the Post dive Checklist. At this time, minor repairs shall be made and used supplies shall be restocked.

Inspections. At the discretion of the diving maintenance supervisor, but at least once a year, the chambers shall be inspected, both inside and outside. Any deposits of grease, dust, or other dirt shall be removed and, on steel chambers, the affected areas repainted.

Corrosion. Corrosion is removed best by hand sandpaper or by using a scraper, being careful not to gouge or otherwise damage the base metal. The corroded area and a small

area around it should then be cleaned to remove any remaining paint and/or corrosion and the surface repainted.

4.8.2 Gas Hose test

- Each breathing gas supply hose will be tested initially and every 12 months thereafter, to 1.5 times the maximum working pressure.
- Each breathing gas supply hose will be internally cleaned of hydrocarbons and particulates initially and every 18 months thereafter.
- Divers umbilical will have a coupling pullout test initially and every 12 months.

RECOMPRESSION CHAMBER PREDIVE CHECKLIST	
Equipment	**Initials**
Chamber	
Cleared of all extraneous equipment	
Clear of noxious odors	
Doors and seals undamaged, seals lubricated	
Remove floor Plates	
Visually inspect chamber interior for oily or volatile deposits of any kind	
Replace floor plates	
Inspect view ports for cracks clouding or pitting	
Shut outer hatch and pressurize chamber to 75 psi	
Inspect all hull penetrations and snoop for leaks	
Pressure gauges calibrated/compared	
Release pressure open outer hatch	
Air Supply System	
Primary and secondary air supply adequate	
One-valve supply: Valve closed	
Equalization valve closed, if applicable	
Supply regulator set at 250 psig or other appropriate pressure	
Fittings tight, filters clean, compressors fueled	
Exhaust System	
Valve closed and calibrated for ventilation	
Oxygen Supply System	
Cylinders full, marked as BREATHING OXYGEN, cylinder valves open	
Replacement cylinders on hand	
Built in breathing system (BIBS) masks installed inspected for damage and tested. Clean all BIBS mask with Non-Ionic soap	
Supply regulator set in accordance with OPs	
Fittings tight, gauges calibrated	
Oxygen manifold valves closed	
BIBS dump functioning	

RECOMPRESSION CHAMBER PREDIVE CHECKLIST	
Equipment	**Initials**
Electrical System	
Lights	
Oxygen analyzer calibrated	
Direct Current (DC) power supply	
Communication System	
Primary system tested	
Secondary system tested	
Fire Prevention System	
Fire-retardant clothing worn by all chamber occupants	
Fire-resistant mattresses and blankets in chamber	
Means of extinguishing a fire	
Miscellaneous	
Urinal	
Primary medical kit	
Ear protection, sound attenuators/aural protectors (1 set per person) Must have a 1/16" hole drilled to allow for equalization.	
Stopwatches for recompression treatment time, decompression time, personnel leaving chamber time, and cumulative time.	
U.S. Navy Diving Manual Revision 6	
Ventilation bill	
Chamber log	
Operating Procedures (OPs) and Emergency Procedures (EPs)	
Bedpan (to be locked in as required)	

RECOMPRESSION CHAMBER POSTDIVE CHECKLIST	
Equipment	**Initials**
Air Supply	
All valves closed	
Compressors fueled and maintained per technical manual/PMS requirements	
View Ports and Doors	
View-ports checked for damage; replaced as necessary	
Door seals checked, replaced as necessary	
Door seals lightly lubricated with approved lubricant	
Door dogs and dogging mechanism checked for proper operation and shaft seals for tight-ness	
Chamber	
Inside wiped clean with Nonionic Detergent (NID) and warm fresh water	
All but necessary support items removed from chamber	
Blankets cleaned and replaced	
All flammable material in chamber encased in fire-resistant containers	
Primary medical kit restocked as required	
Chamber aired out	
Outer door closed	
Deckplates lifted, area below Deckplates cleaned, Deckplates reinstalled	
Support Items	
*U.S. Navy Diving Manua*l, Operating Procedures (OPs), Emergency Procedures (EPs), ventilation bill and pencil available at control desk	
Secondary medical kit restocked as required and stowed	
Clothing cleaned and stowed	
All entries made in chamber log book	
Chamber log book stowed	
Oxygen Supply	
BIBS mask removed, cleaned per current PMS procedures, reinstalled	
All valves closed	
System bled	
Breathing oxygen cylinders fully pressurized	
Spare cylinders available	
System free of contamination	
Exhaust System	
Exhaust: valves closed	

PRESSURE TEST FOR *Caldwell Marine International* RECOMPRESSION CHAMBERS

NOTE: All Caldwell Marine International recompression chambers are restricted to a maximum working pressure of 100 psig (225 fsw), regardless of design pressure rating.

A pressure test shall be conducted on every recompression chamber:

- When initially installed
- When moved and reinstalled
- After repairs/overhaul
- At two-year intervals at a given location

Performance of the test and the test results are recorded on a Chamber Air Pressure and Leak Test form (attached).

The test is conducted as follows:

1. Pressurize the innermost lock to 100 fsw (45 psig). Using soapy water or an equivalent solution, leak test all shell penetration fittings, view-ports, dog seals, door dogs (where applicable), valve connections, pipe joints, and shell weldments.
2. Mark all leaks. Depressurize the lock and adjust, repair, or replace components as necessary to eliminate leaks.

   a. View-Port Leaks. Remove the view-port gasket (replace if necessary), wipe clean.

CAUTION
Acrylic view-ports should not be lubricated or come in contact with any lubricant. Acrylic view-ports should not come in contact with any volatile detergent or leak detector (non- ionic detergent is to be used for leak test). When reinstalling view-port, take up retaining ringbolts until the gasket just compresses evenly about the view-port. Do not over compress the gasket.

   b. Weldment Leaks. Contact appropriate technical authority for guidance on corrective action.

3. Repeat steps 1 and 2 until all the leaks have been eliminated.
4. Pressurize lock to 225 fsw (100 psig) and hold for 5 minutes.
5. Depressurize the lock to 165 fsw (73.4 psig). Hold for 1 hour. If pressure drops below 145 fsw (65 psig), locate and mark leaks. Depressurize chamber and repair leaks in accordance with Step 2 above and repeat this procedure until final pressure is at least145
fsw (65 psig).
6. Repeat Steps 1 through 5 leaving the inner door open and outer door closed. Leak test only those portions of the chamber not previously tested.

RECOMPRESSION CHAMBER

AIR PRESSURE AND LEAK TEST
(Sheet 2 of 3)
Facility test is conducted _____

NAME PLATE DATA

Manufacturer _____

Date of Manufacture _____

Contract/Drawing No. _____

Maximum Working Pressure _____

Date of Last Pressure Test _____

Test Conducted by _____

1. Conduct visual inspection of chamber to determine if ready for test

Chamber Satisfactory_____Initials of Test Conductor

Discrepancies from visual inspection of chamber:

_____

_____

2. Close inner door lock. With outer lock door open pressure inner lock to 100 fsw (45psig) and verify that the following components do not leak:

Inner lock leak checks Initials of Test Conductor.

A. Shell penetrations and fittings	___Satisfactory
B. View Ports	___Satisfactory
C. Door Seals	___Satisfactory
D. Door Dog Shaft Seals	___Satisfactory
E. Valve Connections and Stems	___Satisfactory
F. Pipe Joints	___Satisfactory
G. Shell Welds	___Satisfactory

3. Increase inner lock pressure to 225 fsw (100 psig) and hold for 5 minutes.

Record Test Pressure_____Satisfactory (Note: Disregard small leaks at this pressure).