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0910-LP-103-3916

U.S. NAVY DIVING AND MANNED HYPERBARIC SYSTEMS SAFETY CERTIFICATION MANUAL

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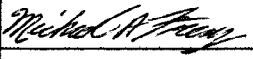
Technical	Michael A. Frey		NAVSEA	00C42	7DEC06
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DEPARTMENT OF THE NAVY
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IN REPLY TO

3151
Ser 00C4/4004
23 January 2007

From: Commander, Naval Sea Systems Command (00C)
To: All U.S. Navy Salvage and Diving Activities

Subj: PROMULGATION OF REVISION 02 OF THE U.S. NAVY DIVING AND MANNED HYPERBARIC SYSTEMS SAFETY CERTIFICATION MANUAL, 0910-LP-312-4600

1. **Purpose**. Promulgate revision to the U. S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual.

2. **Action**. Cancel U.S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual of May 2004 and replace with U.S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual Revision 02 of 1 November 2006.

3. **Implementation.** The requirements of Revision 02 shall be invoked upon receipt. If implementation impairs contracts or agreements in effect prior to the date of this correspondence, any changes require the direction of the Government Contracting Officer.

Richard Hooper
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Director of Ocean Engineering
Supervisor of Salvage and Diving

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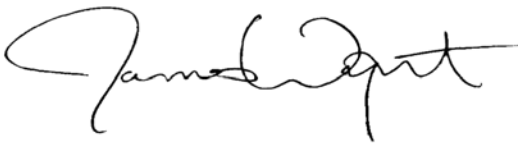
FORWARD

Diving is an inherently dangerous occupation, performed in a hostile environment. The sole purpose of the US Navy Diving and Hyperbaric Systems Safety Certification Program is to make this occupation as safe as possible for the men and women who put their lives on the line, every day, in the service of their country. Through the System Certification Programs, it is our mission to provide a final independent review of diving and hyperbaric system design, fabrication, testing, repair, maintenance and operation.

This revision represents the second major change to the Certification Manual in less than three years. The primary focus of this revision is to remove most of the technical requirements from this manual and refer those readers seeking technical requirements for the design, construction, test, repair and maintenance of diving and manned hyperbaric systems to the appropriate NAVSEA and NAVFAC technical documents. The appropriate technical requirements for shore/shore-based fixed diving and manned hyperbaric installations are contained in UFC 4-159-01N Design: Hyperbaric Facilities Manual (formerly NAVFAC DM-39) and NAVFAC MO-406: Hyperbaric Facilities Maintenance Manual. The appropriate technical requirements for all other Navy diving and manned hyperbaric systems, including shipboard and portable systems, are now found in NAVSEA TS500-AU-SPN-010: U.S. Navy General Specifications for the Design, Construction and Repair of Diving and Hyperbaric Equipment (Diving GENSPECS). The three remaining appendices in this manual are: Design Guidelines For Diver Handling Systems; Re-Entry Control Procedures; and Objective Quality Evidence. Our goal for this manual revision is to separate the system certification requirements that we are responsible for developing and maintaining from the diving and hyperbaric systems technical requirements for which the respective NAVSEA and NAVFAC technical authorities are responsible. The retention of the Divers Handling Systems technical requirements in this revision of the Certification Manual is due to the fact that the NAVSEA Diving Programs Division is not responsible for weight handling systems. Although in the near future, this appendix is expected to migrate into the Diving GENSPECS.

Questions and comments regarding the content of this manual, or the certification process in general, should be submitted by e-mail to NAVSEA at 00C4@supsalv.org. For specific shore-based system issues, submit questions and comments to NAVFAC at hypercert@navy.mil.



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LIST OF ABBREVIATIONS AND ACRONYMS

ABS	American Bureau of Shipping
AHP	Air, High Pressure
ALP	Air, Low Pressure
ANSI	American National Standards Institute
ANU	Authorized for Navy Use
ASME	American Society of Mechanical Engineers
ata	Atmospheres, Absolute
atm	Atmospheres
BIBS	Built In Breathing System
CDRL	Contract Data Requirements List
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CM	Configuration Management
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COC	Certificate of Compliance
DC	Direct Current
DFARS	Defense Federal Acquisition Regulations Supplement
DFS	Departure From Specification
DID	Data Item Description
DLSS	Divers' Life Support System
DOD	Department of Defense
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
EP	Emergency Procedure
EXH	Exhaust
FADS	Fly Away Dive System
FAR	Failure Analysis Report
FARC	Fly Away Recompression Chamber
FAT	Factory Acceptance Test
FMGS	Flyaway Mixed Gas System
GSO	General Specifications for Overhaul of Surface Ships
HAZCAT	Hazard Category Level
HP	High Pressure
HPU	Hydraulic Power Unit
IR	Insulation Resistance
LSS	Life Support System
LWDS	Light Weight Dive System
MAWP	Maximum Allowable Working Pressure
MCM	Mission Configuration Matrix
MES	Milestone Event Schedule
MCR	Manual Change Request
MILSTRIP	Military Standard Requisitioning and Issuing Procedures

MOA	Memorandum of Agreement
MOP	Maximum Operating Pressure
MOT	Manned Operational Tests
MRC	Maintenance Requirement Card
MT	Magnetic Particle Inspection
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NAVOSH	Navy Occupational System and Health
NDT	Nondestructive Testing
NEDU	Navy Experimental Diving Unit
NFESC	Naval Facilities Engineering Service Center
Ni-Cu	Nickel-Copper
NSTM	Naval Ships' Technical Manual
O_2	Oxygen
O&M	Operating and Maintenance
OAS	Obstacle Avoidance System
OPEVAL	Operational Evaluation
OPNAV	Office of the Chief of Naval Operations
OP	Operating Procedure
OQE	Objective Quality Evidence
PFT	Prototype/First article Testing
PIT	Pre-installation Tests
PMS	Preventive Maintenance System
POT	Pre-operational Tests
psia	Pounds per Square Inch, Absolute
psid	Pounds per Square Inch, Differential
psig	Pounds per Square Inch, Guage
PSOB	Pre-Survey Outline Booklet
PT	Liquid Penetrant Inspection
PTFE	Polytetrafluoroethylene
PVHO	Pressure Vessels for Human Occupancy
QA	Quality Assurance
REC	Re-entry Control
SAR	SHIPALT Record
SCA	System Certification Authority
scfm	Standard Cubic Feet per Minute
SCSC	System Certification Survey Cards
SCUBA	Self-contained Underwater Breathing Apparatus
SEADL	NAVSEA Data List
SECNAV	Secretary of the Navy
SHIPALT	Ship Alteration
SIT	System Integration Test
SNDL	Standard Navy Double Lock
SOC	Scope of Certification
SOT	System Operational Test
STP	Standard Temperature and Pressure

TL	Transfer Lock
TR	Time Required
TRCS	Transportable Recompression Chamber Systems
UBA	Underwater Breathing Apparatus
UL	Underwriters Laboratories
USN	United States Navy
UT	Ultrasonic Testing

CHAPTER 1

GENERAL INFORMATION

1-1 Introduction

In accordance with OPNAVINST 3150.27, Navy Diving Program, this manual provides specific guidelines that must be followed for the certification of new and existing U.S. Navy diving and manned hyperbaric diving and manned hyperbaric systems. The guidelines are provided for the design, construction, operation, maintenance, repair, modification, and overhaul phases. U.S. Navy diving and manned hyperbaric systems include all surface-supplied diving systems, saturation diving systems, manned recompression chamber systems, tethered submersibles capable of hyperbaric operations, on-bottom habitats, diver worn equipment (except SCUBA), and handling systems used for maneuvering diving systems or personnel during manned operations. Throughout this manual, where the term “diving systems” is used, it is meant to include manned hyperbaric systems. Diving systems are typically considered to be noncombatant in design and operation.

This manual is not intended to provide the detailed requirements for the design of diving systems. The detailed design requirements for diving systems are provided in the U.S. Navy General Specifications for the Design, Construction, and Repair of Diving and Hyperbaric Equipment, NAVSEA TS500-AU-SPN-010 (NAVSEA Diving Genspecs). For technical requirements specific to the detailed design of ashore systems refer to the Unified Facilities Criteria 4-159-01N Design: Hyperbaric Facilities Manual (formerly NAVFAC Design Manual-39).

The quality control and assurance procedures specified herein shall be translated into technical and contractual specifications by diving system applicants responsible for design, construction, modification, repair and overhaul of these systems. The use of this manual as a contract reference document should be limited to citing specific sections and paragraphs applicable to the work being performed.

System certification is a prerequisite for all diving and manned hyperbaric systems (except SCUBA) used by or operated by U.S. Navy (military and civilian) personnel. This prerequisite pertains to systems built by the Navy or private industry and systems owned by the Navy or operated by the Navy under contract with private industry. Exemptions may be granted only by an operational waiver.

An operational waiver provides authorization to depart from established operating/safety procedures, to use diving equipment that is not currently certified, to exceed specified operational limits, or to deviate from established physical standards

and personnel qualifications for divers. Only Chief of Naval Operations (N773) can approve a request for an operational waiver.

Diving system personnel are occupants of hyperbaric chambers and habitats, internal diving system operators and tenders and in-water divers. The safety of handling system personnel and external equipment operators is not covered by the system certification process, except when the lives and well-being of these personnel have a direct bearing on the safety of diving personnel. The application of this manual to routine shore and marine safety (otherwise covered by MIL-STD-882, Standard Practice for System Safety) is not intended.

The objective of system certification is to verify, by use of an independent technical review, that a diving system provides acceptable levels of personnel safety throughout its specified operating range, when approved operating and maintenance procedures are followed. This review is accomplished by performing a detailed assessment of the material and procedural adequacy of the system. The certification process establishes maximum reasonable assurance that diving system personnel can be recovered without injury. Certification of a diving system does not relieve its operators from the responsibility of maintaining system safety on a continuing basis. System certification cannot positively ensure that an accident will not happen; it is, however, intended to provide “maximum reasonable assurance” that a catastrophic accident will not occur.

The principal participants in the system certification process are: (1) the system applicant and (2) the System Certification Authority (SCA), either Naval Sea Systems Command (NAVSEA 00C), or Naval Facilities Engineering Command (NAVFAC), as appropriate. NAVSEA maintains cognizance of the overall system certification program and establishes priorities and policy with the concurrence of NAVFAC.

The system sponsor is the organizational unit responsible for funding the development, construction, operation, repair, alteration and/or maintenance of the diving system. For a system under development, the sponsor is normally the NAVSEA or NAVFAC Acquisition Manager. For systems already in existence and having achieved initial certification (see Chapter 3), the sponsor is normally the Type Commander, or a subordinate command of the Type Commander.

The system applicant is the organizational unit responsible for the day-to-day operation and maintenance of the diving system. The applicant deals directly with the SCA in matters directly related to the certification process.

The sponsor and the applicant may be the same organizational unit, as in the case of an Acquisition Manager applying for initial certification of a newly-developed system. Throughout the remainder of this manual, only the terms Acquisition Manager or applicant are used when discussing the certification process. This does not, however, exclude the sponsor from participation in the process wherever appropriate.

The responsibility of the SCA to verify the adequacy of a system to operate safely includes the review of the technical documentation generated during the design, fabrication and testing of the candidate system. In addition, the review will include the operating, emergency, and maintenance procedures as they pertain to personnel safety within the specified operation range. This includes verification that these procedures have been approved by the appropriate technical authority. Mission reliability is of concern to the SCA only as it relates to the ability of the diving system to effect recovery of diving system personnel without injury. The ability of the system either to perform meaningful work or to meet program goals, other than safety, is not within the purview of the SCA.

The certification process is most effective and least difficult when:

a. The applicant designates a single, knowledgeable individual to serve as the point of contact for the certification effort and to represent the applicant in negotiations relative to certification of the candidate diving system.

b. The applicant has a clear understanding of the certification process.

c. The SCA has a clear understanding of the candidate diving system.

d. The SCA and the applicant freely and frequently communicate.

The importance of a continuing exchange of information between the applicant and the SCA cannot be overemphasized. Only through discussion and negotiation can the applicant and the SCA establish a realistic balance between cost/time objectives and system safety requirements.

1-2 Standard Navy Syntax Summary

This manual utilizes standard Navy syntax regarding permissive, advisory and mandatory language. The manual's intended word meanings are as follows:

a. "Shall" and "must" have been used only when application of a procedure is mandatory.

b. "Should" has been used only when application of a procedure is recommended.

c. "May" and "need not" have been used only when application of a procedure is discretionary.

d. "Will" has been used only to indicate futurity: never to indicate any degree of requirement for application of a procedure.

1-3 Purpose

The purpose of this manual is to describe the system safety certification process and to provide guidance in implementing the system safety certification program.

Technical information and justification submitted by the applicant forms the basis for determining the material and procedural adequacy of each diving system to perform safely. This manual describes the procedures and criteria that are used by the SCA and that must be followed by the applicant.

Chapters 2 through 6 of this manual provide detailed information about the certification process and the documentation required by the SCA. Appendices A through C provide technical requirements that must be met to successfully achieve certification. The Bibliography lists the references from which the requirements in this manual were taken. Readers of this manual should review the definitions in the glossary before proceeding with the remainder of the manual.

1-4 Scope and Applicability

This manual covers system certification for all afloat, portable and land-based diving and hyperbaric systems capable of supporting one or more divers, operators, and/or occupants embarked in a wet or dry pressurized environment.

Diving systems covered by this manual are grouped as follows:

a. Manned Hyperbaric Systems (Includes all recompression chambers, medical treatment chambers, diving bells and saturation dive systems including deck decompression chambers and personnel transfer capsules. Also includes all associated mechanical, electrical and communications subsystems required to operate these chambers and ensure the safety of their occupants.)

(1) Afloat (permanently installed in or on a ship, boat or barge)

(2) Portable

(3) Shore-based (installed or operated within a building or on a fixed structure)

b. Surface-Supplied Diving Systems (Includes all mechanical, electrical and communications subsystems required to provide for the safety of the diver.)

(1) Afloat

(2) Portable

(3) Shore-based (installed or operated within a building or on a fixed structure)

c. Diver-worn Equipment

(1) Tethered (Surface-supplied and saturation including umbilicals)

(2) Semi-closed and closed circuit underwater breathing apparatus (UBA)

d. Manned Underwater Habitats (The habitat may or may not be pressurized as a step in the implantment evolution, but the design is basically for free access by divers between the habitat and the sea.)

e. Handling Systems (used for maneuvering diving systems or personnel during manned operations)

NOTE: Stand-alone SCUBA charging stations and stand-alone/portable oxygen charging stations are not within the scope of this manual. Where a SCUBA charging station is integrated into a certified system (such as a surface-supplied diving system), the certification boundary for the surface-supplied system may end at the valve that isolates the SCUBA charging station. The valve shall be within the certification boundary. Where an oxygen charging station is integrated into a larger system, the charging station shall be within the Scope of Certification boundary.

1-5 Class Certification of Diver Worn Equipment

The SCA will typically certify a class of diver worn equipment. The initial certification of a new class of diver worn equipment shall follow the guidance contained in Chapters 3 and 6. Once class certification has been granted, certification of subsequent duplicate apparatuses of this class shall be accomplished as described in Chapter 6. All configuration and material changes to class-certified diver worn equipment must be approved by the appropriate Acquisition Manager, and or configuration control board, and the SCA before they may be implemented.

1-6 System Certification Procedure

The organization within the Navy that is contracting for the design, construction, and/or overhaul of a diving system must convert system certification criteria and documentation requirements, clearly and concisely, into the contract specifications. The use of this manual as a contract reference document should be limited to citing specific sections and paragraphs applicable to the work being performed. If a contractor anticipates lease or purchase by the Navy of a diving system he is building, he should become familiar with the documentation requirements necessary to support a system certification technical review. Lease or purchase agreements entered into by the U.S. Navy must be specific in content to preclude any misinterpretation of the requirements of this manual by manufacturers or vendors.

For each diving system, the basis for system certification shall be the evaluation of the Objective Quality Evidence (OQE) (replaces former terms “recordable evidence” and “recorded data” - see Section 2-6.2 for definition) submitted by, or in the custody of, the applicant and such on-site surveys and audits as are deemed necessary by the SCA. For new systems, the number and timing of surveys and audits shall be negotiated between the Acquisition Manager and the SCA when the Milestone Event Schedule is submitted to the SCA for approval. OQE shall, where applicable, encompass areas of:

a. Design

b. Material

c. Construction, fabrication and assembly

d. Quality assurance/control

e. Cleanliness

f. Testing

g. Operability

h. Maintainability

For a new diving system design, the applicant shall present OQE documenting the above areas to the SCA during one or more formal design reviews. Preparation and presentation of this OQE should be specifically required by the terms of the contract or specifications and is the responsibility of the applicant. Failure to include these items in the contract may result in additional program costs and schedule delays.

For a newly-fabricated diving system which is an exact duplicate (e.g., design, material, depth limits, temperature, dive duration, environment, etc.) of an existing certified diving system, on-site surveys of the configuration, quality control, testing records, previous certification documents, and a demonstration of the diving system generally provides sufficient OQE. Any deviations from the original system design must undergo a formal design review process to ensure system safety is not affected.

For an uncertified diving system already in existence and possibly in service, the assembly of sufficient OQE might require considerable effort. If the OQE is not retrievable, the information may have to be recreated. To recreate OQE, the applicant may have to resort to nondestructive and/or destructive testing, inspection, and design review analyses. The level of effort required will be dependent upon the complexity and the intended use of the system. When OQE is recreated it shall be identified as such to the SCA.

It must be recognized that new information that becomes available during the on-site survey, or subsequent to certification, may indicate the existence of an unsafe condition that had not been previously identified. In such cases, when the potential danger from the newly-reported condition warrants, the SCA shall direct a reevaluation of the diving system design for all related systems by the appropriate Systems Command technical authority. Suspension or termination of certification may result.

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CHAPTER 2

THE SYSTEM CERTIFICATION PROCESS

2-1 Introduction

This chapter explains the major events during the system certification process and assists the applicant in preparing the required documents. Figure 2-1 represents the sequence of the major events and identifies whether the action is the responsibility of the SCA or the applicant. The glossary of terms, found in the back of this manual, defines the terms used throughout the certification process. These definitions should be reviewed before proceeding with the remainder of this manual.

2-2 Application for System Certification

The certification process is initiated with a formal application for system certification. The applicant shall apply for system certification to the cognizant SCA: NAVSEA 00C for afloat or portable diving systems and equipment; NAVFAC for fixed, shore-based facilities. Commercial system manufacturers may not apply for Navy system certification. The application shall be in standard Navy letter format and shall include the following items:

a. A clear and definitive statement identifying the system applicant. The applicant should identify a specific point of contact for all certification matters.

b. A general description identifying whether the system is afloat, portable, or shore-based and the type of system; for example, recompression chamber, surface supplied diving system or on-bottom habitat, etc.

c. The desired mission profile or dive scenario including operational limits; for example, a recompression chamber application would include the number of patients/tenders, treatment tables to be used and maximum depth/duration of surface decompression dives to be supported.

d. The desired tenure of certification.

The SCA shall respond to the application, making comments as appropriate, and shall then request submission of the following documents:

a. Initial Scope of Certification (SOC)

b. Milestone Event Schedule (MES)

c. Initial Pre-Survey Outline Booklet (PSOB)

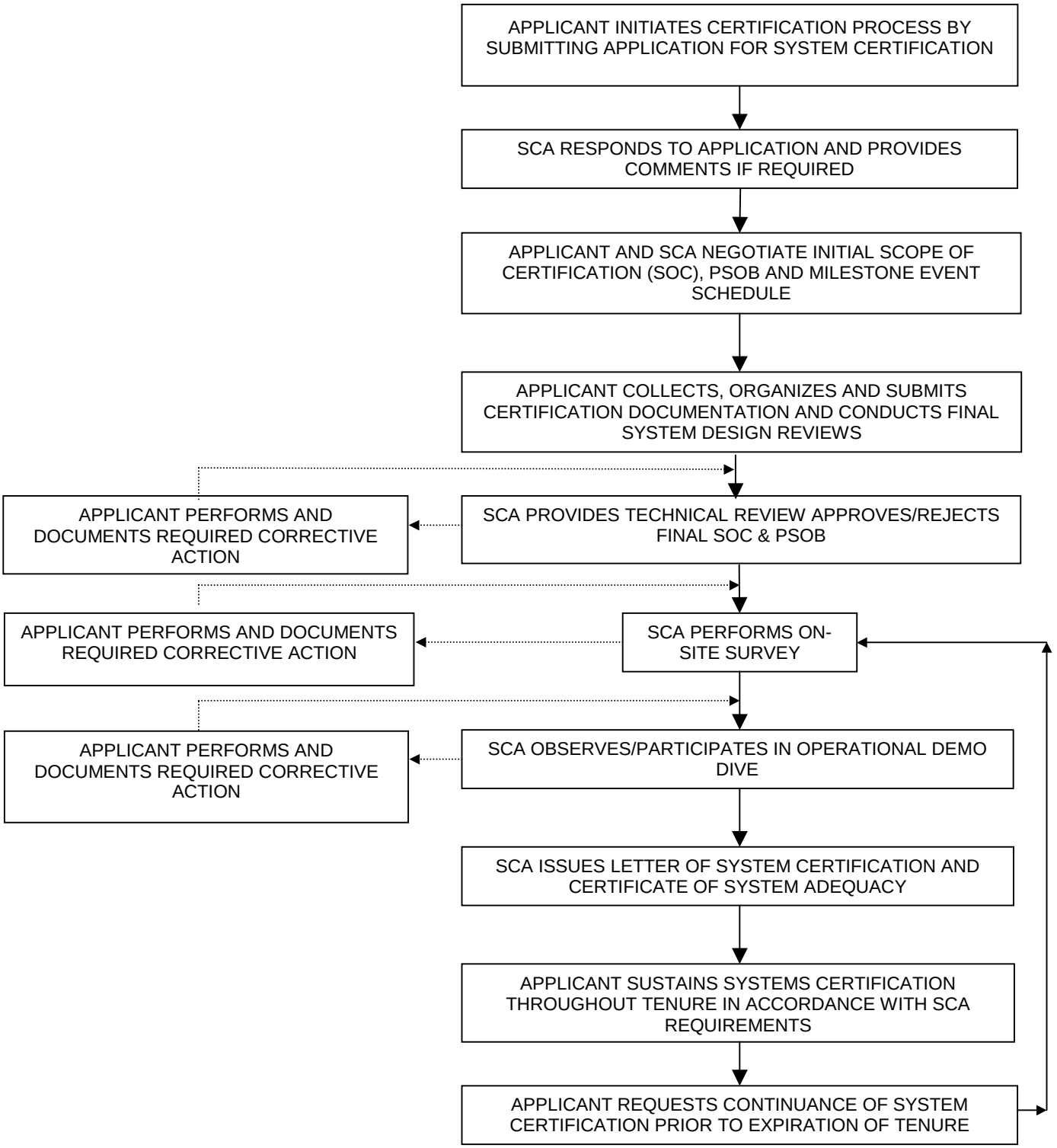

Figure 2-1. Major Certification Events

d. Certification Scope Notebook, if required

e. Mission Configuration Matrix, if required

2-2.1 Scope of Certification (SOC)

The applicant shall submit an initial list of all portions of the system and its ancillary equipment that are expected to fall within the SOC as defined herein, based on the maturity of the design. In addition, the applicant shall include the criteria and supporting justification for limiting the scope of certification. Subsystems and components not initially shown by the applicant to be within the SOC shall be reviewed by the SCA for their contributions to the overall safety of design. Negotiations between the applicant and SCA may be required to define the SOC boundaries. The scope of certification boundaries shall be finalized by the applicant and approved or modified by the SCA when the system design is complete. The SOC must be approved before the final PSOB (see Section 2-2.3) is submitted to the SCA. Statements in this manual pertaining to areas outside the SOC are for guidance only.

As an aid in defining the SOC, especially for complex systems, the applicant is referred to the hazard analysis techniques described in the Hazard Analysis section of MIL-STD-882, System Safety Program Requirements.

Subsystems, components and procedures that must be included in the SOC are:

a. Those which, through malfunction or failure, could prevent the safe return of the operators, divers, or occupants to the surface

b. Those required to keep operators, divers, or occupants safely on the surface following an ascent

c. Those provided to rescue personnel from the diving system and return them to the surface, support ship, or, in the case of hyperbaric chambers, to ambient conditions outside the chamber

d. Those associated with temporary test equipment affecting trim and stability conditions, both surfaced and submerged, which could affect the safe recovery of personnel

e. Written and approved operating and emergency procedures (OPs/EPs) including predive and postdive procedures for subsystems within the SOC

f. Written maintenance and test procedures for systems within the SOC

g. Operating and maintenance (O&M) manuals and/or procedures

h. Drawings outlining the certified baseline configuration

It is recognized that individual diving system designs may vary to such an extent that no single list can encompass the entire spectrum of SOCs. The following is a list of areas that generally require inclusion in the SOC. This list is provided for purposes of illustration and should not be considered all-inclusive or universally applicable:

a. The pressure hull, pressure vessels, hard structure, and appurtenances (penetrations, seals, etc.)

b. The ballast/buoyancy subsystems used to maintain adequate freeboard when operating a submersible capsule or habitat on the surface

c. Jettisoning and emergency ballast blow systems used for emergency ascent

d. Normal and emergency life-support subsystems which provide an acceptable atmosphere to the diving system personnel (may include oxygen admission, carbon dioxide removal, odor removal, humidity and temperature control equipment)

e. Built-in-Breathing System (BIBS) for the treatment of diving related illness or for use in contaminated closed environments.

f. Noncompensated equipment, subject to pressure, which may implode or explode

g. Release devices for external appendages

h. Firefighting devices or subsystems

i. Communication subsystems for two-way communications between the system operators and support personnel

j. Monitoring/detecting devices

k. Equipment which actuates recovery subsystems (includes subsystems which may be required for recovery of personnel from the system following a casualty)

l. Flotation or buoyancy subsystems where failure or inadequacy could prevent the safe return of personnel to the surface or, once on the surface, to remain there

m. Electrical power subsystems which include internal and external electrical protective devices where failure could result in malfunction of a critical component or subsystem or create a shock hazard

n. Support vessel handling subsystems and components such as cranes, winches, brakes, cables, and their ancillary equipment used when the system is handled, through the air/sea interface or onboard the support vessel, with personnel aboard

o. Subsystems and components that protect personnel directly or indirectly against the effects of accidents and hazards

p. Diver-worn equipment, which includes the subsystems and components located on the diver side of the umbilical or supply hose connection required to ensure and preserve the safety and well-being of the diver, such as:

(1) Breathing gas subsystems and components including tubing, valves and regulators, breathing gas containers, and carbon dioxide absorbers

(2) Headgear, face masks, mouthpieces, breathing bags and helmets

(3) Breathing gas hose, umbilicals, gas fittings, connectors, fasteners, and clothing

(4) Instrumentation, sensors, alarms, computers, and set up (predive) equipment

(5) Electrical and communication subsystems

q. Subsystems that provide control of the diver's body temperature and subsystems and components that protect the diver against accidents and hazards in the underwater environment

r. Subsystems located on the gas supply side of the diver's umbilical or supply hose. For surface-supplied diving systems and recompression chamber systems, the scope normally encompasses the entire diver's gas mechanical system. This is usually composed of, but not limited to, compressors, flasks, carbon dioxide scrubbers, filters, separators, reducing stations, receivers, valving and piping up to and including the diver's manifold(s) and recompression chamber and its appendages.

s. Gas analysis subsystems and components

When considering components for inclusion in the SOC, it should be realized that most accidents result from a series of events beginning with a single failure, often relatively minor, which places the diving system personnel or equipment under additional stress. The avoidance or prevention of such initial failures in the normal operation of equipment enhances the overall safety of the system.

2-2.2 Milestone Event Schedule (MES)

The certification Milestone Event Schedule shall include a list of sequential events in the certification process with estimated dates of completion. The time required for documentation submissions, technical reviews and deficiency corrections shall be considered in the MES to ensure timely completion of the certification process prior to the desired use date of the system. Figure 2-2 is an example MES for a typical diving

DIVING SYSTEM CERTIFICATION MILESTONE SCHEDULE

SYSTEM _____ INITIAL SUBMISSION DATE _____
SCA APPROVAL _____ REVISION _____ DATE _____

EVENT	START DATE	EST. FINISH DATE	ACTUAL FINISH DATE	YEAR 20__												YEAR 20__											
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	Nov	DEC
DESIGN REVIEW INFORMATION																											
Scope of Certification (SOC)																											
Pre-Survey Outline Booklet (PSOB)																											
Summary Description of System																											
Configuration Management Plan																											
Design Parameters																											
Subsystem Descriptions																											
Design Analysis																											
System Drawings																											
Operability & Maintainability Procedures																											
Justification of Materials																											
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Process Instructions																											
Welding Procedures																											
Assembly Procedures																											
Cleaning Procedures																											
Quality Assurance Procedures/Data																											
Design and Drawing Control Data																											
Material Control Data																											
Fabrication & Manufacturing Control																											
Cleaning Control																											
TESTING & INSPECTION CONTROL																											
Test Plan																											
Individual Test Procedures																											
Test Procedure Index																											
Test & Inspection Results																											
Re-Entry Control Data																											
OPERATING RECORDS																											
MAINTENANCE RECORDS																											
CORRECT DISCREPANCIES																											
ON-SITE DIRECTORY																											
CORRECT DISCREPANCIES																											
CERTIFICATION DIVE																											
RECEIPT OF CERTIFICATION																											

INSTRUCTIONS: FOR EACH EVENT APPLICABLE TO THE APPLICANT'S SYSTEM, ENTER THE DATE OF COMPLETION (E.G. ▲) IN THE APPROPRIATE BOX

Figure 2-2. Certification Milestone Event Schedule

system. It does not specify review periods, but a review period should be added according to the needs of the project. If it does not meet the needs of a particular system, or if desired, the applicant may develop and submit one of original design. Interaction and negotiation between the applicant and the SCA is stressed in developing the schedule, especially where the applicant's contract with the builder calls for a rapid government review and comment on contractor submitted design documents. Frequent and effective communication can avoid delays in planned schedules and reduce the overall effort required of the applicant and of the SCA. The initial MES may be submitted at the same time or shortly after the initial SOC is submitted. During the certification process, the SCA may require the applicant to submit updated versions of the MES should the original become outdated.

2-2.3 Initial Certification(s) Pre-Survey Outline Booklet (PSOB)

Upon approval of the negotiated initial SOC by the SCA, a Pre-Survey Outline Booklet shall be prepared by the applicant. The PSOB is a detailed checklist, derived from the SOC, which expands each scope item with requirements for supporting documentation and evidence. To facilitate cross-referencing, the PSOB and SOC should be similarly indexed. Items to be included in the PSOB include the following:

a. Design Parameters

b. Design calculations and analyses

c. Material evaluations and selection justification

d. Verification by model testing where required

e. "As-built" engineering drawings with detailed material lists (sufficient detail must be provided in the drawings and material lists such that they can be used to validate the system configuration and to maintain the system after fabrication) for all subsystems

f. Quality Assurance Provisions

g. Fabrication and inspection procedures

h. Material traceability

i. Results of nondestructive testing

j. Proof tests and operational values

k. Pressure Boundary Integrity Surveillance Program (for submerged diving systems only)

l. Operating and emergency procedures

m. Maintenance procedures

n. On-site survey

o. Cleaning and atmosphere testing procedures

p. Operational demonstration

There are 9 PSOB baseline guides presently available from the SCA to aid the applicant. These are:

a. NAVFAC P-1045, “Pre-Survey Outline Booklet for Shore-Based U.S. Navy Surface Supported Diving Systems”

b. NAVFAC P-1046, “Pre-Survey Outline Booklet for Shore-Based U.S. Navy Recompression Chamber Systems”

c. “Pre-Survey Outline Book for U.S. Navy Recompression Chambers”

d. “Pre-Survey Outline Book for U.S. Navy Surface Supported Diving Systems”

e. “Pre-Survey Outline Book for U.S. Navy Surface Supported Diving Systems Light Weight Diving Systems (LWDS) ”

f. “Pre-Survey Outline Book for Transportable Recompression Chamber Systems (TRCS) without TL Scrubber Upgrade”

g. “Pre-Survey Outline Book for Transportable Recompression Chamber Systems (TRCS) with TL Scrubber Upgrade”

h. “Pre-Survey Outline Booklet for Standard U.S. Navy Standard Navy Double Lock (SNDL) Recompression Chamber Systems”

i. “Pre-Survey Outline Booklet for Emergency Evacuation Hyperbaric Stretcher (EEHS)”

Items a and b are available on the NAVFAC website. The web address is: http://www.navfac.navy.mil under NAVFAC HQ, Ocean Facilities Program. Items c through i are available on the NAVSEA 00C website. The web address is: http://www.supsalv.org.

The line items of these PSOB baseline guides are preprinted in a format that follows a typical SOC and includes typical requirements for OQE. The applicant should tailor his PSOB to a particular surface supported diving system, hyperbaric facility, or other diver items. Items that are not covered by the PSOB, but are judged to be applicable due to their relationship to the system, should be added on the additional sheets provided. Complex or unique systems, such as saturation diving systems and diver worn equipment, require more information than is given in the above baseline

guides. For these systems, a PSOB shall be customized to include design characteristics and subsystems not found in standard surface-supplied diving or recompression chamber systems. The format and content of the PSOB should be finalized during the design review process.

The final PSOB shall be completed by the applicant and submitted to the SCA for review and approval, prior to the commencement of the on-site survey(s) (see Section 2-6). After the final PSOB is approved by the SCA, the applicant should use it as a checklist for assembling the supporting documentation. Documentation submitted by the applicant should be indexed to the PSOB item number to facilitate its technical review.

In addition to the PSOB, the SCA uses a System Certification Requirement/ Guidelines Checklist (SCA Survey Checklist). The SCA Survey Checklist is used as a reference for the SCA to ensure all critical material, fabrication, operational, and test attributes have been verified and are documented. The Survey/Audit checklist ties these critical attributes to specifications used in the acquisition and/or maintenance of the system. The Survey/Audit Check List supplements, but does not replace, the PSOB. Upon completion of the survey, the SCA Survey Checklist becomes an official part of the SCA's file, providing evidence that the certification requirements were met during the survey.

2-2.4 Recertification/Continuance of Certification Pre-Survey Outline Booklet (PSOB)

A new Pre-Survey Outline Booklet shall be prepared by the applicant each time the system comes due for recertification or Continuance of Certification. This PSOB contains the same information as was found in the PSOB used during initial certification; plus any changes made to the system configuration. Where changes to system configuration are found, cross-referencing the PSOB and SOC should be similarly indexed. Items to be included in the PSOB for standard surface supplied diving and recompression chamber systems include the following:

a. Equipment identification

b. Operating parameters

c. Air supply system

d. Mixed gas/oxygen supply system

e. Electrical systems

f. Diver handling system

g. Validation of as-built system drawings

h. Inspections, tests and re-entry control records (current certification period)

i. Operating and emergency procedures

j. Maintenance procedures (PMS)

k. On-site survey

l. Operational demonstration

The same PSOB baseline guides discussed in section 2-2.3 are used for recertification. The completed PSOB shall be forwarded to the SCA for approval prior to the scheduled on-site survey.

After the PSOB is approved by the SCA, the applicant should use it as a checklist for assembling the supporting documentation. Documentation submitted by the applicant should be indexed to the PSOB item number to facilitate its technical review.

The SCA uses the SCA Survey/Audit Checklist during the recertification/ continuance of certification on-site surveys. The Checklist, in these cases, is tailored to the fabrication, maintenance, and testing performed on the system since the previous survey.

An example of a typical checklist is the “System Certification Requirements/Guidelines for Afloat and Portable Recompression Chambers and Surface Supported Diving Systems.” This checklist is used during the on-site surveys of most diving/hyperbaric systems and can be downloaded from the SEA 00C website (http://www.supsalv.org) under 00C4 publications. The checklist for ashore systems is available for download from the NAVFAC SCA website (http://www.navfac.navy.mil) under NAVFAC HQ under Ocean Facilities Program.

2-2.5 Supplemental Certification Documentation

The Certification Scope Notebook and Mission Configuration Matrix are two items, produced by the applicant, which have proven to be useful tools in the certification programs of complex diving systems. These items generally are not mandatory for smaller typical surface supplied and recompression chamber systems and class certified UBAs. However, should the SCA require these documents to be developed, they shall be included in the SOC for review by the SCA.

Tailored checklists are typically generated by the SCA to capture unique requirements of complex diving/hyperbaric systems.

2-2.5.1 Certification Scope Notebook

A Certification Scope Notebook contains basic subsystem diagrams that outline those structures, subsystems, and equipment that are within the SOC as described in

the PSOB. The purpose of the Certification Scope Notebook is to aid the operating and maintenance personnel in determining the degree of control that must be applied during maintenance of those subsystems and components that fall within the SOC. Additional information regarding control of work on items within the SOC is contained in Appendix A, Re-Entry Control Procedures. Normally, this is done by schematically representing the subsystem and encompassing the area within the scope. Small areas within this boundary that are excluded from the SOC can also be depicted by contrasting the boundary lines. An example is shown in Figure 2-3.

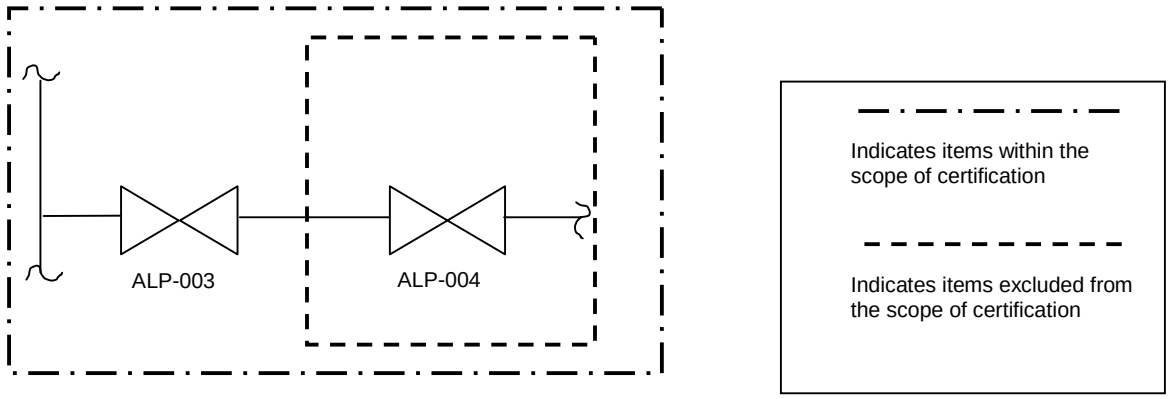

Figure 2-3. Certification Scope Identification

2-2.5.2 Mission Configuration Matrix

Some systems may be designed to accomplish more than one mission or may have redundant subsystems. For these systems, requiring all subsystems and components to be in operating condition when not required for a particular mission may impose undue restrictions on the system. The Mission Configuration Matrix (MCM) is a certification tool that has proven useful to operators and maintenance personnel. The MCM provides a list of equipment required, optional, or not required to be operational to conduct each mission. The MCM shall be approved by the SCA prior to use. Figure 2-4 is a sample Mission Configuration Matrix for a hypothetical diving system.

2-3 Negotiation

Once submitted, all of the items previously discussed must be approved by the SCA. Recognizing that diving and hyperbaric system designs vary greatly depending upon their missions, the SCA allows room for negotiation during the certification process. The negotiation process is simply the method by which the applicant and the SCA come to complete agreement regarding the contents of these documents. In particular, because of the number of systems that require certification, the scheduling of key events requiring the direct participation of the SCA should be worked out well in advance of the events. The approved version of these documents will provide the basis

for the SCA to estimate the cost to complete the certification process. The results of the negotiation process should be documented.

		FMGS Air Dive (0-60FSW)	FMGS Air Dive (60-130FSW)	FMGS AIR DIVE (130-190FSW)	FMGS MIXED GAS DIVE (0-300FSW)
1	MK 20 MOD 0	•			
2	MK 21 MOD 1	•	•	•	
3	MK 21 MOD 0				•
4	EXO BRMS	•	•	•	•
5	Surface Supplied Diving Console	X	X	X	X
6	Volume Tank	X	X	X	X
7	Air Supply	X		X	X
8	O2 Supply				X
9	HE Supply				•
10	HEO2 Supply				X
11	HPAC	•	•	•	•
12	Diver Hot Water System	•	•	•	•
13	Divers Handling System	•	•	•	X
14	Recompression Chamber	•	•	X	X

LEGEND:

x – REQUIRED
• – OPTIONAL
BLANK – NOT REQUIRED

NOTE: This is a sample only and should not be construed to contain the valid technical information.

Figure 2-4. Mission Configuration Matrix

2-4 Submission of Supporting Documentation

Utilizing the approved SOC and PSOB as guides, the applicant shall prepare and submit the following documentation in accordance with the Milestone Event Schedule:

a. Design review information

(1) System drawings (see Section 3-2.9)

(2) Design calculations/analysis

(3) Hazard analysis

b. Construction, fabrication and assembly information

c. Quality program information

d. Test program information

e. Operating and emergency procedures

f. Maintenance procedures

g. Configuration management plan (if applicable according to Section 3-4.1 or 4-5)

Additional information may be required in the course of the certification process to fully justify any areas that are of a safety concern to the SCA due to changes in the system design, fabrication or testing. The PSOB should specify the general types of documentation to be reviewed by the SCA.

In cases where simple diving systems are being designed to the same or a very similar configuration as a previously certified system, the applicant may negotiate with the SCA on what supporting documentation will be required for certification.

2-5 Review and Approval of Supporting Documentation

It is the responsibility of the Diving System Acquisition Manager to ensure detailed technical reviews of the system design are conducted and formally documented. These technical design reviews shall utilize headquarters' technical staff or other recognized technical experts not involved in the system design effort to ensure that the system design meets the requirements of this manual. All supporting documentation submitted shall also be reviewed by the SCA for technical adequacy and for conformance to the requirements of this manual. When additional technical expertise is required, the SCA shall obtain assistance from the headquarters technical staff or such other experts as may be appropriate. By including the SCA in these formal design reviews, the Acquisition Manager can eliminate duplication of effort, and significantly reduce costs associated with these reviews. Obtaining SCA concurrence with the design is strongly recommended prior to beginning construction.

2-6 On-Site Survey

One or more on-site survey(s) of the system shall be conducted by the SCA. The purpose of an on-site survey is to verify that the "as-built" system has been fabricated in accordance with the approved documentation, and that the system can be operated safely and maintained effectively. Each survey shall be officially requested in writing by the applicant and confirmed by the SCA. The SCA addresses can be found at SEA 00C website (http://www.supsalv.org) or NAVFAC website (http://www.navfac.navy.mil). A request for a survey should reach the SCA at least 90 days prior to the desired date of the survey. A survey is not scheduled until after the system PSOB, drawings and

operating and emergency procedures have been submitted and reviewed by the SCA. Any changes made to the PSOB, due to subsequent work performed on the system, shall be identified to the SCA during the on-site survey.

The PSOB, which was used as a checklist during the documentation technical review, is further utilized as the survey outline. Line items of the PSOB that have not been satisfied earlier must be completed during the survey.

A Survey Checklist is also used during the survey. This checklist is used for standard surface supplied diving, recompression chamber, and typical class certified UBA Systems. The items found in the checklist are tied to specific requirements found in this manual, the U.S. Navy Diving Manual and in other upper-level Navy and commercial design and fabrication requirements documents (e.g., NSTM, ASME Boiler and Pressure Vessel Code, etc.). In general, Survey Checklist items pertain to material adequacy, system documentation, system operability, and maintenance.

2-6.1 Survey Team Personnel

The SCA shall assemble a survey team to perform an on-site survey of the system. The type and complexity of the system will determine the size and make-up of the survey team. For more complex systems, typical areas of expertise might include mechanical, electrical, hydraulic, ocean, and structural engineering. Naval Architects and QA specialists might also be required. For a relatively simple system, a single diving system expert will usually represent the SCA.

2-6.2 Objective Quality Evidence (OQE)

OQE is any statement of fact, either quantitative or qualitative, pertaining to the quality of a product or service based on observations, measurements, or tests which can be verified. Evidence shall be expressed in terms of specific quality requirements or characteristics. These characteristics are identified in drawings, specifications, and other documents that describe the item, process, or procedure. One of the main objectives of the survey is to review the OQE to ensure that the system is actually built as designed, and that it will perform safely to the limits for which certification is requested. Accordingly, the survey team shall review OQE in sufficient detail and depth to support a conclusion that the system is safe for manned use. The SCA may require additional technical expertise in cases where safety concerns remain outstanding after the design review findings are closed out. The applicant shall ensure prior to a survey that required OQE not previously submitted to the SCA is readily available for the survey team. Appendix B provides additional guidance on OQE.

2-6.3 Survey Coverage

Survey Coverage shall be negotiated prior to scheduling a survey. The survey shall include, but not be limited to, a review of the following items:

a. “As-built” drawings (see Section 3-2.9) and documentation of the diving system

b. Drawing control procedures and records

c. QA procedures, results and records

d. NDT qualifications and records

e. Construction, fabrication, assembly and test procedures, results, and records (e.g., welding/NDT procedures, records and personnel qualifications)

f. System proof and performance test procedures and results

g. System cleaning procedures and results, including sampling points and pass/fail criteria

h. Accessibility to vital equipment and components

i. Quality of workmanship

j. System component identification and color coding

k. Gage, instrument and relief valve calibration data

l. Repair and maintenance procedures and records

m. Re-entry control procedures and records

n. Air and gas sampling results

o. A physical review of system hardware to determine general material condition

p. Manned and unmanned operational demonstration of the system

2-6.4 Preparation for Survey

The applicant is responsible to make every effort to prepare in advance for the on-site survey. For NAVSEA surface-supplied diving systems and recompression chamber systems, additional useful information can be found in the “System Certification Requirements/Guidelines for Afloat and Portable Recompression Chambers and Surface Supported Diving Systems.” For additional survey information on shore-based hyperbaric systems refer to NAVFAC Shore-Based Hyperbaric System Certification Survey checklist. All formally documented procedures requiring SCA review and/or approval shall have been provided to the SCA prior to requesting the survey. The system shall be operationally ready and all obvious deficiencies corrected prior to commencement of the on-site survey. The supporting documentation discussed throughout this manual shall be available at the survey site in an organized fashion. It is

essential that qualified personnel knowledgeable in all aspects of the system (operation, design, testing, QA, maintenance, etc.) be available and ready to assist the survey team. The survey team is not obligated to spend time locating documents requested but not produced. If essential documents cannot be presented prior to the conclusion of the survey, a survey card shall be issued stating that the material was not available for review.

It is important to note that the applicant is responsible for the accuracy and completeness of documents presented regardless of their source. The applicant or his designated representative shall review all records and data supplied from industrial or support activities prior to the survey. Those that are incomplete or in error shall be rejected and returned for correction.

When performing an on-site material audit of a new system, survey personnel must use a survey check list similar to that used in system surveys. The check list is designed to ensure the critical material OQE, fabrication, operational and test requirements are met.

All documentation shall be presented in an organized and auditable form. The SCA should be able to quickly and easily trace the documentation to the hardware and vice versa. It is strongly recommended that the applicant organize documentation using the SCA's Survey Checklist.

2-6.5 Survey Guidelines

As in all safety-related inspection programs, the intentional concealment of known deficiencies by either action or inaction is deliberate malpractice and could result in death or serious injury. Deficiencies that are known to the applicant and inadvertently overlooked by the survey team shall be brought to the attention of the SCA and discussed. Certification survey cards should not be viewed as representative of either command or personal failure. Rather the findings are those of conscientious specialists in the field of diving equipment, who are responsible for reviewing the material and procedural adequacy of the system, thereby assuring the safety of the occupants and operators.

Surveys shall <u>not</u> be scheduled or conducted, nor survey cards written, for the sole purpose of forcing the command to make fiscal and/or operational resources available to correct known or longstanding deficiencies, which do not pose a safety hazard to the system components.

2-6.6 On-Site Material Surveys/Audits at Fabrication Facilities

When systems or subsystems are fabricated at a contractor facility and later shipped to the installation or command of the applicant, it is strongly advised to request one or more on-site Material Surveys at the manufacturer's facility. Material Surveys are particularly useful for portable systems, or complex systems fabricated by more than

one contractor. The survey team has access to the manufacturing and test personnel as well as any supplemental OQE, typically retained by the contractor, which may be required to ensure the proper fabrication and testing of the system. By performing on-site Material Surveys at the manufacturer's facility, the SCA can identify material or OQE issues, and resolve them prior to the system being shipped to the operational command.

2-7 System Certification Survey Cards

Deficiencies noted during the survey and recommended corrective action shall be documented in the form of System Certification Survey Cards (SCSC). Survey cards are classified by the SCA as follows:

a. Category IA. Corrective action must be accomplished prior to manned use of the system. For a diving system that has already been certified, the issuance of a Category IA SCSC shall result in either the termination or suspension of the existing certification. Prior to further manned use of the system, full recertification, or removal of the suspension by the SCA is required.

b. Category IB. Corrective action must be accomplished prior to system certification. Category IB SCSCs are issued to uncertified systems or previously certified systems for which certification has been terminated or suspended. In the latter case, manned operation cannot be carried out until all IA survey cards are cleared. Manned system operational demonstrations may be permitted by the SCA when Category IB SCSCs are outstanding. System certification cannot be completed until corrective action is taken to clear all Category IA and IB survey cards.

c. Category IC. Corrective action must be accomplished prior to the date or event specified on the card to sustain certification. Certification or continuation of certification may be granted in the intervening time period. Failure to correct the deficiency and officially notify the SCA in writing by the specified date or event shall cause termination or suspension of certification unless advance justification is provided. Category IC SCSCs are generally related to deficiencies concerning administration or documentation, e.g., updating system drawings, revising PMS coverage, conducting studies and evaluations, updating technical manuals, etc. Normally, Category IC SCSCs are not to be used for hardware-related safety deficiencies.

d. Category ID. Corrective action must be accomplished on a specified component prior to its use, but the overall system retains its certification. Some limitation may be placed on the operational parameters of the existing certification, such as reducing the maximum depth or the number of divers, until the card is cleared. An example of a case in which a Category ID SCSC would be appropriate is a surface-supplied diving system in which the primary air supply consists of two medium pressure air compressors that deliver 87 scfm each, and the secondary air supply consists of four high pressure (3000 psig), six cubic foot flasks. If one of the compressors becomes inoperable, a Category ID SCSC should be issued against that compressor, but the system would retain its certification. In this case, where one of the medium pressure air

compressors is sufficient for primary air, no limitation would be placed on the operational parameters. However, if the operational compressor output was less than that required for operations to the maximum depth of the system, the depth or number of divers would be reduced to ensure adequate flow rates to the divers. Although no date or event will be specified for correction of the deficiency, the status of all outstanding Category ID SCSCs shall be reviewed at the next on-site survey. If a Category ID deficiency has not been corrected by the next Survey, the SCA shall, at the request of the diving command, consider removing the component from the SOC, and possibly downgrading the capabilities of the system.

e. Category II. Corrective action is desirable, but not mandatory. Category II deficiencies may be corrected at the applicant's option, but should be addressed by the applicant even if no action is taken.

Each card has space for the survey team to record its findings and recommendations. Separate space is provided for a statement of corrective action (to be completed by the activity that submits the card for clearing). Figure 2-5 is a sample SCSC.

At the conclusion of the survey, a critique or outbrief is held. The survey team leader will review and discuss all survey cards and their recommended corrective actions with the system applicant or his designated representative. The critique is open to all interested parties. Frank discussion and free exchange of information are encouraged. If the applicant disagrees with any of the findings, or with the categorization of any of the SCSCs, or has completed some or all of the corrective action for one or more of the deficiencies found, he should make this information known at the critique. The survey team leader may, as a courtesy, leave preliminary copies of the survey cards. These copies are for discussion purposes only. Expenditure of resources should not be undertaken based on these unofficial cards as they are subject to change prior to official issue. Assignment of responsibility for the performance of corrective action required by the survey cards to activities other than the applicant is not within the purview of the SCA and must be done by the applicant.

Upon completion of the survey, the SCA shall forward the results of the survey team's evaluation of the system to the applicant for action, via the appropriate chain of command. The SCA will provide copies of the survey cards to other activities, when requested by the applicant. If several category IA and/or IB survey cards are issued during a survey, a follow-on survey may be required. If a follow-on survey is necessary, the SCA shall inform the applicant in writing. The applicant is required to request the follow-on survey in writing.

NAVAL SEA SYSTEMS COMMAND
SYSTEMS CERTIFICATION AUTHORITY
SYSTEM CERTIFICATION SURVEY CARD

CARD NO._____

CAT_____

SHIP OR ORGANIZATION _____

ITEM_____ **DATE**_____

TEAM MEMBER_____

CATEGORY OF DEFICIENCY (CHECK ONE)

CAT IA – MUST BE ACCOMPLISHED PRIOR TO MANNED USE

CAT IB – MUST BE ACCOMPLISHED PRIOR TO SYSTEM CERTIFICATION

CAT IC – MUST BE ACCOMPLISHED PRIOR TO DATE INDICATED BELOW TO SUSTAIN CERTIFICATION

CAT ID – MUST BE ACCOMPLISHED ON SPECIFIED COMPONENT PRIOR TO ITS USE, BUT THE OVERALL SYSTEM RETAINS ITS CERTIFICATION

CAT II – DESIRABLE

(A) FINDINGS

(B) RECOMMENDATIONS

(C) CORRECTIVE ACTION

(D) VERIFICATION OF CORRECTIVE ACTION: I have reviewed the above Corrective Action and consider it to fully correct the findings.

_____ _____ _____
SENIOR SYSTEM REP. **DATE** **POSITION**

(E) CORRECTIVE ACTION IS SATISFACTORY

(1) _____ _____ **(2)** _____ _____
NAVSEA 00C **DATE** **NAVSEA 00C** **DATE**

CARD NO._____

Figure 2-5. System Certification Survey Card

The SCA may revise a card or downgrade an SCSC category after its initial issuance. Reasons for revising an SCSC include partial clearing of the deficiency, a change in the nature of the deficiency based on additional information, discovery of a new deficiency closely related to a deficiency already documented on an SCSC, or splitting a single SCSC into multiple SCSCs for ease of tracking status by subsystem. An SCSC may be downgraded if it can be shown that the lower category is more appropriate than the originally-assigned category. SCSCs that include more than one recommended corrective action will not normally be revised based solely on the completion of one of the recommended corrective actions. SCSCs may be revised or downgraded either unilaterally by the SCA or based on a request from the applicant.

When action identified by a specific card has been completed, a brief summary shall be written on the card and the card signed by a senior representative of the applicant. Cards must then be returned to the SCA, via the chain of command, for clearing. Should the clearing of the card involve supporting documentation (e.g., re-entry control forms, test memos, NDT records, calibration data, etc.), the documentation should be referenced on the card and copies provided to the SCA. When the corrective action is satisfactory, as submitted by the applicant, the SCSC shall be signed by two representatives of the SCA (usually including the individual who wrote the card). This action clears the card. If the action taken by the applicant does not satisfy the finding, but instead alters the system mission so that personnel safety is no longer an issue, the SCA may cancel the card. The applicant may, with supporting justification, request that an SCSC be canceled. The request to cancel a card shall be documented by the applicant on the card with the technical justification attached to the card. Canceled cards must also be signed both by a senior representative of the applicant and two representatives of the SCA. If requested by the applicant, the SCA will provide copies of officially cleared/canceled cards to the applicant for record purposes.

Following the granting of either initial certification or recertification of a diving or hyperbaric system, there are two additional times when survey cards may be issued. These are:

a. During a survey performed within the tenure of certification to ensure that certification is being adequately sustained

b. During a survey requested by the applicant to continue certification beyond the original tenure of certification

2-8 Examples of Common System Certification Survey Cards

The SCA has final responsibility for assigning categories to SCSC findings. For the benefit of the applicant, several common on-site survey findings and the resultant SCSC categories are listed below:

a. SCSC Category IA

(1) Lack of system cleanliness verification

(2) Lack of hydrotest data and/or inspection records for newly installed components or for periodic inspection/retest of pressure vessels (i.e., gas flasks, volume tanks, moisture separators, filter housings)

(3) Unqualified weld/NDT procedures or personnel

(4) Unsatisfactory test/inspection results

(5) Damaged or non-operational pressure boundary components

(6) Unauthorized system modifications

(7) Major system drawing discrepancies

(8) Operating and emergency procedures not approved

(9) Inaccessible vital components

(10) Inadequate re-entry control program

(11) Pressure piping chafing on other piping or components such that damage could result

(12) Unauthorized sealing compound on pipe threads

(13) Lack of emergency power when required to provide sufficient breathing gas from electrically driven compressors

b. SCSC Category IB

(1) Unable to perform operational demonstration due to logistical problems

(2) Difficult access to or operation of system components

(3) Unapproved preventive maintenance procedures

(4) No OQE available for replacement component

(5) Brazer/welder qualifications not available for review

(6) Newly installed components that are not in accordance with approved drawings

(7) Administrative errors or omissions on SOC documentation

c. SCSC Category IC

(1) System drawings not updated to reflect as-built configuration of system (accurate red-line drawings are available)

(2) Label plates missing from system valves

(3) System valve hand wheels/piping not color coded

(4) Permanent label plates not installed on diver connections

(5) Dust caps not provided at diver hose connections

d. SCSC Category ID

(1) Redundant component or equipment is non-operational

As previously stated, Category IB SCSCs are not written during an on-site survey to sustain or continue system certification. Survey findings that typically fall into the IB category on an uncertified system are generally considered either category IA or Category IC findings on a certified system.

2-9 Operational Demonstration

A satisfactory survey, including correction of all Category IA discrepancies, allows the commencement of a manned certification operational demonstration to the depth/pressure limits stated in the certification application. Typically, an unmanned operational test is required by the SCA prior to a manned demonstration.

The SCA or his appointed representative shall participate in or observe the operational demonstration of the system. Exceptions to this requirement are:

a. The SCA may grant permission to omit the operational demonstration for recertification of diving systems or diving apparatuses that have had a history of safe and satisfactory performance.

b. The SCA may certify or recertify diving systems for full certification depth based on operational demonstrations to a depth less than full certification depth. This alternative can be exercised by the SCA for those diving systems or apparatuses that have a history of safe and satisfactory performance and cannot conduct full depth operational demonstrations because of the inability or impracticality of transiting to ocean areas that would allow full depth tests. This is not typically done with complex diving systems.

The certification operational demonstration may be conducted in conjunction with other Navy program requirements (e.g., OPEVAL, Sea Trials, etc.) with concurrence by the SCA. Satisfactory completion of the certification operational demonstration and clearing of all open Category IB SCSCs generally justifies the granting of system certification.

2-10 Issuance of Certificate

A formal letter of U.S. Navy Certification of System Adequacy is issued by the SCA after the successful completion of the operational demonstration and the correction of deficiencies. The SCA shall specifically state the operational limits, parameters and tenure for which the certification is granted. The SCA shall also specify the terms and conditions of system certification and additional requirements as appropriate. The applicant is thereafter responsible for sustaining system certification and requesting continuation of system certification or recertification.

2-11 Tenure of Certification

Tenure of certification is the length of time for which certification is granted. The granting of system certification by the SCA does not automatically ensure that it will remain in effect for the full, stated period. System certification shall not be granted for the entire design life of the system. In general, the tenure of certification is initially granted based on the mission profile (scenario), system complexity, and the operating and test histories of similar systems. For systems of a new design, the tenure of certification may be limited to one year subject to reevaluation. The tenure of system certification may be negotiated to coincide with planned events such as overhaul or refurbishment, but is typically limited to three years.

2-11.1 Termination or Suspension of System Certification

2-11.1.1 Termination of Certification

Termination of certification is a withdrawal of system certification. Once certification is terminated, the system cannot be recertified without a complete SCA review of all work undertaken since the last certification survey. Recertification, in this case, always requires an on-site survey.

2-11.1.2 Suspension of Certification

Suspension of certification is a temporary withdrawal of certification, which remains in effect while one or more actual or potential violations of the terms of certification are investigated and corrected. System certification may be suspended by either the user command or the SCA. The user command should suspend system certification anytime there is work to be performed on the system that requires SCA review, or an unsafe system condition is identified. Manned use of the system during the suspension is not authorized. Prior to reinstating system certification, an on-site review of the problem area(s) by the SCA may be required. Once the deficiencies are corrected to the satisfaction of the SCA, the original system certification will be reinstated by the SCA.

2-11.1.3 Conditions for Termination or Suspension

System certification will be terminated or suspended, at the discretion of the SCA, as a result of the following:

a. Violation of the limits and/or terms of the letter granting certification (e.g., depth, time, temperature, etc.)

b. Recognition of the existence of an unsafe condition

c. Expiration of tenure of system certification

d. Modifications to equipment/components within the SOC

e. Overhaul, repair or alteration, as defined in Chapter 5

f. Expiration of a lease contract

g. Failure to correct Category IC cards by specified date or event

h. Issuance of a Category IA survey card

i. Casualty to the system or its occupants/divers pending the issuance of an investigative report dealing with the incident.

2-11.2 Sustaining System Certification

Sustaining system certification comprises those actions required of the applicant to assure the SCA that a diving system remains in the as-certified condition throughout the tenure of certification. As stated previously, granting system certification does not automatically ensure that system certification will remain in effect for the full certification period. The responsibility for sustaining system certification during the certification period rests with the applicant.

2-11.2.1 Design Changes and Alterations

SCA concurrence must be obtained for any design changes or proposed alterations to equipment within the SOC, or which could impact the SOC. Each proposed design change or alteration shall contain an evaluation of the effects of the change on the safe operation of the system in accordance with the requirements of this manual. Accomplishment of design changes and alterations within the SOC without SCA concurrence shall result in termination of system certification.

2-11.2.2 Repairs and Maintenance

The system shall be maintained so that all systems, subsystems and components within the SOC, or as modified by an approved Configuration Matrix, are functioning properly, in the as-certified condition, prior to each operational use.

In complex systems, this requirement may impose severe operational readiness restrictions. To better manage complex systems, the SCA may require the applicant to develop a Mission Configuration Matrix as described in Section 2-2.5.2. The Mission Configuration Matrix must be approved by the SCA prior to use, and shall be part of the system PSOB or Certification Scope Notebook, if one is developed.

All work and testing accomplished during routine repairs and maintenance shall be in accordance with the requirements in Chapters 3, 4, and 5 (Initial Certification, Responsibilities of the Acquisition Manager, and Repair and Overhaul, respectively). Repairs, maintenance, inspections and testing shall be performed by qualified personnel only.

The appendices in this manual give detailed requirements for testing after various types of work. Repairs and non-routine maintenance shall be recorded in a way which:

a. Defines the boundaries of the work performed

b. Specifies the nature of the work performed

c. Defines the post-repair testing and cleaning performed (if pertinent)

d. Records information attesting to the suitability of materials used

e. Records the signatures of those performing, inspecting, testing and approving the work. (All signatures shall be dated at the time the individual performs the task.)

For additional information, see Section 5-7 (Re-Entry Control) and Appendix A (Re-Entry Control Procedures).

2-11.2.3 Periodic Inspection and Operations

Periodic inspections of systems and components within the SOC, if required as a condition for sustaining system certification, shall be performed and the results reported in writing. Requirements for maintaining system certification are listed in the System Certification letter. Each inspection record shall bear the signature of a responsible person. Where specifically required, results shall be reported to the SCA. The SCA may require that periodic system operations be conducted as a condition for sustaining certification.

2-11.2.4 Operating Limits

The system shall be operated only within its certified operational limits. Operation outside of the authorized limits, without a valid CNO waiver, is not allowed and may result in termination or suspension of system certification. Any violation shall be immediately reported to the SCA, stating the cause or justification.

2-11.2.5 Unusual Situations

The SCA shall be advised of any situation that may prevent the system from maintaining its intended operational capability. These may include, but are not limited to, excursions below certified depth or exceeding certified pressure, physical damage, grounding, entanglements, fires, emergency ascents or depressurizations, and casualties resulting in loss of diver consciousness, injury or death. Further, a report shall be submitted to the SCA containing an evaluation of the extent of damage, proposed repair methods, and probable cause of the emergency (e.g., personnel error, nature of the operations, system or component failures, etc.). It is not intended that these emergency situations include failures that only temporarily interrupt the operational capability of the system and are corrected by routine repairs.

2-11.3 Continuation of System Certification

Continuation of system certification is an extension by the SCA of the certification period beyond that initially granted. This is normally done to permit continued use of a system that has had no changes to the basic design, SOC or general operating characteristics, and where the material condition of the system supports the continuation. During this continuation of system certification, all requirements noted in Section 2-11.2 (Sustaining System Certification) shall be observed. The applicant shall arrange with the SCA for a continuation of certification, and submit a request for an on-site survey no less than 90 days prior to the desired certification date.

2-11.4 Recertification

Recertification is a new certification of a system where the existing certification has expired or has been terminated. In order to recertify a system, the SCA shall determine those requirements of this manual that must be accomplished. Following a recertification, all requirements noted in Section 2-11.2 (Sustaining System Certification) shall be observed.

2-11.5 Extension of Certification

The SCA may extend system certification for short durations in three cases:

a. When emergency operational commitments of the system prevent it from being available for an on-site survey at the time of the expiration of certification

b. When the system is scheduled for overhaul within 90 days after expiration of the current certification

c. When the SCA is unavailable due to prior commitments

Extensions of certification will be granted only for systems that have required no more than routine maintenance and repairs during the original tenure of certification. Any non-routine work performed on the system should be reported to the SCA. The SCA requires equipment hydrostatic test dates, inspection dates, gage calibration dates, and a statement that the system is operational prior to granting an extension of certification. If requested, the applicant shall provide the SCA with a list of all work accomplished on the system during the tenure of certification and justification for the request for an extension.

2-12 Transfer of System Custody

Occasionally, a fleet command may find it is in need of additional diving systems to accomplish their mission. Conversely, a fleet command may find itself in possession of excess diving systems. Systems such as dive boats, portable surface-supplied dive systems, portable recompression chambers and diver worn equipment may be transferred (either temporarily or permanently) only after notifying the NAVSEA Supervisor of Diving (NAVSEA 00C3). In addition, the SCA shall be kept apprised of all pending equipment transfers.

2-12.1 Temporary Transfer of Custody

A temporary transfer of diving system custody may be arranged directly between two fleet diving commands, via their respective chains of command, as long as the Supervisor of Diving is notified. In order to be considered temporary, transfer of system custody shall not exceed ninety (90) days. Only a complete, fully operational, and currently certified system may be transferred on a temporary basis.

The following actions shall be taken when arranging a temporary transfer of diving system custody:

a. The custodial command shall notify the Supervisor of Diving and the SCA of the impending temporary system transfer. Included in the notification shall be the name of the recipient command and the anticipated dates of transfer and return of the system.

b. Upon system transfer, the custodial command shall forward a copy of the current certification letter, the preventive maintenance package (including Cycle and Quarterly Schedules), applicable system drawings and technical manuals, operating and emergency procedures and a copy of the Re-entry Control Log to the recipient command. The custodial command shall retain responsibility for ensuring that

preventive maintenance and re-entry control procedures are maintained up to date, even while the system is in the custody of another command.

c. Upon return of the system to the custodial command, the recipient command shall notify the Supervisor of Diving that the system has been returned to the custodial command in a fully operational and certified status.

d. The recipient command shall return the documentation originally provided by the custodial command. The preventive maintenance package, including all completed and deferred maintenance actions, and the Re-entry Control Log, including all new re-entry control packages shall be complete and current.

Extensions of the ninety (90) day temporary custody limit shall not be allowed except in an emergency situation. Should an extension become necessary, the recipient command shall contact the SCA for guidance.

For class certified diver worn equipment, guidance for temporary transfer of custody must be obtained from the Supervisor of Diving.

2-12.2 Permanent Transfer of Custody

The custodial command shall inform the Supervisor of Diving, via the chain of command, that it has an excess diving system available for permanent transfer. The recipient command shall inform the Supervisor of Diving, via the chain of command, that it is in need of a diving system. Only the Supervisor of Diving may authorize a permanent transfer of system custody.

a. After authorization for a permanent transfer of custody has been granted by the Supervisor of Diving the following actions shall be accomplished:

(1) The custodial command shall inform the recipient command of the operational condition of the system, all operational and documentation deficiencies (including open REC's) and outstanding System Certification Survey Cards.

(2) The custodial command shall prepare a "turn-over file" consisting of as-built system drawings, current PSOB, all re-entry control documentation, test records, technical manuals, operating and emergency procedures, a complete Preventive Maintenance System (PMS) package and all certification survey documentation from previous surveys. The turn-over file shall accompany the system to the recipient command.

b. After receipt of the system hardware and certification documentation, the recipient command shall take the following action:

(1) Establish a formal QA plan and re-entry control procedures in accordance with Appendix A.

(2) Verify that the system drawings, technical manuals and operating and emergency procedures reflect the as-built condition of the system. All required drawing revisions and operating and emergency procedure revisions shall be submitted to the Supervisor of Diving for review and approval.

(3) Initiate the preventive maintenance plan for the system.

(4) Develop a new PSOB and submit it to the SCA for review and approval.

(5) Request an on-site survey of the system by the SCA.

Upon completion of a successful on-site survey, the SCA shall grant the system a new certification. This procedure applies to all new systems except class certified diver worn equipment.

The procedure for permanent transfer of custody of class certified diver worn equipment is similar except that revision of documentation and development of a new PSOB is not required. The SCA must be contacted to determine whether an on-site survey of the equipment will be required. Additional guidance is provided in Section 6-5 (Custody Control of Diver Worn Equipment) of this manual.

2-13 Responsibility for Certification Costs

The appropriate Systems Command normally budgets for expenses related to the survey team's travel costs and documentation reviews. For portable and afloat USN diving systems, costs directly associated with system certification are borne by the OPNAV Sponsor. For non-USN DOD portable diving systems, the cost of system certification is negotiated between the SCA and the appropriate DOD systems command, and defined in a Memorandum of Agreement (MOA) between the two. In rare cases, the applicant may be requested to provide funds to support system certification efforts. The requirement for an on-site survey shall not be waived due to an inability of the requesting activity to fund travel and other related costs. Certification costs for new construction of diving systems shall be negotiated between the Acquisition Manager and the SCA.

2-14 Disposition of Diving Equipment

Any command having excess diving equipment that it intends to dispose of shall contact the Supervisor of Diving (NAVFAC for shore-based systems) for disposition instructions. Diving systems may not be sent to the Defense Reutilization and Marketing Office (DRMO), or similar facility, in an operational condition. The Supervisor of Diving or NAVFAC, for shore-based systems, will issue instructions for dismantling these systems to ensure they cannot be used by unqualified personnel.

Should the command desire to remove any components from the SOC boundaries for re-use in another system, formal re-entry control packages shall be generated. The re-entry control package must contain the pressure and type of gas or fluid of the

system from which the component was removed. For instance, a valve used in a 100 psig exhaust system could not be re-used in a 3000 psig oxygen system without verification of oxygen compatible material, a new hydrostatic test and re-cleaning to oxygen standards. The removed components shall be placed in segregated storage, and must be directly traceable back to the removal re-entry control package. Removed components shall be maintained cleaned or re-cleaned prior to the reinstallation in another system. No component previously used by another system shall be re-used in a different dive system without adequate OQE to document that the component is adequate for use in that new system.

CHAPTER 3

INITIAL CERTIFICATION

3-1 Introduction

This chapter describes the criteria that must be met in order to obtain initial certification for a diving or hyperbaric system. Assembly of the necessary OQE and adherence to these criteria should coincide with the design and construction/fabrication of the new system. For a system designed, manufactured and/or placed in service outside the purview of this manual (i.e., a system built by and for private interests, placed in service, then purchased by the U.S. Navy), the task of assembling the necessary documentation may be very difficult. In such cases, additional testing and analysis is generally required. In all cases, the Acquisition Manager shall initiate the process by submitting an application for system certification to the SCA, as described in Section 2-2 (Application for System Certification).

3-2 Design Review Information

The Acquisition Manager shall submit, or make available for review and/or approval, the documentation and evidence described in the following paragraphs. During review of this evidence by the SCA, the Acquisition Manager may be required to supply additional information and to consult with the SCA. If, in the course of supplying information required by the SCA, it becomes necessary for the designer/builder to disclose information he considers proprietary or classified, he should so identify it. The SCA will cooperate with the designer/builder in the protection of such information.

In cases where simple diving systems are being designed to the same or a very similar configuration as a previously certified system, the Acquisition Manager may negotiate with the SCA regarding what design review information will be required for certification.

The design documentation submitted by the Acquisition Manager for review and/or approval shall include the following as a minimum:

a. Scope of Certification (SOC)

b. Milestone Event Schedule (MES)

c. Pre-Survey Outline Booklet (PSOB)

d. Summary Description of the Diving System

e. Subsystem Description

f. Design Parameters

g. Design Analysis

(1) Design Calculations

(2) Stress Analysis

(3) Design Verification (System meets all procurement specification requirements)

h. System Drawings

i. Operability and Maintainability Criteria and Procedures

(1) Operability Analysis

(2) Maintainability Analysis

(3) Operating and Emergency Procedures

(4) Maintenance Procedures

j. Justification of Materials

k. Toxic and Flammable Materials Data

l. Hyperbaric Chamber Vacuum Data

m. Hazard Analysis

The Acquisition Manager shall provide items a. through m. above to the SCA for review and/or approval prior to conducting formal design reviews.

Items f. through m. shall be forwarded to the SCA by the Acquisition Manager at least 60 days prior to convening each formal design review, or as required by the Milestone Event Schedule. The number and scope of formal design reviews will be governed by the size and complexity of the system and can be negotiated between the Acquisition Manager and the SCA. See Section 2-5 (Survey Guidelines) for additional information concerning reviews of technical documentation.

3-2.1 System Scope of Certification (SOC)

The Acquisition Manager shall submit an initial baseline Scope of Certification, described in Section 2-2.1, to the SCA for review. The SOC shall be modified and kept current as the system design matures. The final SOC requires SCA approval.

3-2.2 Milestone Event Schedule (MES)

The Acquisition Manager shall submit the Milestone Event Schedule, described in Section 2-2.2, to the SCA for review and approval.

3-2.3 Pre-Survey Outline Booklet (PSOB)

The Acquisition Manager shall submit an initial baseline Pre-Survey Outline Booklet, described in Section 2-2.3, to the SCA for review. The PSOB shall be modified and kept current as the system design matures. The final PSOB requires SCA approval.

3-2.4 Summary Description of the Diving System

To aid the SCA in performing a safety evaluation, the Acquisition Manager shall submit a summary description of the diving or hyperbaric system including design and construction details and a mission profile or diving scenario. A written explanation of the features of the system, along with appropriate schematic drawings to show their functional relationship during manned operation, shall be included. The content of the summary description shall be commensurate with the complexity of the system. Simple, conventional systems need only brief summary descriptions; complex systems require more detail.

3-2.5 Subsystem Descriptions

Each subsystem within the SOC shall be described. These subsystems normally include those described in Section 2-2.1, as well as all significant mechanical and structural features.

Each subsystem design submitted must include both a written description and a function/flow diagram. The description shall clearly delineate objectives of the design and include safety considerations. It should also include a subsystem hazard analysis of the consequences of a failure or loss in normal operating mode. The diagram shall clearly show how the subsystem accomplishes its intended function. As the subsystem design matures, additional information shall be included to identify the specific components and their location, size, material, etc.

3-2.6 Design Parameters

The design parameters of the system must be identified. The design parameters provide the basis for evaluation of system adequacy. Design parameters that the Acquisition Manager must consider and which will be evaluated by the SCA include:

a. Type of life-support equipment

b. System complexity

c. System volumes

d. Manning requirements

e. Design safety factors

f. Design life and service period (useful life, number of cycles, etc.)

g. Effect of ambient operating conditions and mechanical shock and vibrations on design life

h. Replacement/replenishment requirements

i. Depth/pressure limitations

j. Limits for breathing gas composition, pressure, flow, temperature, and humidity

k. Specification and justification of breathing gas contamination limits

l. Temperature limits for both normal and emergency operating conditions

m. Thermal protection requirements

n. Identification of anticipated hazards

o. Physiological considerations of occupants/divers/operators

p. Emergency equipment requirements and capabilities

q. Communications requirements

r. Corrosion allowance/resistance requirements

s. Applicable industry design codes and standards

t. Soil and foundation considerations (permanently mounted shore installations only)

3-2.7 Design Analysis

A complete and thorough design analysis shall be submitted for SCA review and concurrence. The design analysis shall consist of formal design calculations and a complete stress analysis as explained below. The design analysis must also correlate the maximum mission parameters (depth, time, number of occupants, current, sea state, temperature, etc.) with the design requirements.

3-2.7.1 Design Calculations

Calculations will be submitted to the SCA, by the Acquisition Manager, to demonstrate the adequacy of design in terms of the design parameters of the diving or hyperbaric system, and with all assumptions clearly stated. Components, equipment and systems shall be designed to properly operate at the most limiting design conditions. Information will be submitted in sufficient detail to permit independent analysis of the design. Documentation submitted by the Acquisition Manager shall be tabulated to ensure that the information completely covers the design.

a. Structural design calculations shall show the effect of fabricating to worst case dimensions and tolerances. Potential effects of corrosion caused by oxidation, pitting, galvanic interaction of dissimilar metals, and stress corrosion cracking must be considered. Appropriate reference shall be made to applicable test data operational requirements, codes and standards, safety standards and operating experience when used to support a calculation technique.

b. Piping and mechanical systems, loads, power supplies, etc. shall have calculations to show the capability of the system to perform its intended function. This includes system flow characteristics, velocity, flow rates, and storage and/or air bank capacity, where applicable.

c. Design calculations for electrical equipment and systems will contain as a minimum:

(1) Electrical load calculations

(2) The maximum current carried by conductors, and the heating effect of such current on the wire and insulation

(3) Maximum heat generated by the equipment, and the maximum anticipated temperature

(4) Where available, information obtained from the manufacturers of the electrical/electronic equipment may be used in lieu of actual calculations provided that technical justification to support the manufacturer’s information is provided

3-2.7.2 Stress Analysis

The Acquisition Manager shall verify the adequacy of the design by performing detailed stress analyses and conducting the tests described in the appendices of this manual, when appropriate. Applicable sections and provisions of pressure vessel and piping design codes shall be applied. Test programs in support of system certification shall consider all ramifications of the stress analyses. Stress analyses and test reports submitted by the Acquisition Manager shall also consider the most critical loading case which includes the cumulative detrimental effects of design allowances, dimensional variations, and tolerances. The Acquisition Manager may request that specific designs

utilizing standard materials or components be exempted from stress analysis, based on technical justification. In cases where the pressure boundary is a unique and complex shape, destructive testing can be accomplished if the validity of a stress analysis is in question. The SCA will then make a determination of those materials and systems which do not require the stress analyses and will inform the Acquisition Manager whether material may be exempted.

Examples of loads to be considered are:

a. Weight of water used for hydrostatic testing

b. Forces encountered while transporting, securing, removing, or handling the system or its components

c. Static loads imposed by the clamping or securing devices used to secure the system

d. Maximum operating pressure of gas within the system

e. Thermal stresses due to the maximum operating temperature range of the system

f. Reactions due to differential thermal expansion between the system and the structure to which it may be fixed or due to elastic expansion of the system caused by internal pressure

g. Vibration transmitted from the shipping platform transporting the components of the system

h. Shock, including accidental blows

i. Vertical and horizontal loads on foundations

j. Seismic requirements

k. Forces developed by shipboard accelerations, ship vibrations or imposed by ship motions

l. Dynamic loads, such as those encountered:

(1) When launching, retrieving, or handling the Diving System

(2) In normal or casualty operations such as explosively jettisoning external equipment

(3) From collapse of any nonpressure-compensated elements

m. Fatigue load life of the pressure resisting components and piping for a specified number of cycles in a cold water environment

n. Effects of corrosion

3-2.7.3 Design Verification

For complex systems, an analysis may be required to verify that all technical requirements have been met. These technical requirements are typically found in the system procurement specifications.

3-2.8 System Drawings

Certification of all diving systems shall require drawings meeting the requirements of MIL-DTL-31000, which are adequate to support technical design reviews. A drawing index that includes and identifies the systems and components within the SOC shall be prepared by the Acquisition Manager for approval by the SCA. The level of drawing detail shall reflect the level of design maturity that has been attained at the time of each design review. The number and type of drawings required for an adequate technical design review will be determined by the function and complexity of the subsystem being reviewed. In addition to showing system and subsystem configuration, drawings normally required to support a technical design review must have adequate detail to show material, fabrication, cleaning, testing and special assembly requirements. In most cases where mechanical or electrical systems are being reviewed, system schematic diagrams with the above information are acceptable. However, where critical equipment such as recompression chambers are being evaluated, actual assembly drawings are required for the final design review. The Acquisition Manager shall submit up-to-date copies of drawings, signed by the appropriate technical agent, for each subsystem to be evaluated during a design review.

Each component or item on a drawing shall be identified by the manufacturer's model or type number, part number, vendor identification, applicable military specification, federal specification or standard as appropriate. Each component that provides a control, sensing or similar essential function that impacts on the operation of the system (valves, gages, pressure regulators, etc.) shall have a unique identifier made up of a system designation and a number. The color coding in accordance with U.S. Navy Diving Manual is recommended for Diving System design. These unique identifiers shall be shown on the drawings and shall be used in the operating and emergency procedures, and the system hazard analysis.

When the final system design has been approved, a complete set of Product Drawings, as defined in MIL-DTL-31000, shall be produced and distributed as determined by the Acquisition Manager. The Acquisition Manager may request the use of alternative commercial drawing specifications where appropriate. Where appropriate, the drawings shall specify any special material control requirements. The Acquisition Manager shall confer with the SCA to determine which drawings will be required to

maintain system certification, and shall ensure that those drawings are distributed to the activity that will operate the system after initial system certification has been achieved. The system operators will then keep those drawings current by ensuring that they reflect “as-built” system configuration. This may be accomplished by “red-line” marking of the drawings. Red-line drawings must be officially revised after each system major configuration change or when 25% of any drawing sheet has been red-lined, whichever comes first. A major configuration change would be a change that involves (1) health; (2) performance; (3) interchangeability, reliability, survivability, or maintainability; (4) effective use or operation; (5) weight; or (6) appearance (when a factor). All drawing revisions shall be formally documented and the reason and authority for each revision shall be explicitly stated on the drawing.

3-2.9 Operability and Maintainability Criteria and Procedures

The criteria and procedures upon which operation and maintenance are based shall be explained and supported by technical manuals and other documentation. Human engineering factors and emergency procedures are to be included.

3-2.9.1 Operability Analysis

For complex or unique systems (SRDRS, Saturation Diving, etc.), the Acquisition Manager shall submit the analyses used to evaluate the operability of the system. As determined by system complexity, such analyses should include an information flow diagram, an operational sequence diagram, a human engineering analysis of the instrumentation and control layouts, and an analysis of the life-support control and monitoring systems. Also included, shall be an analysis of the various emergency modes of operation to assure that the design reflects the needs of these special conditions.

3-2.9.2 Maintainability Analysis

For complex or unique systems (SRDRS, Saturation Diving, etc.), the Acquisition Manager shall submit the maintainability analyses used to develop the maintenance procedures and schedule. The analyses shall show that the design permits rapid positive identification of malfunctions, and rapid isolation and repair of these items by system personnel.

3-2.9.3 Operating and Emergency Procedures

The Acquisition Manager shall develop and submit operating and emergency procedures that cover all normal and foreseeable emergency evolutions that the system may be required to undergo. Refer to Section 3-6 (Assembly Procedures) for detailed requirements concerning operating and emergency procedures.

3-2.9.4 Maintenance Procedures

The Acquisition Manager shall provide the SCA with formal maintenance procedures for all systems, subsystems and components within the scope of certification. This requirement can be met using the U.S. Navy Planned Maintenance System (PMS) and pre- and post-dive procedures. These procedures will be considered in the certification process insofar as they relate to safe operation of the system. Refer to Section 3-7 (Cleaning Procedures) for additional information.

3-2.10 Justification of Materials

All materials and their applications, used in the design of a diving system, shall be justified. Selection of materials shall be consistent with the stated operating environment.

Some systems are designed to operate in more severe environments than others and new materials and configurations may be employed. It is not the intent of this manual to limit materials and their applications. New materials, or time-tested materials in new applications, may be used if sufficient data exists to assure the material adequacy of the system. Justifying data must include the requirements for care, preservation and maintenance of new materials for the projected life cycle of the material.

The less information and experience available concerning a given material and its application, the greater the burden upon the Acquisition Manager to justify the proposed material application.

For the purpose of system certification, the various types of materials and/or components are grouped into the following three categories.

a. Category 1 - Category 1 materials and components are those for which considerable operating experience is available.

b. Category 2 - This category includes materials and components that have not been extensively used in their specific, intended applications, but are classified as conventional due to identification by military or federal specifications, or recognized American commercial standards.

c. Category 3 - Category 3 materials and components include items for which definitive information and experience are not available.

When required by the SCA, material selection, design, and fabrication techniques shall be justified in accordance with military and/or recognized commercial engineering practices. Proper consideration shall be given to complex configurations and intersections, cyclic fatigue and low temperature requirements as appropriate for a man-

rated diving system. Examples of recognized engineering design and fabrication practices are:

a. ASME Boiler and Pressure Vessel Code, Section VIII, Divisions 1 and 2

b. Safety Standard for Pressure Vessels for Human Occupancy, ASME PVHO-1

c. Unified Facilities Criteria 4-159-01N Design: Hyperbaric Facilities

d. Welded Joint Design, MIL-STD-22D

e. ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

For typical design criteria of diving systems, the Acquisition Manager should refer to the U.S. Navy General Specification for the Design, Construction, and Repair of Diving and Hyperbaric Systems, NAVSEA-TS500-AU-SPN-010 (NAVSEA Diving Genspecs).

3-2.11 Toxic and Flammable Materials Data

The Acquisition Manager shall submit, for review and approval, a list of all potentially toxic and/or flammable materials to be used during construction, or to be installed or used in operating and maintaining the diving system. Toxic materials may be paints, insulation, adhesives, sealants, gaskets, bedding, clothing, lubricants, equipment, instruments, fittings or other items that could give off noxious fumes at operating pressures and temperatures or at any temperature below 200 degrees Fahrenheit. Flammable materials are those which will ignite or explode from an electric spark or when heated and will continue burning in the presence of air or in any oxygen-enriched atmosphere. Flammable materials shall be evaluated under both normal and emergency atmospheric conditions.

Prior to manned use of a diving system, an analysis of the system atmosphere must be submitted to the SCA for review. Refer to the NAVSEA Diving Genspecs for further information.

3-2.12 Hyperbaric Chamber Vacuum Data

All hyperbaric chambers designed for human occupancy, including all diving recompression chambers, shall be designed to prevent the possibility of unintentionally causing a pressure of less than one atmosphere while the chamber is occupied. Should the Acquisition Manager become aware that this condition exists, the SCA must be notified immediately so that appropriate action can be taken.

3-2.13 Hazard Analysis

As part of the design process for a diving system or equipment, a hazard analysis must be performed to evaluate the effects of all possible failures. MIL-STD-882, Standard Practice for System Safety, provides an acceptable set of guidelines for the conduct of hazard analyses. The application and tailoring guidelines given in MIL-STD-882 should be carefully followed in order to make the hazard analysis no more complex than is necessary to prove the safety of the design. The hazard analysis is typically performed assuming that only one failure occurs at a time - not multiple failures occurring at the same time. The Acquisition Manager shall submit the hazard analysis of the diving system for review and approval by the SCA. The hazard analysis shall describe the possible effects of a mechanical failure or operator error for each component or assembly. Those failures that could affect the safety or recoverability of personnel shall clearly show what features, warnings or procedures have been incorporated into the design, operation and maintenance of the system to preclude or minimize the probability of failure. It is the responsibility of the Acquisition Manager to ensure that conditions identified as significant safety hazards are eliminated or reduced to a level that provides maximum reasonable assurance that the safety of the system occupants is not jeopardized.

Mishaps are not always the result of equipment failure. Human error when responding to a routine command or a minor problem, or operation of a control function at the wrong time can result in catastrophe. Operating and emergency procedures must be specific, clear and concise in order to avoid confusion. The hazard analysis shall show that this type of failure has been considered in the design of the system and that safeguards have been taken to reduce the likelihood of such an occurrence.

For shore-based hyperbaric facilities, the hazard categories (HAZCAT) described in MIL-STD-882 are also used to determine the requirements for repairing various systems and components. More information on shore-based HAZCAT requirements are provided in Section 5-3.1 (Overhaul of Shore-Based Systems).

3-3 Fabrication and Assembly

Documentation is required to verify that fabrication and assembly procedures meet engineering standards necessary to deliver a safe, reliable diving system. Copies of all documentation must be submitted with the certification package or otherwise made available for SCA review in a manner negotiated between the SCA and the Acquisition Manager. All written fabrication and assembly processes that may affect the designed performance of the diving system must be identified. Documentation must include fabrication drawings and specifications, as well as supplementary information, not necessarily specified on the drawings, but which does affect the process. Information of importance includes, but is not limited to,

a. Controlled work procedures

b. Process instructions

c. Welding procedures

d. Brazing procedures

e. NDT Procedures

f. Assembly procedures

g. Cleaning procedures

h. Quality assurance procedures/inspections

i. Personnel qualifications

j. Fabrication and assembly documentation for all chambers built per ASME PVHO-1

k. Any other processes, procedures, or instructions required for construction of the diving system.

Adequacy of these processes must be substantiated by a history of satisfactory use or by documented qualifications and tests.

3-3.1 Controlled Work Procedures

Controlled work procedures must define the scope of work and provide production personnel with step-by-step instructions on how the work is to be accomplished in accordance with Appendix A (Re-Entry Control Procedures). When controlled work procedures are written to accomplish repairs, maintenance or modifications, they shall state the specific reason for performing the work. These instructions are required wherever fabrication, assembly, cleaning and/or testing of components or systems, within the SOC boundaries, is to be performed. Controlled work procedures shall also provide all inspection and retest requirements and any warnings or cautions that must be observed while performing the work. Controlled work procedures shall be generated prior to commencing work. Where work procedures already exist (e.g., technical manuals, standard process instructions, approved drawings, PMS, etc.), the specific paragraphs from those documents shall be called out in the controlled work procedure. Procedures shall be signed with printed name and signature by the person responsible for completing the work, inspections and retest of the system or component. Any change to the scope of work being performed shall cause a revision to the controlled work procedure to be issued. All controlled work procedures shall be made available to the SCA for review during on-site surveys.

3-3.2 Process Instructions

Process instructions are those standardized procedures that have been developed by a production activity for work which they commonly perform. In order to be used in a controlled work procedure, the process instruction must provide step-by-step instructions for accomplishing the work. All process instructions that the production activity intends to use during fabrication or repair of a diving system shall be provided to the SCA for review. In cases where critical training and skills are involved (e.g., welding, brazing, NDT and cleaning), process instructions must be approved by NAVSEA or NAVFAC (for shore-based systems) technical authorities, or their designated representatives prior to use.

3-3.3 Welding Procedures

All welding shall be performed in accordance with written and approved welding procedures (see Section 3-3.2). The Acquisition Manager must make available the written welding procedures and the welder qualification records, including any destructive/nondestructive test (NDT) records required for welding procedure and proof-of-welder qualifications on the specific material selected, for SCA review. All NDT records of welds performed within the SOC shall also be made available to the SCA for review. All NDT records shall clearly indicate that each joint has satisfactorily met or exceeded the specification requirements and must be signed by a qualified inspector. Any repair involving heat or welding shall be accomplished in accordance with approved written procedures and subjected to the tests and inspections specified for construction. For shipboard and portable systems, all welded pipe joints must be documented and inspected in accordance with the P-1 requirements in S9074-AR-GIB-010/278 or ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications, as supplemented by NAVSEA required inspections and documentation. The Acquisition Manager must obtain a documented exemption from the SCA in order to use an alternate welding specification. For shore-based installations, piping design and fabrication shall be per ASME B31.1, as supplemented by NAVFAC required inspections and documentation. The fabrication activity must provide traceability between the joint record and the actual welded joint for each welded pipe joint or structural weld joint.

The following procedures are typical of satisfactory welding practices:

S9074-AR-GIB-010/278, Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels

T9074-AD-GIB-010/1688, Requirements for Fabrication, Welding and Inspection of Submarine Structure

MIL-STD-1689, Fabrication, Welding and Inspection of Ships Structure

ASME B31.1, Power Piping (with additional NAVFAC inspection/documentation)

ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications (with additional NAVSEA or NAVFAC inspection/ documentation)

The following procedures are typical of satisfactory welder qualification practices:

NAVSEA S9074-AQ-GIB-010/248, Requirements for Welding and Brazing Procedures and Performance Qualification

ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications

3-3.4 Brazing Procedures

For new construction, brazed joints are typically not permitted. Exemptions shall be technically justified by the Acquisition Manager. In piping systems fabricated with brazed joints, all brazing shall be performed in accordance with written and approved brazing procedures (see Section 3-3.2) which meet or exceed the requirements of Class P-3A, Special Category I, Table 3-1, described in NAVSEA 0900-LP-001-7000, Fabrication and Inspection of Brazed Piping Systems. The Acquisition Manager must make available the written brazing procedures and the brazer/brazing operator qualification records, including any destructive test records required for proof of brazer/brazing operator qualification, for SCA review. Any repair to joints involving heat or brazing shall be accomplished in accordance with approved written requirements and subjected to, as a minimum, the tests and inspections specified for construction.

For all brazed life support piping systems, with the exception of saturation systems, and systems subjected to vibration and/or transportation loads, ultrasonic testing (UT) is required only for those brazed joints located between the recompression chamber and the first manually-operated stop valve external to the recompression chamber. When ultrasonic testing or other nondestructive tests are required on brazed joints within the SOC, the test records shall be made available to the SCA for review. All records shall clearly indicate that each joint has met the specification requirements and must be signed by a qualified inspector.

3-3.5 Tube Flaring and Flanging Procedures

For piping systems, all tube flaring/flanging shall be performed in accordance with qualified written procedures. Tube flaring/flanging procedures shall specify requirements and acceptance criteria for each applicable category of tube flaring/flanging material. Tube flaring/flanging procedures shall be qualified for each type of flaring/flanging equipment. Both the written procedures and qualification results shall be made available to the SCA for review.

3-3.6 Assembly Procedures

Special procedures for assembly of components and systems (e.g., torque specifications, lubrication requirements, etc.) should normally be called out in technical

manuals and approved drawings. Where used, assembly procedures shall be issued prior to the start of production and shall be followed by personnel performing the work. All assembly procedures to be used shall be called out in the controlled work procedure. Where assembly procedures are provided by drawing notes or technical manuals, the controlled work procedure shall call out the specific paragraphs that apply. Assembly procedures shall be verified as completed by the person responsible for the work and these records shall be available for SCA review during the on-site survey.

3-3.7 Cleaning Procedures

Cleaning of breathing gas systems shall be performed in accordance with approved written cleaning procedures. Cleaning may be accomplished during fabrication/assembly, upon final completion of assembly, or in a combination of both, in accordance with the overall contamination control process developed by the production activity or invoked by the Acquisition Manager. Cleaning procedures shall include methods for sampling and criteria for acceptance. Quantitative analysis to verify system cleanliness must be performed and documented prior to manned use of the system. Hydrocarbon contamination is of particular concern because hydrocarbons may be both toxic and flammable. For guidance in atmosphere evaluation and cleaning, refer to the Cleaning and Gas Analysis for Diving System Handbook, NAVSEA SS521-AK-HBK-010 (HBK-010) or NAVSEA Diving Genspecs.

3-3.8 Quality Assurance Procedures/Inspections for Contractual Work

Prior to any work on a divers life support or hyperbaric system, the Acquisition Manager should prepare a formal Quality Assurance (QA) plan that includes the procedures to be followed and the inspections to be performed. In cases where costly or non-typical work is to be done, it is strongly recommended that the Acquisition Manager submit the QA plan to the SCA for concurrence. Past experience has demonstrated that significant time, effort and cost savings can be realized when the SCA has reviewed and concurred with the proposed QA plan prior to commencing work. Section 3-4 provides guidance for developing a QA program and generating a suitable QA plan.

3-3.9 Personnel Qualifications

Where required by specification or standard, personnel involved in critical fabrication and inspection procedures must be trained and qualified to perform such tasks. The qualification records of welders, brazers, NDT inspectors and personnel involved in the repair and cleaning of oxygen system components shall be up to date and available for SCA review.

3-3.10 PVHO Pressure Vessel Documentation

When designing, fabricating and testing a hyperbaric chamber shell to approved commercial standards (e.g., ASME PVHO-1, American Bureau Shipbuilding), specific

documentation is required by the SCA. The minimum required documentation is given in the NAVSEA Diving Genspecs.

3-4 Quality Assurance Program

The QA program for contractual work shall provide a systematic plan of all actions necessary to ensure that a diving system conforms to established technical requirements. The Acquisition Manager shall assure that these QA provisions are maintained through completion of all work and testing. The quality assurance program shall provide documented OQE in the following areas:

a. Configuration management, document and drawing control

b. Material control

c. Fabrication and manufacturing control

d. Cleanliness control

e. Testing and inspection control

f. Atmosphere analysis

g. Re-entry control

The vigorous enforcement of a comprehensive QA program will greatly decrease the chance that system safety will be jeopardized due to substandard workmanship or materials. QA provisions are typically applied during new construction of a system. However, it is the responsibility of the Acquisition Manager to ensure the quality of an existing system is evaluated. QA programs developed in accordance with ISO 9000, International Standards for Quality Management, or similar industry-developed standards are typically acceptable.

Due to the life-support nature of diving systems, QA and personnel safety are inseparable. Documented QA procedures are required in all areas that affect the safety of the operators, divers, or occupants. These areas include material, fabrication, assembly, cleaning, testing, inspection, calibration and operation of all SOC items. The authority and responsibility of QA personnel in each of these areas shall be clearly delineated. It is the responsibility of the Acquisition Manager to ensure manufacturing, fabrication, and assembly work conducted within the builder's plant, system maintenance facility or industrial activity is carefully controlled. Such control shall include a formal review and an engineering evaluation of all manufacturing processes, tolerances and deviations. A formal QA program to effectively control purchased materials and subcontracted work shall be required. The activity that operates the system after initial system certification shall assure that the re-entry control provisions of Appendix A are utilized in its QA program.

Records are a major form of OQE in an effective QA program. The QA program shall be implemented to ensure that records are complete and reliable. It cannot be overemphasized that care and frequent review of the record keeping process is essential.

It is essential that the Acquisition Manager conduct periodic internal QA audits during the course of production work. Internal audits often uncover deficiencies which, if left uncorrected, could cause extensive rework; with associated cost and schedule overruns. The Acquisition Manager shall submit and retain copies of information relative to the quality provisions in sufficient depth, detail and organization to permit audit and evaluation by the SCA. QA documentation shall be legible, accurate and complete. Each document shall be dated and signed. The person shall indicate, by a signature, that the work or procedure meets the requirements of the approved QA procedures. Such data is vital in the effort to sustain certification. The Acquisition Manager is responsible to make arrangements for the retention, storage and retrieval of all QA documents. The Acquisition Manager shall request SCA concurrence prior to disposing of such records.

3-4.1 Configuration Management, Document and Drawing Control

The Acquisition Manager is responsible for establishing configuration control of the diving system and its design documentation. The Acquisition Manager must ensure that current design drawings are promptly distributed to manufacturing personnel, and that only current drawings are used. The Acquisition Manager shall show that the configuration management system requires removal of obsolete drawings from all points of use. The configuration management system shall also provide control over supplemental specifications, process instructions, production engineering instructions, industrial engineering instructions, and work instructions that either implement the design or supplement design drawings to accomplish the manufacture and assembly of the system. The Acquisition Manager shall maintain the technical data and drawings that reflect as-built conditions of the system. When establishing a configuration management program the Acquisition Manager should consult, MIL-HDBK-61A(SE), Configuration Management Guidance. The principles of Configuration Management as provided in ANSI/EIA-649, "National Consensus Standard for Configuration Management" should be used to establish a Configuration Management Program.

3-4.2 Material Control

The program for material control must be effective for new construction, and during overhaul or repair of existing systems. The program shall ensure that materials used conform to the applicable technical requirements. A system of documenting the identity of tested and approved materials shall be implemented. Controls shall be established to prevent the inadvertent use of other than specified material. Raw materials, vendor procured items and in-process material shall be segregated from materials for other programs, and must be readily identifiable as diver life support or hyperbaric system material (See Appendix B for material OQE requirements).

3-4.3 Fabrication and Manufacturing Control

The Acquisition Manager shall provide a QA program that ensures that the system has been manufactured in accordance with the approved drawings and manufacturing processes. All production records required by the fabrication specifications and drawings shall be completed, signed, dated, and made available, in an auditable format, for review by the SCA.

The hazards associated with the performance requirements of a diving system dictate that only the highest quality workmanship be acceptable. Consequently, the evaluation of the workmanship evident in the finished system is a significant factor in determining the acceptability of the individual system. Acceptance standards to verify high quality workmanship shall be implemented and shall establish acceptance/rejection criteria. It is the responsibility of the prudent designer and Acquisition Manager to specify to the builder what criteria shall be met. It is the responsibility of the builder and the Acquisition Manager to assure that the specified quality is achieved.

3-4.4 Cleanliness Control

The Acquisition Manager shall provide an effective program for achieving and maintaining cleanliness of all breathing gas flow paths under the close control of the builder during and after system assembly.

The Acquisition Manager shall use only NAVSEA or NAVFAC approved diver life support or hyperbaric system cleaning procedures during and after system fabrication. Strict adherence to system cleaning procedures cannot be overstressed. Failure to keep these systems clean may cause serious injury or death to the system occupants and/or operators due to fire or toxic/noxious contaminants. The NAVSEA Diving Genspecs and HBK-010 provide additional guidance concerning cleanliness control of diver life support and hyperbaric breathing gas systems.

The final levels of cleanliness shall be documented as having met the approved requirements. Records of the date, method and results of sampling shall be kept and made available to the SCA for review. Documentation of system cleanliness shall include cleaning sheets and sketches and shall indicate that each component, section or subsection of a system has been satisfactorily cleaned and that the entire system is free of contamination.

Once a system is verified clean within acceptable limits, approved quality control procedures are required if the system is to be entered. Any uncontrolled opening of a life support system to the surrounding atmosphere may require recleaning of the entire system in order to re-establish system cleanliness. Additional guidance concerning re-entry control procedures can be found in Appendix A.

3-4.5 Testing and Inspection Control

The Acquisition Manager shall provide an effective test and inspection system in place. The system must establish those inspections and tests necessary to ensure that items within the SOC are in conformance with the specified requirements. All inspection and test requirements shall be called out in the controlled work procedures (see Section 3-3.1). The inspection system shall incorporate clear, complete, and current instructions for inspection and shall include criteria for acceptance and rejection. Records of all inspections and tests shall be maintained and shall indicate the nature and number of observations made, the number and type of deficiencies found and the nature of the corrective action taken. Where no deficiencies are found, the satisfactory condition shall be noted. All test and inspection documents shall clearly show the following as a minimum:

a. The testing activity

b. Required prerequisite tests

c. The items, subsystems, and systems tested

d. The procedure used, including minimum acceptance criteria (where applicable)

e. That test results either meet or exceed requirements. Departures from test requirements must be justified, documented and approved by the cognizant technical authority

f. The dated signatures of individuals responsible for testing and final evaluation of test data

The inspection system shall serve to verify that the latest applicable drawings, specifications and process controls, with all authorized changes incorporated, are used for fabrication, inspection and testing. The inspection system shall describe the training and qualification of inspectors and shall include demonstration of competence in techniques such as radiographic, ultrasonic, dye penetrant and magnetic particle inspection, where used. The inspection system shall also provide for calibration of inspection equipment. In those areas where competence in technique must be demonstrated, it is imperative that the inspection be conducted by a qualified person other than the person performing the work to be inspected, unless specifically allowed by the inspection criteria. Test documents and data that fail to meet test criteria, are incomplete or are not technically evaluated and signed off as satisfactory by an authorized representative of the Acquisition Manager will be rejected by the SCA. Additional guidance concerning test requirements is provided in Appendix A and NAVSEA Diving Genspecs.

3-4.6 Atmosphere Analysis

The Acquisition Manager shall ensure that an atmospheric analysis of each new diving system has been accomplished and the results satisfy the requirements for manned use (See NAVSEA Diving Genspecs and HBK-010). For existing systems, the requirement to perform atmosphere analysis will be based on whether the work performed may have introduced any contaminants into the system. The analysis results must be forwarded to the SCA for review prior to manned use.

3-4.7 Re-Entry Control (REC)

A “re-entry” is initiated any time that the Scope of Certification boundary of a system is disturbed (e.g., breaking a mechanical joint or a silver brazed or welded joint, removal of a valve bonnet, repairing a gland, repairing or replacing electrical system components, etc.). Re-entry includes any and all work including testing of equipment/systems within the diving and hyperbaric systems from first entering to final testing and return to service.

The Acquisition Manager shall ensure that a system of re-entry control (REC) procedures has been formally promulgated. When a system has been cleaned and/or tested in accordance with certification requirements, no re-entry into that system shall be accomplished without strict adherence to formal REC procedures. All re-entry into diving systems shall comply with the standard diver’s re-entry control procedures of Appendix A.

Commands desiring to use an alternate re-entry control system, in place of that system which is detailed in Appendix A, shall obtain SCA approval in writing.

3-5 System Testing Program

The Acquisition Manager shall develop and implement a written test program. It shall outline a comprehensive and integrated series of tests, fully demonstrating the adequacy of all systems and equipment within the SOC to maintain a safe environment for the system occupants/operators. The test program normally consists of the following elements:

a. A test procedure index which is a listing of all individual test procedures (test memos) with an identification number, title, latest revision number, and date of issue

b. A test plan that indicates the sequence in which the individual test procedures are to be accomplished, thereby establishing the prerequisite(s) for each succeeding test procedure. A network diagram, procedure chart or bubble chart that clearly shows all parallel and convergent paths is a useful method of presenting this information.

c. The individual test procedures that clearly show the type of testing to be performed, step by step procedures for conducting the test, required test instrumentation and acceptance criteria.

The test program shall have SCA concurrence prior to execution and shall be kept current by the Acquisition Manager so that it can be utilized for future testing required to sustain certification. The test program shall not be revised without prior approval by technical authority and the concurrence of the SCA. It may become necessary for support facilities to assign new identification numbers, compatible with local procedures, to individual tests being performed. If so, a cross reference of test procedure index numbers shall be provided to facilitate test record verification. For complex or unique diving systems, the SCA may require the Acquisition Manager to submit the test procedures for review prior to conducting testing.

Examples of some items that require testing include:

a. Pressure vessel systems

b. Flotation and buoyancy systems

c. Mechanical systems

d. Emergency deballasting and jettisoning systems operation

e. Life-support systems including breathing gas purity control

f. Handling equipment systems

g. Electrical power, control and communications systems

h. Instrumentation and monitoring systems

i. Safety feature operation

The Acquisition Manager must provide test results (data) that have been evaluated as satisfactory, by an authorized technical representative of the Acquisition Manager, to the SCA for review.

3-5.1 Test Categories

The test categories listed in items a through d below are all unmanned tests that must verify that the candidate system operates safely as designed. Upon satisfactory completion of unmanned testing, the Acquisition Manager shall request an on-site certification survey. Manned testing, described in item e below, shall not start until all on-site Category IA survey findings (those which affect the safety of the system operators) have been corrected. SCA authorization prior to conduct of manned testing is required.

a. Factory Acceptance Test (FAT). This category covers testing that is performed by an equipment or component manufacturer to ensure that the material functions in accordance with specified limits. FATs should be required on all material where operation is of such a critical nature that failure to perform within the specified limits would jeopardize the safety of the divers. Testing of this material at the factory is usually required in cases where material/component testing is of such a specialized nature that the diving system fabricator may not have the necessary test apparatus. Syntactic foam and acrylic for viewports are examples of material that require FATs.

b. Prototype/First article Testing (PFT). This category of test may be required to prove the design of critical components or entire systems that are developmental in nature. Performance of materials, components and systems that are unique or untried in a similar environment and are within the Scope of Certification (SOC) must be demonstrated by such tests prior to manned use. PFTs will often incorporate life cycle testing to verify that a component or system will operate within design limits and will not fail prematurely. The MK 16 Underwater Breathing Apparatus and Light Weight Dive System MK 3 MOD 0 are examples of systems that have been subjected to PFTs.

c. Pre-installation and Pre-operational tests. Pre-installation tests (PIT) are those tests that are performed on components prior to installation in a system (often referred to as bench tests). Hydrostatic and seat tightness testing of valves are examples of PIT level testing. Pre-operational tests (POT) are those tests performed at the system level, but prior to operating the system. Insulation resistance and continuity tests and mechanical system tightness tests are examples of POT level testing. These tests shall normally be conducted on each system produced.

d. System Operational and System Integration Tests. System Operational Tests (SOTs) are required to verify that separately each subsystem operates satisfactorily within its design parameters. System Integration Tests (SITs) are performed to verify that all subsystems can be operated concurrently, as designed. SITs are also used to verify that the system operating procedures can be used to operate the system safely prior to conducting manned operational testing.

e. Manned Operational Test (MOT). MOTs shall be performed after satisfactory completion of all unmanned testing and SCA concurrence with unmanned testing results. MOTs are performed as the final verification that the candidate system operates as designed, using approved operating and emergency procedures. The test procedures for all manned operational tests shall be provided to the SCA for approval prior to conducting these tests. All diving systems require a manned demonstration prior to system certification.

3-5.2 General Requirements for Test Procedures

The Acquisition Manager shall submit an index of all FATs, PFTs, PITs, POTs, SOTs and SITs test procedures to the SCA, indicating those within the SOC. All test procedures within the SOC shall be approved by the Acquisition Manager. Once the test procedures have been approved, the test director, upon concurrence of the

Acquisition Manager, is authorized to modify them to suit conditions prevailing at the time of the test. For example, the test director may authorize the substitution of a piece of test equipment for one called out in the test procedure because of availability. However, only the Acquisition Manager may authorize changes to a test parameter, such as a test pressure. Operational and system integration test procedures for systems within the SOC must be reviewed by the SCA. The SCA shall advise the Acquisition Manager which test procedures require SCA review and concurrence and which should be submitted for information. The format of the test procedures shall provide, in a single document, both the test procedure and the data to be collected.

As each step in the test procedure that requires data to be recorded is satisfactorily completed, the witnessing representative of the builder's test or QA organization shall so indicate by dated signature. The date on which the test was performed shall also be indicated. If the test requires that a particular parameter be within a specified range, both the range and the actual value must be recorded.

A test schedule shall be provided to allow the SCA to schedule presence at the test site for those tests the SCA chooses to witness. The SCA reserves the right to require a rerun of any or all of the system operational and integration tests if results are not clear or are inconclusive. Upon completion of all system testing, the SCA shall be provided with indexed documentation containing all completed tests with satisfactorily evaluated results.

Specific pipe and piping components and system pressure testing requirements are provided in NAVSEA Diving Genspecs.

3-5.3 Electrical Testing

The Acquisition Manager shall submit test procedures designed to demonstrate the adequacy of electrical continuity and Insulation Resistance (IR) of all electrical circuits that are in the SOC.

a. Electrical components with differential pressure boundaries exposed to ambient pressures greater than one atmosphere or those components exposed to sea water require special testing to ensure the design of the electrical component is adequate for its intended use and the watertight integrity is maintained. Refer to NAVSEA Diving Genspecs for additional testing requirements for these electrical components.

b. A dielectric strength test at 60 Hertz for one minute shall be performed on all electrical cable assemblies, equipment, and devices within the SOC. The dielectric test voltage shall be the test voltage of twice-rated plus 1,000 volts. The cable dielectric tests shall be performed between all conductors and the sheath and also between individual conductors. This is a go/no-go criteria test. For previously tested electrical cable assemblies, equipment and devices where a dielectric strength test has been performed, re-testing is not required unless damage is suspected. Subsequent

performed, re-testing is not required unless damage is suspected. Subsequent dielectric strength testing shall be conducted at 75% of the voltage applied the first time. Dielectric strength tests shall always be followed by an IR test.

c. The Acquisition Manager shall submit test procedures designed to demonstrate the adequacy of electrical continuity and Insulation Resistance (IR) of all electrical circuits that are in the SOC. The requirements for electrical testing can be found in the GENSPECS.

d. A dive abort is mandatory at a system IR value of 50K ohms or less, unless the system can be safely isolated.

e. Perform all electrical testing using calibrated test equipment. Document the following information:

(1) Platform and system tested

(2) Component or circuit tested

(3) Pass/fail test criteria

(4) Actual test data

(5) Date test conducted

(6) Calibration dates and serial numbers of test equipment

(7) Test Acceptance Signature

NOTE: The Test Acceptance Signature shall be annotated as attesting that the person who actually performed or witnessed the test is verifying that all associated test parameters were met.

3-6 Operating and Emergency Procedures (OPs and EPs)

The Acquisition Manager shall make normal and emergency operating procedures available for review by the SCA. All operating and emergency procedures shall contain the date of revision, and shall be approved in writing by either the U.S. Navy Supervisor of Diving or the NAVFAC SCA. The SCA requires that this approval be granted prior to scheduling the on-site survey. During the on-site survey, the SCA will verify the adequacy of and the operators' compliance with the OPs and EPs. Compliance with approved operating and emergency procedures is a requirement for sustaining system certification. Any changes to these procedures must have the approval of the U.S. Navy Supervisor of Diving or the NAVFAC SCA and the concurrence of the SCA. Written operating and emergency procedures are required for the following purposes:

a. To ensure that the normal operation of the diving system is within the range of conditions for which certification is granted

b. To ensure that there are adequate procedures to cope with emergencies

c. To ensure that there are checklists of prerequisites for various major evolutions (e.g., pre-mission, pre-dive, post-dive and post-mission procedures)

d. To ensure that sufficient operating stations are identified and that the duties of operating personnel are adequately defined

e. To ensure that up-to-date information is available for the training of operators and that it is consistent with safe operation of the diving system

3-6.1 Specific Emergency Procedures

The procedures shall be supplemented as necessary by diagrams, system alignment procedures, system shutdown procedures, pre- and post-operation procedures and such other procedures as may relate to normal and emergency operations. Component designation on all operating and emergency procedures must agree with the system drawings.

Specific emergency procedures are dependent upon the type and complexity of the diving system involved. Conditions typically covered by emergency procedures include:

a. Loss of primary gas supply

b. Loss of electrical power

c. Low/high O_2

d. High CO_2

e. Contaminated gas

f. Rapid increase/decrease in pressure

g. Loss of diver

h. Fouling of an umbilical

i. Fire in the chamber

j. Fire outside the chamber

k. Storm conditions

Additional emergency procedures may be required depending on the type and complexity of the system, and the results of the hazard analysis.

Operating and emergency procedures shall be demonstrated during the on-site survey by the SCA. This shall include a demonstration of the accessibility to vital equipment or systems to ensure that personnel can operate the equipment and systems under normal and emergency conditions. Where an actual demonstration is not practical, the Acquisition Manager may propose an alternate means of demonstrating acceptability of the procedures. In cases where it is found that a procedure cannot be performed in a satisfactory manner, the Acquisition Manager must prepare an acceptable procedure for accomplishing the desired objective. The satisfactory accomplishment of each step in each procedure shall be initialed and dated by a qualified, representative of the Acquisition Manager.

3-7 Maintenance Program

Sustaining system certification is predicated on maintaining the system in the “as-certified” condition. The Acquisition Manager must implement a maintenance program that includes, as a minimum, the following elements:

a. Preventive maintenance procedures including calibration and alignment of instrumentation and servicing of other equipment in the diving or hyperbaric system

b. Corrective maintenance procedures including repair and replacement of components and spare parts control

c. Re-entry control procedures that cover component removal, repair and post-repair inspection and testing required to ensure proper system operation

The Acquisition Manager shall provide instructions, for use by the system operators and maintenance personnel, for conducting periodic inspections and tests to ensure continued safe operation of the system. The instructions shall include the scope of the inspections and tests and shall provide pass/fail criteria. The conduct of these periodic inspections and tests shall be a condition for sustaining certification. Inspections, tests and repairs that require the expertise of a repair facility or equipment manufacturer should be scheduled to coincide with planned overhaul periods.

For portable and afloat systems owned, maintained and operated by the Navy, maintenance shall be conducted in accordance with OPNAVINST 4790.4, Ships’ Maintenance and Material Management (3-M) Manual. For shore-based hyperbaric systems certified by NAVFAC, the applicable maintenance criteria is provided in NAVFAC MO-406, Hyperbaric Facilities Maintenance Manual. For other systems covered by this manual, the Acquisition Manager shall submit a formal preventive and corrective maintenance program to the SCA for concurrence. In addition to the above elements, this program shall include personnel responsibilities and provide both record keeping requirements and detailed, step-by-step procedures. All diving system maintenance and inspection programs shall be reviewed by the U.S. Navy Supervisor of Diving (portable and afloat systems) or NAVFAC SCA (shore-based systems) prior to system certification.

3-8 Operating and Maintenance Manual

Depending on the complexity of the diving system, one or more operating and maintenance manuals shall be provided to describe all equipment during all phases of system operation. The manuals shall contain the following information, as a minimum:

a. System Description and Operation. This section shall identify and describe the purpose and functional operation of all systems and subsystems. System and subsystem modes of operation and operating parameters shall be described in detail. System drawings should also be included.

b. Component Description. Sufficient design information shall be included to identify and describe all major system components and their functions. Component drawings showing internal parts should be included.

c. Instrumentation and Controls. This section shall discuss the control philosophy used in the system design and provide a detailed description of the controls and instrumentation used.

d. Operating Procedures (OPs). This section shall identify all normal system operations and evolutions that involve personnel. The approved system of operating procedures for these normal operations and evolutions may be provided as part of this manual or separately if desired. See Section 3-6.

e. Emergency Procedures (EPs). This section shall identify conditions requiring emergency action and provide procedures to be followed in the event of their occurrence. Emergency action is defined as operation under conditions of system malfunction or failure such as loss of power, component failure, physical damage, fire, and, in the case of diver equipment, loss of breathing gas pressure or flooding of breathing circuits. The approved system of emergency procedures for dealing with these emergency actions may be provided as part of this manual or separately if desired. If emergency procedures are excluded from the manual, a list of approved emergency procedures must be included.

f. System Limitations, Precautions, and Setpoints. In this section, the Acquisition Manager shall clearly identify all system operational limitations. This section should also state all precautions to be taken during normal operation to preclude potentially unsafe conditions. A list of system operation setpoints which represent the normal operation of the system shall be included. See NAVSEA Diving Genspecs for life-support system limits.

g. Handling Equipment and Procedures. The Acquisition Manager shall provide information for any handling system whether used to control the motion of a manned dive system (on the surface, through the air/sea interface or in the water column) or to mate pressure vessels. This section shall describe all procedures, and precautions required to maintain safe control of the dive system during handling operations. Normal and emergency handling system procedures must be approved by either the NAVSEA

Supervisor of Diving or the NAVFAC Chief Engineer. In addition, these procedures shall be concurred with by the SCA. The approved routine and emergency handling system procedures may be provided as part of this manual or separately if desired.

h. System Maintenance. This section shall describe all required preventive maintenance and basic repair procedures for supporting the dive system and its associated handling system. All components that must be repaired by the manufacturer or depot level repair facility shall be identified. While step-by-step detailed preventive maintenance procedures may be promulgated separately, the basic repair procedures should be included in this section.

i. Assembly, Disassembly and Transportation. This section shall contain detailed step-by-step procedures for assembly, disassembly, stowage and transportation of portable systems, including the handling system. Where appropriate, these procedures shall include all precautions required to ensure the system will not be damaged. In addition, all post-assembly system retest requirements shall be clearly delineated. The detailed step-by-step retest procedures may be provided as part of the manual or separately if desired.

j. System Lay-up and Start-up. This section shall describe all disassembly and maintenance required to place the system in lay-up for an extended period of time. Additionally, instructions for system start-up, after extended storage, shall be provided. These instructions shall include all assembly, maintenance, and testing required to bring the system out of storage and into an operationally ready condition.

k. System Troubleshooting. This section shall provide guidance to be used to assess the symptoms, then locate and repair probable causes of a system malfunction. For the procedures used to repair failed components, this section may refer to the section on system maintenance.

3-9 Granting Initial Certification

The role of the Acquisition Manager is defined in Chapter 4. It is the responsibility of the Acquisition Manager to ensure that the system is considered certifiable prior to its transfer to a user command. To be certifiable the SCA must concur that all system design, fabrication and testing has been performed satisfactorily, in accordance with previously approved technical specifications. In addition, all system drawings, technical manuals, PMS and certification related documents shall have been approved and issued. Custody of a diving or hyperbaric system will normally be transferred from the Acquisition Manager to the user command once the SCA deems the system certifiable but prior to granting initial system certification. Initial certification of an individually certified system is typically granted to the initial user command.

In addition, the Acquisition Manager shall prepare a “turn-over file” consisting of as-built system drawings, fabrication records, test records, technical manuals, operating and emergency procedures and a complete Preventive Maintenance System (PMS) package. The turn-over file shall accompany the system to the fleet user command.

After receipt of the system hardware and certification documentation, the new Fleet user command shall take the following action:

a. Establish a formal QA plan and re-entry control procedures in accordance with Appendix A.

b. Initiate the preventive maintenance plan for the system.

c. Revise the existing PSOB supplied by the Acquisition Manager or develop a new PSOB, whichever is more appropriate, and submit it to the SCA for review and approval.

d. Review and submit any necessary operating and emergency procedures to the NAVSEA Supervisor of Diving or the NAVFAC Chief Engineer.

e. Request an on-site survey of the system by the SCA.

Upon completion of a successful on-site survey and a demonstration dive, the SCA will grant the system “Initial Certification”. This procedure applies to all new systems except class certified diver worn equipment.

For class certified diver worn equipment, the SCA normally grants initial certification to the Acquisition Manager. Diver worn equipment may be transferred to user commands only after the SCA grants class certification. See Chapter 6 for more information.

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CHAPTER 4

RESPONSIBILITY OF THE ACQUISITION MANAGER

4-1 Introduction

This chapter defines the role of the Acquisition Manager in relation to certification requirements for new diving systems built for use by U.S. Navy personnel. The Department of Defense acquisition program is set forth in the DOD Federal Acquisition Regulations Supplement (DFARS). The management of acquisition programs is guided by DOD Directive 5000.1, Defense Acquisition, and DOD Instruction 5000.2, Defense Acquisition Management Policies and Procedures. In addition, system safety certification procedures must be clearly defined and rigidly followed in every phase of the procurement process due to the life critical nature of diving systems. Therefore, the Acquisition Manager shall establish the certification effort in the earliest conceptual phase of the program.

The Acquisition Manager is designated as the applicant for initial certification of a new diving system until the new system is delivered to the designated user activity. Early and frequent communication between the Acquisition Manager and the SCA is essential to the efficient prosecution of the system certification process. This point cannot be overemphasized.

In all aspects of the certification process, the line of communication is between the SCA and the Acquisition Manager and not between the SCA and the contractor, manufacturer or shipyard manager. While discussions and conferences with these organizations are useful, the line of action and responsibility is between the SCA and the Acquisition Manager.

During a major overhaul or repairs involving configuration changes to the system, the individual diving command (unless otherwise directed by the Type Commander) typically assumes the responsibilities of the Acquisition Manager.

4-2 System Certification Requirements in Contracts

The Acquisition Manager, who contracts for or otherwise arranges for the design, construction, testing and delivery of a new diving system must translate system certification criteria and documentation requirements, clearly and concisely, into contract specifications. The use of this manual as a contract reference document, which allows the contractor to interpret certification requirements, shall be limited to referencing specific sections and paragraphs. If a contractor anticipates lease or purchase by the Navy of a diving system he is building, he should become familiar with the documentation requirements necessary to support the system certification process. However, lease or purchase agreements entered into by the U.S. Navy must be specific

enough in content to preclude any interpretation of the requirements of this instruction by manufacturers or vendors. Areas of particular importance in the preparation of contract specifications are described in the following paragraphs.

4-2.1 Contract Data Requirements List (CDRL)

The CDRL must specify all data requirements in procurement instruments in sufficient detail to provide a basis for a full, clear and firm understanding between the government and the contractor with respect to the total data requirements at the time the contract is placed. For items within the SOC, SCA review of CDRL requirements is strongly recommended. The CDRL must allow for sufficient time for Government review of and comment on the submitted information. Government review time shall be incorporated into the Certification Milestone and Event schedule. For detailed information on the preparation of the CDRL, see NAVSEAINST 4000.6A, Data Management Program.

4-2.2 Data Item Description (DID)

In accordance with the requirements of NAVSEAINST 4000.6A, a DID shall be cited in support of each data line item on the CDRL. NAVSEA unique DIDs which specifically identify the data item as diving system certification data will be selected from the NAVSEA Data List (SEADL) where possible. If standard DIDs are not selected, the specific requirements of diving system certification must be delineated in the “Remarks” section of the CDRL.

4-2.3 Certification Requirements When Using Commercial Contracts

In the absence of the CDRL, it is incumbent on the Acquisition Manager to ensure the requirements of applicable sections of this manual are met. All documentation deliverables that are received as a result of the commercial contract also require the documentation requirement of this manual are met.

4-2.4 Material Specifications

All materials used for the construction, fabrication and assembly of parts, components, subsystems and systems which are within the scope of certification must meet or exceed the specifications set forth in the NAVSEA Diving Genspecs. This material shall also be provided with documented OQE and test data verifying to its acceptability, in accordance with Appendix B. The Acquisition Manager shall ensure that contract specifications are complete and accurate in this respect and that deviations from these specifications are authorized only with the approval of the appropriate NAVSEA or NAVFAC technical authority and the concurrence of the SCA.

4-2.5 Performance and Procedure Specifications

The Acquisition Manager shall ensure that the performance and procedure specifications for the construction, fabrication and assembly of diving systems, as defined in this manual, are clearly and accurately described in contract documents, and concurred with by the SCA.

4-2.6 Quality Assurance (QA)

The Acquisition Manager shall ensure contract documents require the contractor to provide a QA Program Plan. The QA Program Plan shall be provided to the SCA for review and concurrence. The QA Program must specifically address the critical requirements of system certification. Contract documents should recommend the designation of a certification manager within the contractor's organization. This individual will serve as a single point of contact between the contractor and the Acquisition Manager on matters concerning system certification. The role of Certification Manager is often filled by the contractor QA Manager.

4-3 Document Control

It is the responsibility of the Acquisition Manager to ensure that adequate document control procedures are developed and implemented in the earliest phase of the procurement process. These procedures must be strictly adhered to in every phase and at all levels of the procurement process. All documentation required by Section 1-6 of this manual shall be reviewed and evaluated by the Acquisition Manager or his agent prior to submission to the SCA. If an agent is used, the agent shall not be affiliated with the system designer or fabricator.

4-4 Preparation of Certification Application

The Acquisition Manager, acting as system applicant, shall prepare and submit the application for system certification. The application for system certification shall be prepared in accordance with the provisions of Chapter 2 of this manual and shall be submitted to the SCA.

4-5 Configuration Management (CM) Plan

The Acquisition Manager, acting as system applicant, shall ensure that a configuration management plan is developed and prepared early in of the procurement process. DODINST 5000.2, Operation of the Defense Acquisition System, provides policy and guidance for the preparation of configuration management plans. The configuration management plan shall be provided to the SCA for review and concurrence.

4-6 Technical Design Reviews

DODINST 5000.2 requires Acquisition Managers to conduct design reviews and OPNAVINST 3150.27, Navy Diving Program, requires the SCA to conduct independent technical review to assess the adequacy and safety of all diving systems. This applies to both new design systems and those systems that are undergoing significant modifications.

It is strongly recommended that the Acquisition Manager invite the SCA to participate in the normal system technical design review process. An understanding between the Acquisition Manager and the SCA should be reached early in the system design regarding technical design reviews. The number, timing and level of detail of the technical design reviews should be dependent upon the uniqueness and complexity of the system. These points should be negotiated between the Acquisition Manager and the SCA, and promulgated in the Certification Milestone Event Schedule.

The design review process is best served when the Acquisition Manager assembles additional technical personnel, not affiliated with the system designer, to review the system design. Sufficient technical expertise shall be used in the design review process to ensure that electrical, structural and mechanical systems are thoroughly evaluated.

The SCA recognizes that the level of detail provided in each design review will depend on the maturity of the actual subsystem design. Therefore, it is essential that all design documentation be reviewed by the design review team prior to conducting each formal review.

For complex systems, the Acquisition Manager should issue a design review checklist for each subsystem to be reviewed. This checklist should include verification that all design review information required in Section 3-2 of this manual is available for technical review. The checklist should be completed by the Acquisition Manager, technical design review team and SCA during the design review.

At the completion of each technical design review, the Acquisition Manager shall formally issue findings and recommendations regarding all system design deficiencies. The method of issue of design review findings should be discussed between the SCA and Acquisition Manager prior to the design review. Those deficiencies that are determined by the Acquisition Manager and SCA to be within the Scope of Certification shall be identified as such during the design review. During the first on-site survey, the SCA will issue SCSCs for any unresolved safety-related deficiencies from prior design reviews. The Acquisition Manager is responsible for ensuring that corrective actions for all design review findings are formally documented, and those items within the SOC are forwarded to the SCA.

4-7 Associated Documents

The Acquisition Manager, acting as system applicant, shall ensure that all associated documents, such as technical manuals, PMS, test memos, etc., are prepared and submitted in accordance with the Milestone Event Schedule (see Section 2-2.2) during the acquisition process

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CHAPTER 5

REPAIR AND OVERHAUL

5-1 Introduction

Periodically, diving systems require major repair or overhaul, beyond that normally conducted during routine maintenance procedures. During such industrial periods, system certification shall be terminated or suspended until the requirements for recertification, specified in Chapter 2 of this manual, have been satisfied.

Whenever the configuration of a certified afloat or shore-based system is to be significantly modified (i.e., Title K SHIPALTs and initial installation of Title D SHIPALTs and major system upgrades), the appropriate NAVFAC or NAVSEA Acquisition Manager shall assume the responsibilities of the Acquisition Manager, for those modifications funded by the Program Office only, as stated in Chapter 4. However, the user command to which the system is assigned shall remain the applicant for system certification. Close coordination between the Acquisition Manager and the applicant is crucial to ensure that the system certification process does not become disjointed and unmanageable.

For subsequent major system upgrades, Title D SHIPALTs and installations (normally funded by the user command or Type Commander), the system user command and the NAVFAC or NAVSEA Acquisition Manager may negotiate which activity will act as the Acquisition Manager. For system configuration changes that are minor and are not being performed as a SHIPALT, the user command shall assume the responsibilities of the Acquisition Manager (unless otherwise directed by the Type Commander). In all of the above instances, the number and extent of technical design reviews for SHIPALTs shall be negotiated between the Acquisition Manager and the SCA.

It is the responsibility of the system applicant to ensure that the requirements for recertification are satisfied during repair or overhaul periods. As stated in Chapter 4 of this manual, the line of communication concerning certification is between the SCA and the system applicant and not between the SCA and the activity responsible for the performance of the work. The applicant may designate an individual or organization to act as certification manager. The certification manager will be the single point of contact for liaison both with the overhaul organization and with the SCA on matters concerning certification. In cases where the Acquisition Manager and the applicant are not representatives of the same activity, the applicant typically designates the Acquisition Manager as the certification manager. If the Acquisition Manager and System Applicant are not from the same activity, it is recommended that an MOA be written early in the planning phase of the repair effort specifically identifying each activity's roles and responsibilities.

5-2 Certification Status During Repair or Overhaul

When a ship undergoes a regular overhaul and the entire diving system is overhauled, system certification is terminated or suspended. During other maintenance availabilities, however, work on the diving system may range from no work to system alteration or overhaul. Also, component repair or overhaul may be required between scheduled availabilities.

Minor work on the diving system that does not involve hot work (welding/brazing), and does not modify the certified system configuration, does not terminate system certification if the work and testing are documented under the re-entry control system. Though notification of the SCA is not required, all documentation of the minor work and testing will be reviewed at the next certification on-site survey. Examples of minor work that does not terminate or suspend system certification are:

a. Repairing leaking piping joints by replacing o-rings

b. Replacing diving systems components (mechanical joints) with the same components as specified by the system drawing

c. Requalifying system hoses, volume tanks, filter housings or moisture separators as required by PMS

d. Calibrating gages and relief valves

e. Taking a six month air sample

f. Repairing weight handling system used only for surface supplied diving

g. Conducting NDE testing/inspection of HP air/gas flask or bottles, when mechanical joints for those flask or bottles are not disturbed

Should the scope of work exceed minor work (as described above), termination or suspension of system certification may be required. This applies whether the work is accomplished during a scheduled maintenance availability as day-to-day work or to correct a casualty. The applicant shall immediately notify the SCA when this work is required so the SCA can make a determination with respect to termination or suspension. Examples of significant work that may terminate or suspend system certification are:

a. Conducting testing/inspection of HP air/gas flasks (e.g., DOT-E Composite Flask, MIL-F-22606 HP flasks) when mechanical joints for those flasks are disturbed

b. Overhauling a compressor, within the SOC boundary, or performing any work that would affect compressor ability to produce the specified volume, pressure or quality of gas

c. Replacing recompression chamber viewport

d. Welding or brazing on the diving system pressure boundary

e. Overhauling the diving system

Depending on the scope of the work performed, the SCA will make a determination whether an on-site survey will be required, once the work is complete.

5-3 Pre-Overhaul Requirements

Prior to the commencement of overhaul or repair of a diving or hyperbaric system, the applicant shall submit the following to the SCA for review:

a. Results of the Pre-Overhaul Test and Inspection (if performed)

b. A detailed definition of the scope of the overhaul including a list of repairs, SHIPALTS to be accomplished, significant components to be replaced, modifications, etc.

c. The overhaul or repair work package including appropriate drawings, description of work, tests and inspections to be accomplished and procedures to be followed

d. Quality assurance provisions of the overhaul work package including Re-Entry Control procedures. For overhaul of complex systems (i.e., installed shipboard systems, saturation diving systems, etc.), the repair activity shall develop a formal Quality Assurance program in accordance with Section 3-4

e. A schedule showing major overhaul milestones

Pre-Overhaul information shall be submitted as early as possible to allow sufficient time for review by the SCA. The SCA, in conjunction with appropriate technical authorities, shall review all work and procedures that involve system certification.

In cases where the work package includes SHIPALTs, the Fleet Modernization Program Management and Operations Manual, NAVSEA SL720-AA-MAN-010, shall be used to provide guidance for the control of the SHIPALT process. The timing of formal technical design reviews shall be negotiated between the applicant and the SCA, and shall be dependent upon the complexity and uniqueness of the SHIPALT.

Major alterations to shipboard diving systems (Title K SHIPALTS, initial installations of Title D SHIPALTs) will be concurred with by the NAVSEA Acquisition Manager. It is the responsibility of the applicant to ensure design reviews are conducted for all SHIPALT modifications. In order to minimize delays and costly rework, the applicant should bring the SCA into the SHIPALT process prior to development of the SHIPALT Record (SAR).

Work on the diving system is controlled, and is the responsibility of the applicant, not the contractor. When a diving system is given to a contractor to perform an overhaul, the applicant must ensure that all work is properly controlled and documented by contract and work processes.

5-3.1 Overhaul of Shore-Based Systems

All shore-based hyperbaric facilities shall be overhauled, as described below. **The length of time between overhauls of a particular facility shall be determined by the activity, applicant and SCA, but shall not exceed 10 years, unless written technical justification is provided by the applicant and approved by the SCA.** Should a shore-based hyperbaric facility be taken out of service (moth-balled) for more than two years, an overhaul shall be conducted prior to placing the facility back in service. Exceptions must be approved by the SCA.

The overhaul of shore-based hyperbaric facilities shall be accomplished in three phases. First, a pre-overhaul test and inspection of existing systems and components must be performed to determine the condition of the facility. Second, all systems and components that do not perform to specifications must be repaired or replaced to bring the facility into conformance. And last, the facility shall undergo Final System Functional Testing to verify the acceptability of the work performed. Functional Testing includes those tests that are performed upon completion of an overhaul. Functional testing is to be witnessed by an SCA representative and shall be conducted on the entire facility.

The level of overhaul accomplished shall be based on the criticality of the respective system. As described in Section 3-2.13, Hazard Analysis, each system has an assigned Hazard Category Level (HAZCAT) based on the criticality of failure per the requirement of MIL-STD-882. In general, inspection, repair and testing as described below, shall be performed on all components in a particular HAZCAT system. NAVFAC MO-406, “Hyperbaric Facility Maintenance Manual,” provides guidance with respect to maintenance of shore-based hyperbaric facilities and complying with certification requirements.

HAZCAT I SYSTEMS: All components that are a part of a HAZCAT I system shall be pre-overhaul tested and refurbished to the “as-new” condition. The “as-new” condition of a component is that condition which was acceptable in the original design and/or meets the quality control requirements of the Commercial or Military Specification for that component. The “as-new” condition includes, but is not limited to the following: complete internal/external visual inspection, replacement of all software, operational test and cleaning. In the event the component can not be restored to “as-new” condition, an in-kind replacement for the component required shall be installed. The in-kind replacement must pass all the tests for the design requirements of the original component. NAVFAC MO-406 provides guidance with respect to maintenance of shore-based hyperbaric facilities and complying with certification requirements. In-kind replacement of a component is defined as replacement with an identical

component if that component is still manufactured. In the event an identical component is no longer manufactured, the replacement component must meet all of the original component's design criteria. Should there be any doubt as to whether a component is an in-kind replacement, contact NFESC.

HAZCAT II SYSTEMS: All HAZCAT II systems shall be envelope functionally tested to their complete design parameters. Envelope functional testing is defined as testing each component of the respective HAZCAT II system to its system design parameters (i.e., ball valves, completely shut off and fully open; needle valve, fine tuned and flow as required for original design; pressure gages, accurately record tested parameters). In addition, Functional Testing, as performed originally when the system was installed, shall be conducted for all HAZCAT II systems. HAZCAT II system components shall not be removed or refurbished, unless the component does not perform or if a noticeable flaw is found during functional testing of the system. NAVFAC MO-406 provides guidance with respect to maintenance of shore-based hyperbaric facilities and complying with certification requirements.

HAZCAT III AND IV SYSTEMS: All HAZCAT III and IV systems shall be demonstration tested to system design requirements. Demonstration testing is the functional testing level performed originally when the system was installed. HAZCAT III and IV system components shall not be removed or refurbished unless the component does not perform, or if a noticeable flaw is found during demonstration testing of the system. NAVFAC MO-406 provides guidance with respect to maintenance of shore-based hyperbaric facilities and complying with certification requirements.

All HAZCAT I, II, III AND IV system components shall receive routine maintenance as required by facilities PMS or as required by the manufacturer of the respective component. Routine maintenance shall include, but is not limited to: replacement of belts, pulleys, lubrication, filters, calibration, o-rings, calibration of gages, replacement of filter elements, calibration of sensors and indicators, etc.

5-4 Document Control

The requirement for adequate document control during overhaul and repair is as essential to recertification as it is in the initial certification process. The applicant shall ensure that all documentation required to support design, material selection, work procedures, tests and inspections are prepared and maintained in accordance with the requirements of Chapters 3 and 4 of this manual.

For major modifications due to SHIPALTs, the Acquisition Manager shall ensure that applicable fabrication and test documentation (i.e., drawings, technical manuals, test memoranda, etc.) is revised and reviewed by the SCA. For repairs or alterations not related to SHIPALTs, the responsibility of updating this documentation lies with the applicant.

5-5 Procedures

Those procedures required to perform work, inspection and testing shall meet the requirements set forth in Sections 3-3, 3-4, and 3-5 and be so specified in contract documents. These procedures shall be available for review and concurrence by the SCA during on-site surveys. Procedures requiring specialized skills (e.g., welding, NDT, etc.) must be approved by a SCA recognized technical authority prior to use.

5-6 Quality Assurance (QA)

Quality Assurance requirements during contracted overhaul and repair shall be the same as those specified in Section 3-3.8 of this manual and shall be specified in contract documents.

5-7 Re-Entry Control (REC)

Particular attention must be directed to the proper use of approved re-entry control procedures as described in Appendix A. Re-entry control forms must be accurately completed and must contain all required signatures prior to re-entry into a system that is within the scope of certification. All re-entry control actions must be either satisfactorily completed and signed or a departure from specifications approved prior to manned use of the system. Establishment and implementation of a REC program shall be specified in contract documents.

5-8 Retest Requirements

Repairs and modifications to systems require the same stringent testing requirements as newly designed systems. The following guidelines should be used to determine the level of testing required during systems overhaul periods:

a. Factory Acceptance Tests will not be required unless the replacement equipment is of such a specialized nature that the repair activity is unable to perform testing.

b. Pre-Installation Tests will be required only for replaced or repaired components.

c. Pre-Operational Tests will be required only when a subsystem is repaired or modified. These tests need to be performed to ensure that those sections of the system that were repaired or modified are properly reinstalled.

d. System Operational Tests shall be conducted on all subsystems that have been repaired, modified or placed in lay-up during an availability. The extent of unmanned system operational testing may be negotiated with the SCA.

e. Manned Operational Tests may be required for subsystems that directly effect life support and have undergone repairs or modifications. Normally, manned

operational tests shall be conducted to the maximum operating depth of the system. When certification has been suspended or terminated, permission must be obtained from the SCA prior to conducting manned operational tests.

Additional information concerning test requirements is provided in Section 3-5, Appendix A and the NAVSEA Diving Genspecs.

5-9 Technical Requirements

The General Specifications for Overhaul of Surface Ships (GSO) (NAVSEA S9AA0-AB-GSO-010) is the primary source of technical requirements for the overhaul, repair and alteration (SHIPALTs) of existing ship's equipment and components. In all cases, however, the approved diving system drawings and technical manuals shall take precedence over the GSO.

For shore-based facilities, the primary source of technical requirements is UFC 4-159-01N: Hyperbaric Facilities Manual.

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CHAPTER 6

CERTIFICATION REQUIREMENTS FOR DIVER WORN EQUIPMENT

6-1 Introduction

Diver worn equipment is defined as those items worn by or attached to the diver and necessary for the diver's safety and life support. This category is divided into surface-supplied diving equipment (e.g., UBA MK 20, and UBA MK 21, UBA EXO MS BR) and self-contained diver life support systems (e.g., UBA MK 16, UBA MK 25 and UBA Viper). Typically, the SOC includes all associated hardware, communications systems, equipment harnesses, thermal protection devices, carbon dioxide scrubbers and chemical absorbent material, integrated weights, umbilical hoses, integrated breathing gas hoses, control valves, and connectors or adapter fittings as required for interfacing with an umbilical. The SOC also includes set-up, test and calibration equipment that may be unique to the UBA. Some of these items may appear in the current NAVSEAINST 10560.2, Diving Equipment Authorized for Navy Use (ANU). Exclusion of such items from the SOC may be negotiated with the SCA. The SOC for diver worn equipment also includes items described in Chapter 2 and 3, with particular emphasis on approved operating and emergency procedures, deployment procedures, and pre-dive and post-dive equipment checks.

For initial certification of a diving apparatus, the following steps, as a minimum, will be accomplished by the SCA or his officially designated representative:

a. Participate in the formal design review process to ensure the equipment design meets safety related technical requirements, as outlined in Chapter 3.

b. Validate results of tests or evaluations accomplished by the manufacturer or Naval test activities.

c. Conduct an on-scene audit of the manufacturer's quality control, fabrication, assembly, and test procedures for the apparatus.

d. Obtain verification that each apparatus within a certified class conforms to the approved configuration.

e. Witness or participate in a demonstration dive of the prototype or first delivered units (First Article Testing) and selected units from follow-on deliveries to verify that the apparatus is fully capable of meeting all required parameters.

f. Ensure that each apparatus within a certified class is serialized. Exceptions to this requirement shall be negotiated with the SCA.

g. Obtain assurance that the applicant maintains a current list of all serialized units within a certified class identifying the user activity of each unit.

After certification has been granted, any proposed changes to the design, configuration, or operating parameters of the class must be approved by the SCA.

6-2 Class Certification of Diver Worn Equipment

The applicant may request that diver worn equipment, which is procured in lots or in multiple lots, be certified as a class provided that the requirements of this manual are satisfied. The basic difference between class certification and system certification, as described elsewhere in this manual, is that in class certification each piece of equipment will not be issued a separate Certificate of System Adequacy. One certificate will be issued to the equipment Acquisition Manager, along with a list of certified units by serial number and their assigned user commands. Depending on the complexity and quantity of equipment, the SCA may require that each unit or randomly selected units of each production run be physically surveyed.

6-2.1 Responsibilities of the Acquisition Manager/Applicant

Naval Sea Systems Command (NAVSEA) is the designated Acquisition Manager and System Certification Applicant for all U.S. Navy diver worn equipment. Inquiries regarding any diver worn equipment should initially be directed to the U.S. Navy Supervisor of Diving. It is the responsibility of the NAVSEA Acquisition Manager to ensure that the requirements of this manual are adhered to throughout the acquisition process, certification process and life cycle of diver worn equipment. Class certification for diver worn equipment shall be granted, based in part, upon the satisfactory review by the SCA of:

a. Design information as outlined in Chapter 3 including production drawings, design calculations, justification of materials and hazard analysis.

b. Construction, fabrication and assembly procedures and records that meet or exceed the requirements outlined in Chapter 3.

c. The test and inspection program and applicable records of the manufacturer, vendor or other organization designated by the NAVSEA Acquisition Manager. This program shall be comprehensive and encompass all aspects of safety and life support and shall be managed and conducted by a qualified test and evaluation organization following approved written test procedures.

d. Fabrication specifications, deliverable documentation requirements, requirements for First Article Testing and new component qualification testing.

e. Manufacturer's or vendor's Quality Assurance (QA) Program and contractual requirements for the implementation and monitoring of the QA program. (See Section 4-2.6.)

f. Operability and maintainability criteria and procedures. The available facilities and capability of the user command to properly maintain the equipment in accordance with approved procedures.

g. Configuration management plan, developed, implemented and maintained by the Acquisition Manager. It is the responsibility of the Acquisition Manager to inform the SCA in writing of all pending equipment configuration changes.

h. On-site audits of the manufacturer or vendor facilities by the SCA, or his designated representative.

Documentation to be reviewed by the SCA for class certification, shall be prepared and submitted by the Acquisition Manager in the same format and within the same parameters as that documentation required for individual system certification. (See Section 3-2.)

6-2.2 Responsibilities of the User Commands

The user activity having custody of and exercising operational control of certified diver worn equipment shall:

a. Operate certified diver worn equipment in accordance with the provisions of this manual, the U.S. Navy Diving Manual, and such other publications and directives as may be issued by NAVSEA. In cases where additional procedures are developed and issued locally, those procedures shall be reviewed by the SCA or his representative during an on-site survey.

b. Make no alterations to certified diver worn equipment unless specifically authorized in writing to do so by the NAVSEA Acquisition Manager and the SCA.

c. Refer all matters concerning certification of diver worn equipment to the NAVSEA SCA.

d. Not operate diver worn equipment outside its established certification limits.

e. Prepare and submit a Failure Analysis Report (FAR) on form NAVSEA 10560/4 when a failure or malfunction occurs which can be attributed to design, material or manufacturing inadequacy.

f. Maintain the equipment in accordance with approved maintenance procedures and established Re-Entry Control procedures.

g. Immediately notify the SCA in accordance with OPNAVINST 5100.19 Series Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, when a failure occurs, causing diver injury or loss of consciousness. In addition the failed UBA shall be immediately retrieved and prepared for shipment to the Naval Experimental Diving Unit (NEDU) per the U.S. Navy Diving Manual. NEDU shall be

contacted for shipping instructions. No inspection or adjustment to the UBA will be permitted without the expressed consent of NEDU.

6-3 Operational Demonstration

The SCA or his designated representative shall participate in an operational demonstration of selected units of a multiple unit procurement of diver worn equipment. Selected units that must undergo operational demonstration include, but are not limited to, the following:

a. All prototype units

b. Each unit of the initial delivery of a group of units (First Article Tests)

c. Randomly selected units of each production run of a group of units after initial delivery

d. Such other units as the SCA may direct

6-4 Continuation of Class Certification

Continuation of certification of a class of diver worn equipment will be contingent upon:

a. Periodic reviews by the SCA of user organization (Fleet) units on a statistical basis to determine adequacy of the maintenance program

b. Continuous SCA monitoring of and participation in the configuration management program

c. Statistical analysis of Failure Analysis Reports (FARs) and other information provided by user activities

d. Written assurance by the Acquisition Manager that all equipment configuration changes have received SCA concurrence.

Class certification shall be terminated when the terms under which certification was granted have been violated or when a situation arises which would cause the equipment to be considered unsafe for continued use. When major repair or overhaul of an individual item of class-certified equipment is required, further use of that item of equipment is prohibited until it has been restored to the “as-certified” condition. It is the responsibility of the system Acquisition Manager to direct corrective actions for equipment deficiencies noted during on-site certification surveys at user commands.

6-5 Custody Control of Diver Worn Equipment

Each individual item of a certified class of diver worn equipment shall be identified by a serial number and shall be distributed to the user activities by the Acquisition Manager. The Acquisition Manager shall maintain an accurate record of the serial numbers and custodians of all certified diver worn equipment and shall provide this information to the SCA upon request. Custody of certified diver worn equipment shall not be transferred from one activity to another without the approval of the NAVSEA Acquisition Manager and notification of the SCA and NAVSEA Supervisor of Diving.

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APPENDIX A

RE-ENTRY CONTROL PROCEDURES

A-1 Standardization of Re-Entry Control Procedures

The following procedures pertain to all diving and hyperbaric systems certified by NAVSEA 00C and/or NAVFAC SCA. The forms and supporting Personal Qualification Standards are to be used by all applicants to standardize procedures, qualifications and training throughout the DOD Diving Community.

This program is currently taught in entry level and advanced diver courses at the Naval Diving and Salvage Training Center, Panama City, FL. The use of this program throughout the Fleet wide promotes continued professional development in the DLSS maintenance and certification process. Also, the standardization of re-entry control (REC) between commands and services enhances DLSS reliability and mission readiness by immediately using a newly transferred diver's existing knowledge, vice learning new procedures at each command.

CAUTION: REC procedures contained herein are mandatory for any activity conducting work within the SOC. Failure to follow these procedures will result in loss of system certification. Commands requesting to deviate from the requirements of the Standard Diver Re-Entry Control Program shall formally submit their request, along with technical justification, to the SCA for approval.

NOTE: This appendix incorporates and supercedes the procedures, processes and requirements from enclosure (1) to NAVAL SEA SYSTEMS COMMAND letter Ser 00C/4225 dated 23 Oct 96.

A-2 Acronyms

The following acronyms are used throughout this procedure:

CGA - Compressed Gas Association

DFS - Departure from Specification

DLSS - Divers Life Support System (Includes dive weight handling systems)

DOT - Department of Transportation

FAR - Failure Analysis Report

MILSTRIP - Military Standard Requisitioning and Issuing Procedures

MRC - Material Requirement Card

PMS - Planned Maintenance System

OQE - Objective Quality Evidence

PSOB - Pre-Survey Outline Booklet

REC - Re-Entry Control

SCA - System Certification Authority

SOC - Scope of Certification

A-3 Introduction

These procedures provide the necessary instructions for maintaining the DLSS in the “as-certified” condition. A re-entry is defined as any disturbance of the SOC boundaries of a certified system (e.g., breaking a mechanical joint, silver brazing or welding, replacing a viewport, repairing or replacing an electrical connector, removing a gage for calibration, painting the interior of a recompression chamber, etc.). REC is the documentation used to provide an accurate and auditable record of all work performed within the SOC. This documentation provides positive assurance that all systems, subsystems and components that have been breached are restored to a fully certified condition.

REC applies to all work and testing of equipment/systems within the SOC, from first breaching through final testing. REC ensures that fabrication, material, assembly and cleanliness procedures have been fully documented.

Once a newly fabricated system has been successfully cleaned and/or tested for the first time, and cleanliness verified and/or test results approved, no further entry into that system shall be accomplished without strict compliance to formal REC procedures. Likewise, any disturbing of the boundaries of new systems, after completion of testing which verifies the adequacy of those boundaries, also requires the use of formal REC procedures.

A REC is not required for normal system operation, or the routine replacement of consumables where such replacement is covered in operating procedures (e.g., CO_2 scrubber canisters, K bottles, compressor lubricating oil, etc.). Likewise, REC is not required for connecting or disconnecting dive umbilical, portable system interconnecting hoses, etc., where these components are connected using approved pre-dive or post-dive procedures.

A REC package consists of all appropriate forms and supporting OQE necessary to demonstrate re-entry work was authorized and executed in accordance with this procedure.

REC provides written evidence of, or reference to

a. Authorization of reentry requests

b. Reason for work

c. Description of work accomplished, including specific boundaries breached, manufacturing operations performed and retest requirements

d. System isolation, test boundaries and safety precautions

e. Information concerning when, where, why and by whom the work was accomplished

f. OQE, including new material acceptance and in-process testing and results

g. Quality Assurance validation

h. Compliance with applicable specifications, drawings, procedures and instructions.

The forms provided in Figures 1 through 12 are designed to provide a straightforward method of documenting the items above, and ensure that responsible, technically qualified personnel have authorized, performed, accepted, and tested the work accomplished. The use of forms in Figures 1 through 11 are mandatory for all DLSS certified by NAVSEA 00C and NAVFAC SCA. The use of the Request for Departure from Specification (DFS) (Figure 12) is mandatory unless otherwise directed by the Type Commander. These forms provide the minimum documentation requirements to support REC. Additional material control and testing documentation may be required for saturation diving and medical hyperbaric systems. In these cases, the SCA and the applicant shall negotiate any additional REC requirements necessary to ensure the work performed is properly documented.

Requests to use an alternate REC system must be formally submitted to the SCA for review and approval. Approval will be considered only for currently established re-entry control systems that contain all of the elements of the REC program in this appendix.

A-4 Re-Entry Control Program Resources

Work requests, job orders and controlled work procedures shall identify SOC work and provide as much amplifying information as possible. Amplifying information shall be based upon such resources as the certification scope notebook, PSOB, certification letters, mapping and layout drawings, PMS MRCs, technical manuals, etc.

To determine whether work is within the SOC, references shall be made to the appropriate certification documentation (e.g., PSOB and/or certification boundary drawings). The proper identification of SOC items will allow repair activities to

adequately control all work within the certification boundaries, and provide continuity of certification.

When the work to be accomplished is major in scope, the sponsor shall contact the SCA for a determination as to whether system certification must be suspended or terminated. Manned operations of any diving system with a suspended or terminated certification are not permitted.

A-5 Re-Entry Control Responsibilities

In order to implement an effective REC program, the applicant must write and issue local instructions. These instructions shall define all personnel, and their responsibilities, involved in the REC process.

Implementing the requirements of the REC program and assigning individuals responsible for certification requirements and authorized representatives is the applicant's responsibility. The applicant is ultimately responsible for all REC procedure implementation, forms, logs, records, and REC adequacy.

The following paragraphs define the duties and responsibilities of essential REC personnel.

A-5.1 DLSS Re-Entry Control Maintenance Technician

A DLSS REC Maintenance Technician shall be qualified to operate and maintain any portion of a DLSS and must be thoroughly trained in the use of REC procedures and documentation requirements. The maintenance technician is also responsible for completing the REC form and obtaining the required signatures prior to work. In addition, the maintenance technician shall complete the required supporting forms, while performing the maintenance action in accordance with approved written procedures.

A-5.2 DLSS Re-Entry Control Supervisor

The DLSS REC Supervisor shall be qualified to manage the routine operation and maintenance of assigned DLSS. The REC Supervisor is responsible for training maintenance technicians, reviewing RECs prior to start of work, and filing and maintaining all required documentation related to DLSS maintenance. The REC supervisor must be thoroughly familiar with technical manuals and MIL-STD/MIL-SPECs that apply to system maintenance, cleanliness, and testing. The REC Supervisor reviews the work of the Maintenance Technician and signs RECs during opening and closing reviews.

A-5.3 Senior Diving Supervisor

The Senior Diving Supervisor, usually the Master Diver, if one is assigned, manages the daily operation and maintenance of all DLSS assigned to their

cognizance. The Senior Diving Supervisor provides the final technical review and signature for RECs, both prior to and upon completion of DLSS work.

A-5.4 Diving Officer

The Diving Officer acts as the single point of contact with the SCA and has overall responsibility for maintaining the DLSS in an "as-certified" condition. In addition, the Diving Officer is responsible, via the chain of command, for the overall condition of the system and for maintaining all required documents concerning system certification. The Diving Officer's signature is required as administrative approval for re-entry and verification that work was satisfactorily completed. Signature authority may be delegated to the Senior Diving Supervisor. Notice of such delegation shall be included in the implementing REC instructions.

A-5.5 Commanding Officer

The Commanding Officer's signature is required prior to any manned operations of a certified DLSS after a maintenance action. Signature authority for the REC Form (Figure 2) may be delegated to the Diving Officer. Notice of such delegation shall be included in the implementing REC instructions. The Commanding Officer's signature may not be delegated when requesting major departure from specification approval using the Request for Departure from Specifications Report (Figure 12).

A-5.6 Contracting Out Work Within the SOC

In cases where the applicant is not actually conducting the repairs, the work request to the repair activity must be very specific in defining what work is to be performed, including cleaning and testing requirements. The activity performing the repairs shall provide the applicant with a written statement that all work performed (including a list of repair parts) by the repair activity, within the SOC, has been satisfactorily completed in accordance with applicable documents and specifications. For major system repairs, made by an industrial activity, supporting documentation will be developed and submitted, commensurate with the procedures described herein. All industrial activity repairs will be monitored by the applicant and records maintained on file. For those system modifications directed by the Acquisition Manager, the user command and Acquisition Manager shall work together to define the responsibilities of each regarding the monitoring of the work to be performed.

A-6 Approach to Re-Entry Control Process and Unique Considerations

The first step in preparing to work on a DLSS is to identify what aspects of the work will fall within the SOC. Using the applicable diving system SOC documentation, locate the work area within the SOC and properly identify all material involved.

Establish all actions necessary to accomplish the work involved, including material control and inspection requirements, using the system technical documentation.

A-6.1 Revision

When performing maintenance or repairs using REC, it may be discovered that additional work is required, or procedures that differ from the REC under which work is being performed. In that case, a revision to the original REC must be issued. For example, during a filter element replacement, the inspection reveals damaged filter housing threads. If repair or replacement of the filter housing is required, a revision to the original REC must be issued.

To document a revision in the REC Log, follow the directions in Figure 1. Ensure that the REC Log "CLOSE" block for the original REC is annotated with superseding information to show that work was completed on the revision. Without closing the original REC, issue another REC that defines the additional work to be performed. The revision will include the same information and documentation required by the original procedure and additional procedures and documentation required to complete the added work. The revision will be attached to the original REC and be routed for review and approval. After completion of the work, the revision REC Form (with all pages of the original attached) will be completed and routed for closure. Only the revision is required to be closed out (list supporting documentation and include final approval signatures).

A-6.2 Rework

A rework is required/can be used to perform the exact same procedures again. The need for rework would normally be discovered during the testing phase of REC procedures. If during testing, an unsatisfactory condition is discovered, a rework can be performed to correct the condition if the exact same procedures are required to correct the unsatisfactory condition (e.g. an o-ring may be pinched during installation and may not be discovered until final testing).

To document a rework in the REC Log, place a dash (-) in the original REC number followed by a sequential number (e.g. 96-001-1, would be the first rework of REC 96-001). This number will be used to identify all documentation associated with the rework.

A-6.3 Planned Maintenance

All planned maintenance (e.g., PMS) conducted on systems within the certification boundaries shall be accomplished using only NAVSEA/NAVFAC approved maintenance procedures (e.g., MRCs). The maintenance procedures for all equipment within certification boundaries will contain one or both of the following two notes to alert personnel conducting planned maintenance that they are working on certified equipment:

a. "This maintenance involves certified equipment and applicable certification procedures must be followed."

b. “For the purpose of sustaining system certification use only renewable parts listed in the “Tools, Parts, Materials, Test Equipment block.”

The accomplishment of planned maintenance on certified equipment requires strict adherence to the approved procedures. When the procedures indicate spare parts are required, they shall be drawn only from controlled spares stores and not from uncontrolled shop stores.

To ensure that the certification requirements are met, the maintenance procedures promulgated by the applicant shall be referenced in the REC procedures.

A-6.4 Repair Parts Control

Adherence to an established repair parts control procedure is considered vital to maintaining system certification. Material control for replacement of repair parts in a certified system is regulated by the bill of material contained in the as-built drawings and in the operation and maintenance manual.

A-6.5 Component Handling and Cleanliness

Extra care shall be taken when handling gas system components. Leakage problems can result from careless handling of valves, regulators, and other components. Components used in helium systems are particularly vulnerable.

The DLSS shall be cleaned in accordance with approved cleanliness standards. When a component is drawn from controlled spare stores for use during a re-entry, ensure there is a label within the packaging certifying it has been cleaned per NAVSEA/NAVFAC approved DLSS cleaning procedures. When cleaning procedures other than MIL-STD-1330 or MIL-STD-1622 are used, NAVSEA 00C3 or NAVFAC SCA shall be contacted to verify those procedures have been approved. The serial number of the component, cleanliness data sheet or tag shall be entered on the Re-Entry Control Form Continuation Page (Figure 3) as supporting documentation. Any component that cannot be verified as being clean per approved procedures shall be considered contaminated, and may not be installed in the DLSS until its cleanliness is verified. The original cleanliness data sheet or tag shall be made available to the SCA during certification surveys. When cleaning is accomplished by an outside activity, copies of the cleaning data sheets are acceptable.

A-6.6 Re-Entry Control Review

A thorough and systematic review process must be followed for the approval and close out of all REC documentation. Each person signing for approval reviews must ensure that all safety precautions are included, that the procedures incorporate sound engineering practices and that all materials listed meet material specifications. Each person signing for closeout reviews shall ensure that written procedures were followed, only approved materials were installed and that the results of all testing was satisfactory.

A-6.6.1 Approval

The REC supervisor reviews the REC to ensure technical specifications will be met, technical adequacy of procedures, cleanliness standards are adequate and verified, prior to signing that work is ready to commence.

The Diving Officer review is a quality check of completeness and adequacy of the entire REC procedure. Re-entry into the system is not authorized until the Diving Officer's signature has been obtained.

A-6.6.2 Close Out

The REC Supervisor, Diving Officer, and Commanding Officer will enter signatures on the REC Form indicating that all work and testing has been successfully completed and re-entry is complete.

The REC Supervisor will enter a signature after all related technical documentation has been accomplished. The Diving Officer's signature indicates that administrative and technical requirements are complete. The Commanding Officer or a designated representative's signature in the Final Approved block of the REC form is required prior to manned operations. If certification has not been terminated or suspended, DLSS manned operations may resume upon final closeout of the REC. If system certification has been terminated, the command shall formally request a survey be conducted by the SCA. If system certification has been suspended, the command shall formally request a reinstatement of the existing certification.

A-6.7 Objective Quality Evidence

Any statement of fact, either quantitative or qualitative, pertaining to the quality of a product or service based on observations, measurements, or tests that can be verified. (Evidence will be expressed in terms of specific quality requirements or characteristics. These characteristics are identified in drawings, specifications, and other documents which describe the item, system process or procedure).

A-7 Re-Entry Control Documentation

Work on DLSS must always meet the requirements to support certification, as prescribed by the SCA. Strict adherence to these requirements preserves confidence that the system will perform in a manner that provides the highest level of safety to the diver. An overview of the standardized DLSS REC forms is provided below. These forms meet the joint requirements established by NAVSEA and NAVFAC and provide process managers a standardized format for documentation of maintenance procedures.

A-7.1 Forms Application

Re-Entry Control Forms, Figures 1 through 12, are to be completed in accordance with the instructions on the back of each form.

A-7.1.1 Re-Entry Control Log (Figure 1)

Purpose. To provide a record of command/unit entries into the SOC systems or components. The REC Log is used to summarize the chronological record of the RECs for the life of the certified system.

A-7.1.2 Re-Entry Control Form (Figure 2)

Purpose. Whenever a certified system is opened or breached for maintenance, documentation is required to verify that the work was done completely and correctly in accordance with technical directives. This and associated forms are used to authorize re-entry and to recertify that the system is safe for manned use. This form shall be used in conjunction with a Controlled Assembly Report and a Test and Inspection Report for each reentry of a system, component, or portion thereof.

An individual REC shall be restricted to related maintenance actions on a single system or a single subsystem. This form is used to authorize and document maintenance within the SOC.

A-7.1.3 Re-Entry Control Continuation Page (Figure 3)

Purpose. To be used as a continuation of any of the blocks on the REC Form, or as needed to record supplemental data required to provide further guidance to the maintenance technician. It can be used to provide a list of references, parts/materials, or to write steps of procedures where no previously approved procedure is available for the maintenance action.

A-7.1.4 Re-Entry Control Continuation Page Rework (Figure 4)

Purpose. When an unsatisfactory condition is discovered during the performance of a REC and the exact same procedures are required to correct the discrepancy. See paragraph A-7.2.

A-7.1.5 Test and Inspection Report (Figure 5)

Purpose. To provide a report form for test and inspections either prior to or upon completion of repairs. This form can be used for installed system testing, shop inspections, cleanliness inspections, and other tests and inspections deemed necessary. A separate form is required for each type of test (i.e., hydrostatic, seat tightness, system/joint tightness).

A-7.1.6 Controlled Assembly Report (Figure 6)

Purpose. To provide a report form for documenting component parts replacement, reuse, inspections, torque and lubricants. This form should be used for documenting all assembly procedures, parts, lubricants, and fastener inspections used in repairs and maintenance in accordance with a REC.

A-7.1.7 Test and Inspection Report, Joint Tightness Test (Figure 7)

Purpose. To provide a report form for joint tightness testing and inspections. This form can be used for operational testing or shop testing.

A-7.1.8 Test and Inspection Report, Valve Seat Tightness Test (Figure 8)

Purpose. To provide a report form for test of valve seat leakage. This form can be used for installed system testing, or bench testing as necessary.

A-7.1.9 Test and Inspection Report, Hydrostatic/Pneumatic Test (Figure 9)

Purpose. To provide a report form for hydrostatic/pneumatic testing and inspections. This form can be used for installed system and bench testing.

A-7.1.10 Test and Inspection Report, System Drop Test (Figure 10)

Purpose. To provide a report form for system drop test and inspections.

A-7.1.11 Departure From Specifications Log (Figure 11)

Purpose. To provide a record of ship/unit DFS on the SOC systems or components. The DFS Log will summarize the chronological record of the DFSs for the life of the certified system.

A-7.1.12 Request for Departure From Specifications Report (Figure 12)

Purpose. To establish standard procedures to be used by the DLSS applicants for requesting approval and clearance, at the earliest opportunity, of all DFS.

The form shown in Figure 12 shall be used to document the DFS unless otherwise directed by the Type Commander.

Specifications are engineered requirements such as type of materials, dimensional clearances, electrical values, vibration levels, flow rates and physical arrangements to which components are purchased, installed, tested and maintained. All DLSS are designed and constructed to specific technical physical requirements. It is imperative that every effort be made to maintain all systems and components to their designed specifications. There are, on occasion, those situations in which the applicable specifications can not be met and the system or component is controlled with a departure from specification. To maintain a precise control of any DLSS technical

configuration, all deviations must be recorded and approved by the proper recertification authority.

A-7.2 Forms

The standardized forms included at the end of this Appendix are to be used to document re-entry procedures when performing work on certified DLSS, unless specifically exempted by the SCA.

A-7.3 Disposition of Re-Entry Control and Supporting Documentation

The original REC logs and completed REC forms shall be maintained by the sponsor in a separate file and in an auditable fashion. All data identified on the REC form as supporting documentation shall be appended to the form and filed as a complete REC package. All primary OQE records, such as weld and NDT records, material conformity, cleaning and hydrostatic testing data that support REC documentation, shall also be maintained with the REC in an auditable fashion. When in a shipyard or REC is done by contract, the repair activity quality assurance officer shall provide the sponsor with a copy of the REC log and copies of all RECs generated for DLSS maintenance. REC Logs shall be retained for the life of the system.

Re-entries into SOC boundaries can be classified into two categories, repair/replacement of SOC material after failure and routine scheduled maintenance. Repair/replacement consists of that maintenance required to replace or repair a failed component or other non-scheduled maintenance. Routine maintenance is regularly scheduled reoccurring maintenance, such as PMS.

All REC packages generated during a certification period must be kept available for the next on-site survey, even if superceded during that timeframe. REC packages generated for component or material repair/replacement shall be retained for the life of the component, or until the REC is superceded by the same repair or replacement of the component/material. For example, the seat for pressure regulator AHP-25 is replaced; the REC package and OQE must be retained until the seat is replaced again, or the entire regulator is replaced. The REC package for the AHP-25 seat replacement must be retained for audit during the next on-site certification survey. After the on-site survey, the REC package may then be put into long-term storage until such time as the REC is superceded.

REC records for routine maintenance must be kept during the certification period and be available for review during the next on-site certification survey. This is normally a three-year period. REC records that are reviewed during the certification survey, but not yet superceded by the same maintenance shall be retained until the identical maintenance has been repeated. For example, there is a 60M-1 to hydrotest composite gas flasks. The REC package for this maintenance shall be retained for the next on-site certification survey, and then retained in long-term storage until the same 60M-1 MRC is completed 5 years later.

A-8 Electrical/Electronic Components

A-8.1 Purpose

To provide guidance in the documentation of the work performed on electrical/electronic components within the DLSS-SOC.

A-8.2 General

It is difficult to acquire the skills necessary to work on electrical/electronic equipment from on the job training without previous formalized classroom type schooling. In most cases, divers are billeted to diving commands, not by rate, but by their diving NEC. For this reason, it is not unusual for particular diving commands to lack divers with this background. This type of maintenance must be handled differently than mechanical preventative or corrective maintenance.

A-8.3 Quality Characteristics of Electrical Maintenance

The primary difference with maintenance is that the electrical technician need not be fully oriented in DLSS procedures and training as long as the work is observed and/or inspected for the following attributes of quality work:

a. All work performed on or within the pressure boundary of the system is personally witnessed by a qualified DLSS Maintenance Technician who oversees and documents the cleanliness, procedures, and materials used in the process.

b. The electrical/electronic technician performing the work presents or describes the technical guidance, repair manual or drawing that was used in the repair to a REC Supervisor. This information will be documented in the REC package as described in this section.

c. All pre-installation checks (if any) that are required by the component maintenance manual shall be performed and documented. For example, a new power supply for a communication system may require voltage level checks and ground fault interruption tests prior to use.

d. The component shall be operationally tested and the results documented in the presence of a REC Supervisor in accordance with normal operating procedures and technical references used in the repair.

e. The forms normally used in the electrical/electronic repair shall consist of the REC Form (Figure 2), the Test and Inspection Report (Figure 5), and the Controlled Assembly Report (Figure 6). In rare occasions, the Hydrostatic/Pneumatic Test (Figure 7) and System Drop Test (Figure 10) and Inspection Reports may have to be used for implodable, explodable, or items requiring helium compatibility testing. These forms are included as attachments in Section 12.

A-9 Qualifications and Training

Individuals assigned to install, repair and maintain certified DLSS must be trained and fully understand the rigid material, process and testing requirements established to attain and/maintain certification and to ensure as-built conditions are strictly enforced.

The following qualification standards are to be used to specify and document the minimum knowledge level and proficiency of DLSS REC Maintenance Technicians and DLSS REC Supervisors prior to performing controlled work within the scope of a Certified DLSS.

A-9.1 Qualification Requirements

The qualification requirements are IAW NAVEDTRA 43910; PQS for Diving Salvage Warfare Specialist (DSWS). All DLSS REC Maintenance Technicians shall complete watchstation 308 of the DSWS Personal Qualification Standard (PQS). All DLSS REC Supervisors shall complete watchstation 314 of the DSWS PQS. All civilian or non-Navy Service personnel shall complete equivalent training in lieu of the DSWS PQS.

A-9.2 Qualification Records

Watchstations 308 and 314 of the DSWS PQS shall be used as the qualification records for REC Maintenance Technicians and Supervisors. All civilian or non-Navy Service personnel shall document completion of equivalent training.

A-9.3 Training And Continued Education

All DLSS REC Maintenance Technicians and REC Supervisors should attend recurring training that covers topics which specifically deal with proper adherence to this procedure and should also cover topics which concern the entire DLSS maintenance/certification process.

Training should include, at a minimum, the following information:

- Identification of the correct material and process to use
- Identification of the specifications to which work is performed
- Identification of the tests that are necessary to recertify the work
- Identification of the cleanliness standards and techniques

The methods of approval and documentation when specifications can not be met.

This information may also be derived from other sources such as PMS cards, technical manuals, vendor technical information sheets, other NAVSEA procedures, and system technical documents.

A-10 On-Site Surveys

On-site surveys provide a systematic method of comparing records to requirements in order to ensure compliance.

Surveys are conducted on each command at set periodicities. Each command should complete the check-off sheet in the “Annual Survey Checkoff List” prior to the on-site survey.

A-11 Reference Publications

The following is a list of the most commonly used publications for DLSS during contractual work and daily maintenance. Non-Government activities should contact the Acquisition Manager for copies of required references.

- NAVSEA S9086-AA-STM-010 - Naval Ships’ Technical Manual

NOTE: This is the CD ROM version that contains all chapters and requires a computer that has a CD drive and Windows installed to run the disk. Individual NSTM chapters may be ordered from the Naval Logistics Library at https://nll1.ahf.nmci.navy.mil.

074(V1)	S9086-CH-STM-010, Welding and Allied Processes
074(V2)	S9086-CH-STM-020, Nondestructive Testing of Metals, Qualification and Certification requirements for Naval Personnel (Non-Nuclear)
075	S9086-CJ-STM-000, Threaded Fasteners
078	S9086-CM-STM-010, Seals
262	S9086-H7-STM-010, Lubricating Oils, Greases, Specialty Lubricants, and Lubrication System
504	S9086-RJ-STM-000, Pressure, Temperature, and Other Mechanical and Electromechanical Measuring Instruments
505	S9086-RK-STM-010, Piping Systems
550	S9086-SX-STM-010, Industrial Gases; Generating, Handling and Storage
551	S9086-SY-STM-010, Compressed Air Plants and Systems
589	S9086-T4-STM-010, Cranes
613	S9086-UU-STM-010, Wire and Fiber Rope and Rigging

A-12 Military Standards/Specifications

These publications can be obtained from a Technical Library or through a website such as the one set up by IHS, Inc.

MIL-F-22606	Flask, Compressed Gas and End Plugs for Air, Oxygen, and Nitrogen
MIL-HDBK-245	Handbook For The Preparation of Statement Of Work (SOW)
MIL-HDBK-288	Review And Acceptance Of Engineering Drawing Packages
MIL-HDBK-695	Rubber Products; Recommended Shelf Life
MIL-STD-1330	Standard Practice For Precision Cleaning And Testing Of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen, And Hydrogen Systems
MIL-STD-1622	Cleaning Of Shipboard Compressed Air Systems
T9074-AS-GIB-010/271	Requirements For Nondestructive Testing Methods

A-12.1 Compressed Gas Association

These pamphlets are used by the Department of Transportation regarding any DOT type flask or bottle at your command, and can be obtained by contacting:

Compressed Gas Association
4221 Walney Road, 5th Floor
Chantilly, VA 20151

CGA C-1 Methods For Hydrostatic Test Of Compressed Gas Cylinders

CGA C-6 Standards For Visual Inspection Of Steel Compressed Gas Cylinders

CGA E-9 Standard For Flexible PTFE Lined Pigtails For Compressed Gas Service

CGA P-5 Suggestions For The Care Of High Pressure Air Cylinders For Underwater Breathing

CGA V-1 Standard For Compressed Gas Cylinder Valve Outlet And Inlet Connections

CGA V-7 Standard Method Of Determining Cylinder Valve Outlet Connections For Industrial Gas Mixtures

CGA V-9 CGA Standard For Compressed Gas Cylinder Valves

A-12.2 NAVFAC Manuals

NAVFAC UFC 4-159-01N Design: Hyperbaric Facilities

NAVFAC MO-406 Hyperbaric Facilities Maintenance Manual

NAVFAC TM-CHENG/05-010-SCA, NAVFAC System Certification Authority (SCA) Policy For Hyperbaric Pressure Vessels And Associated Relief Valves

A-12.3 NAVSEA Manuals

This publication can be obtained via the supply system.

S6470-AA-TED-010 Piping Devices, Flexible Hose Assemblies

RE-ENTRY CONTROL LOG

1. COMMAND/UNIT			2. SYSTEM				3. PAGE _____ OF _____
4. REC NO.	REV	5. ASSOCIATED RECs	6. SYSTEM/SUBSYSTEM/COMPONENT	7. DATE OF: ISSUE	START	CLOSE	8. REMARKS

Figure 1

RE-ENTRY CONTROL LOG

PROCEDURE
The numbered blocks on the Re-Entry Control Log correspond with the instructions below, and will be entered by the Master Diver/Diving Supervisor and audited for accuracy by the Diving Officer quarterly. When a system is to be returned to a depot or transferred to another activity, this log and all RECs will accompany the system.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the system.

2. SYSTEM
Enter the noun name of the system to be breached (e.g., CAOS-65, Transfer Lock-23, TRC-22, etc.) and the work center number, if applicable (e.g., EM01, etc.).

3. PAGE ____ OF
Enter the page number of the REC Log. At years end, enter the number of total pages for that year. (e.g., "PAGE 4 OF 5 " represents the fourth page of a total of five in the same year)

4. REC NO./REV
Enter the Re-entry Control Number in the following manner, yy-###, where yy is the year and ### is the sequential number of the REC for that year (i.e., 96-003 represents the third REC of 1996). Enter the current revision, with the original version being a Dash (-), the first revision being A, second revision B, etc (i.e., 96-003A). If rework is required(i.e., a replated component leaks from a disturbed joint), a number shall be added to the end of the REC (i.e., 96-003-1).

5. ASSOC RECs
Enter REC numbers of open RECs on the same system which cannot be closed out until this work is complete. Enter "NONE" if there are no associated RECs.

6. SUBSYSTEM/COMPONENT
Enter the name of the subsystem and component identification to be worked on (e.g., CAOS-065/TRANSFER LOCK PRIMARY AIR/AHP-F-3, Transfer lock-23/CHAMBER OXYGEN/OXLP-B-5, TRC-22/SECONDARY HP AIR/AHP-V-20, etc.).

7. DATE OF
ISSUE - Enter the date that the REC number is issued.
START - Enter the date that the actual work is started on the system.
CLOSE - Enter the date the Command/Unit C. O. designated representative signs the REC as complete, thereby returning the system to its certified condition. If the REC is superceded by a revision, note the revision in this block (i.e., See Rev A)

8. REMARKS
Enter information that will help identify the nature of the work accomplished.

RE-ENTRY CONTROL FORM

1. COMMAND/UNIT	2. REC NO.	REV
3.a. SYSTEM RE-ENTERED	4. PAGE 1 OF _____	
	5. ORIGINATOR	
3.b. SUBSYSTEM/COMPONENT RE-ENTERED	6. ASSOCIATED RECS	
WORK DESCRIPTION INCLUDING BOUNDARIES		
7. SYSTEM DRAWING/REV		
8. WORK DESCRIPTION AND RETEST REQUIREMENTS		
9. BOUNDARIES ISOLATION: WORK: TEST:		
10. REASON FOR WORK	11. FAR REQUIRED? ( ) YES FAR SERIAL NO. ( ) NO	
APPROVAL FOR RE-ENTRY		
12. REC SUPERVISOR SIGN PRINT _____ DATE	13. DIVING OFFICER/SENIOR DIVING SUPERVISOR SIGN PRINT _____ DATE	
VERIFICATION AND CERTIFICATION		
14. OBJECTIVE QUALITY EVIDENCE ( ) CONTROLLED ASSEMBLY REPORT ( ) SUPPLY DOCUMENT	( ) TEST/INSPECTION REPORT ( ) OTHER	
ABOVE WORK HAS BEEN SATISFACTORILY COMPLETED AND RETESTED		
15. REC SUPERVISOR SIGN PRINT _____ DATE	16. DIVING OFFICER/SENIOR DIVING SUPERVISOR SIGN PRINT _____ DATE	
FINAL REC CLOSEOUT CERTIFICATION		
17. COMMAND UNIT C.O. DESIGNATED REPRESENTATIVE SIGN PRINT _____ DATE		

Figure 2

RE-ENTRY CONTROL FORM INSTRUCTION

PROCEDURE
The numbered blocks on the Re-Entry Control Form correspond with the instructions below and will be completed by the personnel assigned.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the system (e.g., MDSU 2 Charlie Team, First Force Recon. Co., USS Safeguard, NNSY, etc.).

2. REC NO./REV
Enter the Re-entry Control Number from the Re-entry Control Log. Enter a dash in the REV block for the original REC and sequentially letter each revision. If a revision is necessary, explain why in block 8.

3.a. SYSTEM RE-ENTERED
Enter the name of the system to be breached. For commands with multiple DLSS (e.g., FADS II-3, TRCS 001, LWDS 003, LCM-8, YDT-15, etc.). For commands with a single system (e.g., CHAMBER LP OXYGEN, HP AIR, RECOMPRESSION CHAMBER, etc.).

3.b. SUBSYSTEM/COMPONENT RE-ENTERED
Enter the name of the subsystem and component identification to be worked on (e.g., TRANSFER LOCK PRIMARY AIR /AHP-F-3, CHAMBER OXYGEN/OXLP-B-5, SECONDARY HP AIR/AHP-V-20, etc.).

4. PAGE 1 OF
Enter the total number of pages used for the REC. Include Re-entry Control continuation page(s), controlled assembly forms, test and inspection forms, supply documents, etc. This cannot be completed until the work has been completed and the REC is ready for closure.

5. ORIGINATOR
Enter the name of the maintenance technician who conducted the research and is preparing the REC.

6. ASSOCIATED RECS
Enter REC numbers of open RECs on the same system which cannot be closed out until this work is complete. Enter "NONE" if there are no associated RECs.

7. SYSTEM DRAWING/REV
Enter a drawing number or figure and technical manual number that illustrates the system and identifies the work and retest boundaries (e.g., DWG # 516-5364883, Fig. 2-7 of SS500-AW-MMM-010, etc.).

8. WORK DESCRIPTION AND RETEST REQUIREMENTS
Enter the type of work to be accomplished and the retest requirements for continuation of certification. (e.g., replace inlet o-ring on OLP-V-102, leak test to maximum operating pressure). If this record is for a revision, explain why the revision was necessary.

9. BOUNDARIES
ISOLATION: Enter the valves, switches or other components that must be verified as being open, shut, reenergized, etc. to ensure the safety of maintenance personnel. Include the required position of each isolation component.
WORK: Enter the first stop valve upstream and downstream of the joint/component being entered.
TEST: For low pressure systems, pressure boundaries and work boundaries may be the same stop valves. For high pressure systems, enter the first and second valves upstream and downstream of the joint/component being entered.
NOTE: For portable systems that are joined by flexible hoses, add a note if applicable, that warns the worker to ensure that hoses from a pressure source are either disconnected or valves at the source are included in the tag-out.

10. REASON FOR WORK
Enter the reason for reentry (i.e., DIVEALT #, SHIPALT #, MIP/MRC #, Job Control Number, Work Order Number, etc.). If corrective maintenance, be specific (e.g., AHP-4 leaks by seat, HP air compressor overhaul due to low 3rd stage pressure, etc.).

11. FAR REQUIRED?
Check the applicable block. If yes, complete the FAR in accordance with the U.S. Navy Diving Manual. Enter the serial number in space provided.

APPROVAL FOR RE-ENTRY
12. REC SUPERVISOR
The REC Supervisor signs this block signifying that work procedures and retest requirements are correct for the work to be accomplished. A signature, printed name and date are required.

13. DIVING OFFICER/SENIOR DIVING SUPERVISOR
The Diving Officer or Senior Diving Supervisor signs this block granting authorization to re-enter the system. A signature, printed name and date are required.

VERIFICATION AND CERTIFICATION
14. OBJECTIVE QUALITY EVIDENCE
During the closeout review, the technician should enter the number of pages for each form used in documenting the work accomplished and the supply documentation of parts replaced. Other documents that may be attached are the certificates of compliance from vendor(s) (e.g., cleanliness documentation, PVHO-1 documentation for a viewport).

ABOVE WORK HAS BEEN SATISFACTORILY COMPLETED AND RETESTED
15. REC SUPERVISOR
The REC Supervisor signs this block signifying that technical documentation has been reviewed and is acceptable. A signature, printed name and date are required.

16. DIVING OFFICER/SENIOR DIVING SUPERVISOR
The Diving Officer or Senior Diving Supervisor signs this block signifying that all work and testing is satisfactory and that all associated RECs are complete. A signature, printed name and date are required.

FINAL REC CLOSEOUT CERTIFICATION
17. COMMAND UNIT C.O. DESIGNATED REPRESENTATIVE
The Commanding Officer/Officer in Charge or designated authority will enter signature, printed name, and date signifying the final closure of this REC and returning the system back to readiness condition. This signature is required prior to conducting manned operations.
NOTE: If additional space is needed, use the RE-ENTRY CONTROL FORM CONTINUATION PAGE, Figure I-3.

RE-ENTRY CONTROL CONTINUATION PAGE

1. COMMAND/UNIT	2. REC NO.	REV

PAGE ___ OF _____

Figure 3

RE-ENTRY CONTROL CONTINUATION PAGE

PROCEDURE
This page is to be used as a continuation of blocks on the Re-entry Control Form as needed, or to record supplemental data to provide further guidance to the maintenance technician. Below is a list of information that may be included, but is not intended to limit the content of this form.

REFERENCES
List all references applicable to the performance of the work procedure (i.e., Technical manuals/publications, Local and higher authority instructions, etc.).

ENCLOSURES
List enclosures used to provide additional guidance to the technician in the performance of the work procedure (i.e., Drawing/Diagram of system, copy of technical manual procedures, etc.).

PARTS/MATERIALS
List all parts and materials which are to be used in the performance of the work procedure. Ensure all parts and materials listed meet material specifications.

PRECAUTIONS/PREREQUISITES
List specific precautions to be followed for the type of work being performed.

WORK PROCEDURE
If a pre-approved procedure such as a technical repair manual does not exist, write the steps of procedure here. If using a technical repair manual procedure, include it as an enclosure and write "See enclosure ____.

NOTE 1: When using this page for continuation of a block or blocks from the REC, identify each continuation by starting with "Continued from" and then enter the block number and title (i.e., Continued from block 8, WORK DESCRIPTION AND RETEST REQUIREMENTS).

NOTE 2: This page is not required when using a PMS MRC as a work procedure.

RE-ENTRY CONTROL CONTINUATION PAGE REWORK

1. COMMAND/UNIT	2. REC NO.	REV
3. REASON FOR WORK		
4. STEPS TO BE REPEATED		
5.a. REC SUPERVISOR SIGN PRINT _____ DATE	5.b. DIVING OFFICER/SENIOR DIVING OFFICER SIGN PRINT _____ DATE	

FIGURE 4

RE-ENTRY CONTROL CONTINUATION PAGE REWORK

PROCEDURE
There is no standard format for this page. Using a Re-entry Control Form Continuation Page Rework describes the reason for the rework, and lists what steps of the procedure which will be repeated. The REC Supervisor and Diving Officer or Senior Diving Supervisor will sign and date granting authorization to reenter the system.

> **NOTE 1**: There will be a need to produce new supporting REC forms to be included as a part of the rework.
> **NOTE 2**: The close out of a rework will be conducted on the original Reentry Control Form in accordance with section 17.7.2.2.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the system.

2. REC NO./REV
Enter the Re-entry Control Number from the Reentry Control Log (e.g. 95-001 is 1995 REC 001). Enter a dash in the REV block for the original REC and sequentially letter each revision.

3. REASON FOR REWORK
Enter the reason for which rework is required. (e.g. unsat joint tightness test requires replacement of o-ring.)

4. STEPS TO BE REPEATED
Enter the steps from the original REC that will need to be repeated to correct the deficiency. This does not have to be a copy of the steps but a list of them will suffice.

APPROVAL FOR RE-ENTRY
5.a. REC SUPERVISOR
The REC Supervisor signs this block signifying that work procedures and retest requirements are correct for the work to be accomplished. A printed name, signature and date are required.

5.b. DIVING OFFICER/SENIOR DIVING SUPERVISOR
The Diving Officer/Senior Diving Supervisor signs this block granting authorization to re-enter the system. A printed name, signature and date are required.

TEST AND INSPECTION REPORT

1. COMMAND/UNIT	2. REC NO.	REV
3. SYSTEM/COMPONENT	4. DESCRIPTION OF ITEM	
5. DESCRIPTION OF TEST AND/OR INSPECTION		
6. RESULTS OF TEST AND/OR INSPECTION		
7. TECHNICIAN SIGN PRINT _____ DATE	8. WITNESS SIGN PRINT _____ DATE	

PAGE ___ OF _____

Figure 5

TEST AND INSPECTION REPORT

PROCEDURE
The numbered blocks on the Test and Inspection Report correspond with the instructions below. This form should be completed by the technician conducting the test/inspection and/or the supervisor verifying the test/inspection.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the DLSS.

2. REC NO./REV
Enter the Re-entry Control Number and Revision from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system and component identification to be breached. For commands with multiple DLSS (e.g. FADS II-3 / AHP-F-12, TRCS 001 / PG-F-2, LCM-8 / RV-V-3, YDT-15 / ALP-F-1, etc.). For commands with a single DLSS (e.g. CHAMBER OXYGEN / OX-LP-2, HP AIR / AHP-F-34, RECOMPRESSION CHAMBER / ALP-20, etc.).

4. DESCRIPTION OF ITEM
Enter the piece number or component description to be inspected or tested (e.g., 3 CPV, Globe Valve, Tescom Regulator, etc.).

5. DESCRIPTION OF TEST AND/OR INSPECTION
Enter a detailed description of tests and/or inspections to be performed including the JID(s) and all references required. If the test or inspection has a numerical value (i.e. maximum and/or minimum value) the values will be written in.

6. RESULTS OF TEST AND/OR INSPECTION
Enter the specific results of the test and/or inspection of Block 6. Indicate whether the results/readings are satisfactory or unsatisfactory. If UNSAT, the craftsman will note action proposed or taken to resolve the condition prior to signing Block 7. If UNSAT, the MDV/DIVESUP will review and concur with the action taken/proposed by production personnel to resolve the condition prior to signing Block 8.

NOTE: When required, add the following block(s);
GAGE TYPE & SN_____ RANGE_____CAL DUE DATE
METER TYPE & SN_____ RANGE_____CAL DUE DATE
OTHER TYPE & SN_____ RANGE_____CAL DUE DATE
TEST MEDIA (AIR, N2, TAP WATER, 120 VAC, etc.)

7. TECHNICIAN
The DLSS maintenance technician will enter signature, printed name, and date after completing Block 6.

8. WITNESS
A second DLSS maintenance technician, or DLSS REC supervisor, will be on the job site to witness the testing and the results. The witness will enter signature, printed name, and date after observing the test or inspection.

CONTROLLED ASSEMBLY REPORT

1. COMMAND/UNIT	2. REC NO.
3. SYSTEM/COMPONENT	4. DRAWING/FIGURE NO.
5. JOINT I.D.	6. MRC/WORK PROCEDURE NO.

7. FASTENER INSPECTION	8. LUBRICANT USED (INCLUDE MIL-SPEC)
( )SAT ( )UNSAT	

9. SEALING SURFACE INSPECTION

MALE INLET: ( )SAT ( )UNSAT FEMALE INLET: ( )SAT ( )UNSAT

MALE OUTLET: ( )SAT ( )UNSAT FEMALE OUTLET: ( )SAT ( )UNSAT

10. GASKET/O-RING

PART N0./NSN	COMMERCIAL STANDARD/MIL SPEC	QTY	EXP DATE

11. PARTS REPLACED

PART N0./NSN	NOMENCLATURE

CONTINUED ON NEXT PAGE

Figure 6

CONTROLLED ASSEMBLY REPORT

PROCEDURE

The numbered blocks on the Controlled Assembly Report correspond with the instructions below and will be entered by the preparer and the DLSS maintenance technician as appropriate.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the system.

2. REC NO.
Enter the Re-entry Control Number from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system and component to be tested or inspected.

4. DRAWING/FIGURE NO.
Enter the drawing or figure number from the applicable technical manual that identifies the component and/or system joint assembly details. This should be the same drawing as block 7 of the REC Form.

5. JOINT I.D.
Enter joint identification number. Locally Assigned Joint (LAJ) identification numbers may be used to identify joints breached. When using LAJs use the following format: The REC number followed by the joint number (95-001-01 represents the first joint for REC 95-001). Ensure that a LAJ drawing is included as an enclosure.

6. MRC/WORK PROCEDURE No.
Enter the MRC code, the technical manual work procedure number, or the number of a locally prepared procedure that will be used to accomplish the REC. If no PMS or pre-established procedure is involved, enter NONE.

7. FASTENER INSPECTION[1]
Enter the results of the fastener inspection performed. Inspect the drive portion of the fastener for damage that will adversely affect proper tightening and inspect the working threads of the fastener for damage that would weaken the fastener.

8. LUBRICANT USED
Enter the MIL-SPEC of the grease or oil used during reassembly.

9. SEALING SURFACE INSPECTION
Enter the results of the inspection performed. Inspect mating surfaces to ensure that they are not damaged or deformed. Ensure that o-ring contact surfaces are smooth and free from pits, score marks, or other defects.

10. GASKET/O-RING
Enter the Part Number(PN)/Navy Stock Number (NSN) and Commercial Standard/Military Specification (MIL-SPEC), quantity and expiration date for gasket/o-rings used from the packaging or supply documents at the job site.

11. PARTS REPLACED
Enter the PN/NSN and nomenclature of the new parts that were replaced from the packaging or supply documents at the job site.

[1] Fastners are defined as a component that has internal or external threading. This includes, but is not limited to bolts, screws, nuts, pipe fittings and electrical connectors. Threads shall be inspected for galling, cross threading and stripping.

CONTROLLED ASSEMBLY REPORT

12. PRECISION INSTRUMENT TYPE	SERIAL NO.	CALIBRATION DUE DATE
13. TORQUE DEVICE RANGE	SERIAL NO.	CALIBRATION DUE DATE
14. TORQUE SEQUENCE SKETCH/REQUIRED TORQUE/ACTUAL TORQUE		
15. TORQUE REFERENCE	16. THREAD PROTRUSION ( )SAT ( )UNSAT ( )N/A	
17. REMARKS		
18. TECHNICIAN SIGN PRINT _____ DATE	19. WITNESS SIGN PRINT _____ DATE	

CONTROLLED ASSEMBLY REPORT

12. PRECISION INSTRUMENT
Enter the type, serial number and calibration due date of the precision measurement instrument(s) used for critical measurements during assembly.

13. TORQUE DEVICE
Enter the range, serial number and calibration due date of the torque device used during assembly.

14. TORQUE SEQUENCE SKETCH/REQUIRED TORQUE/ACTUAL TORQUE
Enter a sketch of joint torque sequence used during joint reassembly when more than one fastener is utilized in the make up. Clearly label required/actual torque for each fastener. If there is no required torque, such as for National Pipe Thread (NPT) or Swagelok, enter wrench tight. The actual torque is the observed value on the torque device within 20% to 90% of full scale. If only one fastener is utilized, list required and actual torques without sketch. If required, running torque will be added to the required torque.

15. TORQUE REFERENCE
Enter the reference document from which the torque value was obtained.

16. THREAD PROTRUSION
Record SAT or UNSAT for the proper thread protrusion; if not a nut and bolt type joint enter N/A. Minimum thread protrusion is one thread for non-self locking fasteners.

17. REMARKS
Enter any general remarks or calculations pertaining to the joint reassembly/controlled assembly of the component.

18. TECHNICIAN
The DLSS Maintenance Technician will enter signature, printed name, and date after completing reassembly of the joint.

19. WITNESS
A second DLSS maintenance technician, or a DLSS REC Supervisor will be on the job site to witness the installation of new materials and the reassembly. The Witness will enter signature, printed name, and date after completing reassembly of the joint. The Witness is knowledgeable of the technical requirements of the work to be accomplished and is expected to offer guidance and instructions to the technician if necessary.

TEST AND INSPECTION REPORT: JOINT TIGHTNESS TEST

1. COMMAND/UNIT			2. REC NO.	REV
3. SYSTEM/COMPONENT			4. DESCRIPTION OF ITEM	
5. DURATION OF TEST			6. REQUIRED TEST PRESSURE (psig)	
7. JOINT NUMBER	8. SAT	UNSAT	9. SKETCH AND REMARKS	
10. TECHNICIAN SIGN PRINT _____ DATE			11. WITNESS SIGN PRINT _____ DATE	

PAGE __ OF _____

FIGURE 7

TEST AND INSPECTION REPORT: JOINT TIGHTNESS TEST

PROCEDURE
The numbered blocks on the Test and Inspection Report - Joint Tightness Test correspond with the instructions below. This form should be completed by the technician conducting the test/inspection and/or the supervisor verifying the test/inspection.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the DLSS.

2. REC NO.
Enter the Re-entry Control Number and Revision from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system and component identification to be breached. For commands with multiple DLSS (e.g. FADS II-3 / AHP-F-12, TRCS 001 / PG-F-2, LCM-8 / RV-V-3, YDT-15 / ALP-F-1, etc.). For commands with a single DLSS (e.g. CHAMBER OXYGEN / OX-LP-2, HP AIR / AHP-F-34, RECOMPRESSION CHAMBER / ALP-20, etc.).

4. DESCRIPTION OF ITEM
Enter the piece number or component description to be inspected or tested, (e.g., -3 CPV, Globe Valve, Tescom Regulator, etc.).

5. REQUIRED TEST PRESSURE
Enter the required pressure to recertify the joint to the "as built" condition.

6. DURATION OF TEST
Enter the time required to conduct the entire test. Example: the joint tightness test requirement is 15 minutes plus time to inspect, it takes 5 minutes to test, enter 20 minutes.

7. JOINT
Enter the Joint Identification (JID) number of the joint to be tested. Locally Assigned Joint identification numbers (LAJs) may be used to identify the joints breached. When using LAJs, use the following format: The REC number followed by the joint number (95-001-01 represents the first joint for REC 95-001).

8. SAT / UNSAT
Enter the results of the test. Acceptance criteria for joint tightness test using air or nitrogen as a test medium **shall** be zero leakage. Testing using HE as a test medium shall be 0.6 cc/minute (at standard temperature and pressure). This is identified by only small bubbles forming in the solution like foam but no bubbles large enough to be identified as an individual bubble with the naked eye.

9. SKETCH
Enter a sketch of the system or joint if required to help identify the proper JIDs for testing.

10. TECHNICIAN
The DLSS maintenance technician will enter signature, printed name, and date.

11. WITNESS
A second DLSS maintenance technician, or DLSS REC supervisor, will be on the job site to witness the testing and the results. The witness will enter signature, printed name, and date after observing the test or inspection.

TEST AND INSPECTION REPORT: VALVE SEAT TIGHTNESS TEST

1. COMMAND/UNIT		2. REC NO.		REV
3. SYSTEM/COMPONENT		4. DESCRIPTION OF ITEM		
5. TEST MEDIA (GAS)		6. REQUIRED TEST PRESSURE		
7. VALVE NUMBER	8. ACTUAL TEST PRESSURE	9. LEAKAGE RATE	10. SAT	UNSAT
11. REMARKS				
12. TECHNICIAN SIGN PRINT _____ DATE		13. WITNESS SIGN PRINT _____ DATE		

NOTE: Seat tightness test will be conducted for a minimum of 5 minutes.

PAGE __ OF _____

Figure 8

TEST AND INSPECTION REPORT: VALVE SEAT TIGHTNESS TEST

PROCEDURE
The numbered blocks on the Test and Inspection Report - Valve Seat Tightness Test correspond with the instructions below. This form should be completed by the technician conducting the test/inspection and/or the supervisor verifying test/inspection.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the DLSS.

2. REC NO.
Enter the Re-entry Control Number and Revision from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system (same as block 2 of the REC form, if applicable) and component identification to be breached. For commands with multiple DLSS (e.g. FADS II-3 / AHP-F-12, TRCS 001 / PG-F-2, LCM-8 / RV-V-3, YDT-15 / ALP-F-1, etc.). For commands with a single DLSS (e.g. CHAMBER OXYGEN / OX-LP-2, HP AIR / AHP-F-34, RECOMPRESSION CHAMBER / ALP-20, etc.).

4. DESCRIPTION OF ITEM
Enter the piece number or component description to be inspected or tested, (e.g. -3 CPV, Globe Valve, Tescom Regulator, etc.).

5. TEST MEDIA (GAS)
Enter the type of gas/liquid used for the test. Example: air, HE, nitrogen, water.

6. REQUIRED TEST PRESSURE
Enter the pressure required to test the seat.

7. VALVE NUMBER
Enter the valve number or noun name.

8. ACTUAL TEST PRESSURE
Enter the test pressure from the gauge used during the test. Test pressure shall be applied in the direction of the flow arrow. If a valve is bi-directional, test pressure shall be applied in both directions at separate times.

9. LEAKAGE RATE
Enter the leakage observed during the test.

10. SAT/UNSAT
Indicate whether the test is satisfactory or unsatisfactory. Acceptance criteria for seat tightness test using air or nitrogen as a test medium shall be zero leakage.

11. REMARKS
Enter any general remarks or calculations pertaining to the Valve Seat Tightness Test of the component.

12. TECHNICIAN
The DLSS Maintenance Technician will enter signature, printed name, and date after completing reassembly of the joint.

13. WITNESS
A second DLSS maintenance technician, or DLSS REC supervisor, will be on the job site to witness the testing and the results. The witness will enter signature, printed name, and date after observing the test or inspection.

TEST AND INSPECTION REPORT: HYDROSTATIC/PNEUMATIC TEST

1. COMMAND/UNIT	2. REC NO.	REV
3. SYSTEM/COMPONENT	4. DESCRIPTION OF ITEM	
5. TEST REFERENCE	6. REQUIRED TEST AND INSPECTION POINTS	
7. DIAGRAM OF TEST AREA INCLUDING GAGS, BLANKS INSTALLED AND VALVE POSITIONS		
8. DATE OF TEST	9. REQUIRED TEST PRESSURE (PSIG)	
10. ACTUAL TEST PRESSURE (PSIG)	11. TEST RESULTS ( ) SATISFACTORY ( ) UNSATISFACTORY	
12. REMARKS		
13. TECHNICIAN SIGN PRINT _____ DATE	14. WITNESS SIGN PRINT _____ DATE	

PAGE __ OF _____

Figure 9

TEST AND INSPECTION REPORT: HYDROSTATIC/PNEUMATIC TEST

PROCEDURE
The numbered blocks on the Test and Inspection Report: Hydrostatic/Pneumatic Test correspond with the instructions below. This form should be completed by the technician conducting the test/inspection and/or the supervisor verifying the test/inspection.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the DLSS.

2. REC NO.
Enter the Re-entry Control Number and Revision from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system (same as block 2 of REC form, if applicable) and component identification to be breached. For commands with multiple DLSS (e.g. FADS II-3 / AHP-F-12, TRCS 001 / PG-F-2, LCM-8 / RV-V-3, YDT-15 / ALP-F-1, etc.). For commands with a single DLSS (e.g. CHAMBER OXYGEN / OX-LP-2, HP AIR / AHP-F-34, RECOMPRESSION CHAMBER / ALP-20, etc.).

4. DESCRIPTION OF ITEM
Enter the piece number or component description to be inspected or tested, (e.g. -3 CPV, Globe Valve, Tescom Regulator, etc.).

5. TEST REFERENCE
Enter a the test reference and paragraph that describes the testing requirements. Example: Hydro in accordance with SS521-AA-MAN-010, para. B-9.5, Hydro in accordance with ASME B31.1, para 137.4.5.

6. REQUIRED TEST AND INSPECTION POINTS
Enter the specific test requirements, including inspection points, and test fluid necessary to recertify the work. Example: Hydro to 1.5 times maximum system operating pressure with grade B water, no leakage allowed at Locally Assigned Joint (LAJ) 95-001-02.

7. DIAGRAM OF TEST AREA
Enter a diagram of the test area. Be specific. Include such things as relief valve and gauge locations, blanks, gags, and valve positions, ect.. **ALL VALVES WITHIN THE TEST BOUNDARIES MUST BE IDENTIFIED AND THEIR POSITION (OPEN/SHUT) DURING THE TEST ANNOTATED.**

8. DATE OF TEST
Enter the date the test is conducted.

9. REQUIRED TEST PRESSURE (PSIG)
Enter the required test pressure and tolerances.

10. ACTUAL TEST PRESSURE
Enter the test pressure from the gauge used during the test.

11. TEST RESULTS
Enter an "X" in the appropriate box.

12. REMARKS
Enter any general remarks or calculations pertaining to the test of the component.

13. TECHNICIAN
The DLSS maintenance technician will enter signature, printed name, and date.

14. WITNESS
A second DLSS maintenance technician, or DLSS REC supervisor, will be on the job site to witness the testing and the results. The witness will enter signature, printed name, and date after observing the test or inspection.

TEST AND INSPECTION REPORT: SYSTEM DROP TEST

1. COMMAND/UNIT	2. REC NO.
3. SYSTEM/COMPONENT	4. DESCRIPTION OF ITEM
5. GAUGE RANGE	6. CALIBRATION DATE
7. DURATION OF TEST START TIME: _____ DATE STOP TIME: _____ DATE TOTAL HOURS:	8. ALLOWABLE SYSTEM PRESSURE DROP $\Delta P_{Allowable}$ = _____ psi

DROP TEST (for new construction, major overhaul or flask removal/installation);

a. Air systems above 1000 psig:	Duration = 24 hours	Allowable Drop = 1% of initial pressure
b. Air systems below 1000 psig:	Duration = 6 hours	Allowable Drop = 5% of initial pressure
c. Helium and HEOX systems:	Duration = 24 hours	Allowable Drop = 1 psi
d. Oxygen systems:	Duration = 24 hours	Allowable Drop = 1 psi

Extended Tightness Test (for Major work on a partial or modified portion of a previously tested system (not including flasks));

a. Air systems:	Duration = 90 min	Allowable Drop = 0 psi
b. Helium and HEOX systems:	Duration = 6 hours	Allowable Drop = 0 psi
c. Oxygen systems:	Duration = 6 hours	Allowable Drop = 0 psi

9. INITIAL PRESSURE P_1 = _____ psig + 14.7 = _____ psia	10. INITIAL TEMPERATURE T_1 = _____ °F + 460 = _____ °R
11. ACTUAL FINAL PRESSURE P_{Actual} = _____ psig + 14.7 = _____ psia	12. FINAL TEMPERATURE T_2 = _____ °F + 460 = _____ °R
13. CALCULATED FINAL PRESSURE $P_2 = \frac{P_1}{T_1} \times T_2$ = _____ psia	14. PRESSURE DROP $\Delta P = P_2 - P_{Actual}$ = _____ psi

15. TEST RESULTS

( ) SATISFACTORY $\Delta P \leq \Delta P_{Allowable}$

( ) UNSATISFACTORY $\Delta P > \Delta P_{Allowable}$

16. REMARKS

17. TECHNICIAN SIGN PRINT _____ DATE	18. WITNESS SIGN PRINT _____ DATE

PAGE ___ OF

FIGURE 10

TEST AND INSPECTION REPORT: SYSTEM DROP TEST

PROCEDURE
The numbered blocks on the Test and Inspection Report: System Drop Test correspond with the instructions below. This form should be completed by the technician conducting the test/inspection and/or the supervisor verifying the test/inspection.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the DLSS.

2. REC NO.
Enter the Re-entry Control Number from the Re-entry Control Form.

3. SYSTEM/COMPONENT
Enter the name of the system (same as block 2 of the REC form, if applicable) and component identification to be breached. For commands with multiple DLSS (e.g. FADS II-3 / AHP-F-12, TRCS 001 / PG-F-2, LCM-8 / RV-V-3, YDT-15 / ALP-F-1, etc.). For commands with a single DLSS (e.g. CHAMBER OXYGEN / OX-LP-2, HP AIR / AHP-F-34, RECOMPRESSION CHAMBER / ALP-20, etc.).

4. DESCRIPTION OF ITEM
Enter the piece number or component description to be inspected or tested, (e.g. -3 CPV, Globe Valve, Tescom Regulator, etc..).

5. GAUGE RANGE
Enter the range and divisional increments of the gauge used for testing.

6. CALIBRATION DATE
Enter the calibration date and due date from the gauge used in block 5.

7. DURATION OF TEST
Enter the time and date the test started and stopped, and the total hours of the test. Use the shaded area below block 7 for guidance on the required test duration for the system being tested.

8. ALLOWABLE SYSTEM PRESSURE DROP
Enter the allowable system pressure drop for the test. Use the shaded area below block 8 for guidance on the allowable pressure drop for the system being tested.

9. INITIAL PRESSURE
Enter the initial pressure gauge reading at the start of the test. Convert the gauge pressure reading to absolute units (psia) by adding 14.7 psi to equal P_1.

10. INITIAL TEMPERATURE
Enter the initial Fahrenheit temperature reading at the start of the test. Convert the temperature reading to absolute units (Rankine) by adding 460 degrees to equal T_1.

11. ACTUAL FINAL PRESSURE
Enter the final pressure gauge reading at the end of the test. Convert the gauge pressure reading to absolute units (psia) by adding 14.7 psi to equal P_{Actual}.

12. FINAL TEMPERATURE
Enter the final Fahrenheit temperature reading at the end of the test. Convert the temperature reading to absolute units (Rankine) by adding 460 degrees to equal T_2.

13. CALCULATED FINAL PRESSURE
Calculate the theoretical final pressure (P_2) using the following formula:

$$P_2 = \frac{P_1}{T_1} \times T_2$$

14. PRESSURE DROP
Determine the system pressure drop by subtracting the actual final pressure (P_{Actual}) from the calculated pressure (P_2) as follows:

$$\Delta P = P_2 - P_{Actual}$$

15. TEST RESULTS
Indicate the results of the System Drop Test. If the pressure drop from block 14 is less than or equal to the allowable system pressure drop in block 8, the test results are satisfactory. If the pressure drop from block 14 is greater than the allowable system pressure drop in block 8, the test results are unsatisfactory.

16. REMARKS
Enter the test media and any general remarks or calculations pertaining to the system drop test.

17. TECHNICIAN
The DLSS Maintenance Technician will enter signature, printed name, and date after completing reassembly of the joint.

18. WITNESS
A second DLSS maintenance technician, or DLSS REC supervisor will be on the job site to witness the testing and results. The witness will enter signature, printed name, and date after observing the test or inspection.

DEPARTURE FROM SPECIFICATIONS LOG

1. DFS NO.	2. SCA	3. SYSTEM/COMPONENT	4. DATE ISSUED	5. DATE CLEARED	6. TYPE OF NON-COMPLIANCE		7. DEGREE OF NON-COMPLIANCE
					MAJOR	MINOR	

FIGURE 11

DEPARTURE FROM SPECIFICATIONS LOG

PROCEDURE
The numbered blocks on the Departure from Specifications Log correspond with the instructions below, and will be entered by the Master Diver/Diving Supervisor and audited for accuracy by the Diving Officer Quarterly. When a system is to be returned to the depot or transferred to another activity this log and all DSFs will accompany the system.

1. DFS NO.
Enter the DFS number. The DFS number will consist of a unique sequential number a hyphen and the last two digits of the year. EXAMPLE: 95-01

2. SCA
Enter the appropriate SCA. NAVSEA or NAVFAC

3. SYSTEM/COMPONENT
Enter the noun name of the system effected and the component.

4. DATE ISSUED
Enter the date that the DSF number is issued from the DSF Log.

5. DATE CLEARED
Enter the date the DFS is completed and returning the system to its "as built" condition. This could be after a upkeep or over haul to repair the DFS.

6. TYPE OF NON-COMPLIANCE
Enter the type of DFS. MAJOR or MINOR.
MAJOR - A DFS which affects performance; durability; reliability or maintainability; interchange-ability; effective use or operation; weight or appearance (where a factor); health or safety; system design parameters such as schematics, flow, pressures or temperatures; or component arrangements or assigned function. Major DFSs require SCA approval. EXAMPLE: (1) Wall thickness reduction below the minimum acceptable specification. (2) Repairs, material replacements and maintenance which do not meet specification within the SOC in accordance with the "As Built" drawings, parts list or technical manuals.
MINOR - Requires Commanding Officer approval. These include any departure:
a. Which could be considered a Major DFS except for the fact that specific and definite SCA guidance is available based on documented action for another identical (same component, same application) DFS.
b. For any permanent repair of systems not resulting in a change in configuration to a system or component not involved in unit or personnel safety or not involving integrity or operability of equipment essential to the DLSS. EXAMPLE: (1) Installation of a substitute software. (2) Incorrect torque values.

7. DEGREE OF NON-COMPLIANCE
Enter what the actual condition is. Enter sufficient information to describe the degree of non- compliance (Example: Diameter of window cavity is greater than maximum specs., Volume tank wall thickness is less than min. specs.).

DEPARTURE FROM SPECIFICATIONS REPORT

1. COMMAND/UNIT	2. SYSTEM/COMPONENT
3. DFS NO.	4. SYSTEM CERTIFICATION AUTHORITY POC ( )NAVSEA ( )NAVFAC NAME/CODE:
5a. TYPE ( )MAJOR ( )MINOR	5b. DEGREE OF NON-COMPLIANCE
6. APPLICABLE SPECIFICATIONS	
7. DRAWINGS/REFERENCES	
8. COMMENTS/RECOMMENDATIONS (TEST CONDUCTED, AFFECTED SYSTEMS)	
9. MASTER DIVER/SENIOR DIVING SUPERVISOR SIGN PRINT _____ DATE	10. DIVING OFFICER SIGN PRINT _____ DATE
11a. CO APPROVAL/DISAPPROVAL AND REMARKS THIS DEPARTURE FROM SPECIFICATIONS IS: **APPROVED** / **DISAPPROVED**. (CIRCLE ONE) REMARKS:	
11b. CO SIGNATURE SIGN _____ DATE PRINT	
12a. SYSCOM TECHNICAL AUTHORITY APPROVAL/DISAPPROVAL AND REMARKS THIS DEPARTURE FROM SPECIFICATIONS IS: **APPROVED** / **DISAPPROVED**. (CIRCLE ONE) REMARKS:	
12b. TECHNICAL AUTHORITY SIGNATURE SIGN _____ DATE SCA CONCURRENCE SIGN _____ DATE PRINT	

PAGE _____ OF _____

Figure 12

REQUEST FOR DEPARTURE FROM SPECIFICATIONS REPORT

GENERAL ADMINISTRATIVE REQUIREMENTS
All DFS must be reported and controlled. Each activity must have an auditing system for reporting and controlling DFS until it is approved or cleared.
When the DFS is approved as a temporary repair requiring rework to correct the discrepancy, a method of tracking for correction of the discrepant condition will be initiated by the unit, referencing the DFS sequential number.
Each command shall review all DFS reports prior to each upkeep to establish IMA/shipyard work requirements to clear DFS.
Those departures for a change in configuration which the SCA accepts as a permanent repair will be maintained in a file arranged by systems, until reflected in the system's drawings.

PROCEDURE
The numbered blocks on the Departure from Specifications Report correspond with the instructions below, and will be entered by the Master Diver/Diving Supervisor and reviewed by the Diving Officer.

1. COMMAND/UNIT
Enter the name of the COMMAND/UNIT that has custody of the system.

2. SYSTEM/COMPONENT
Enter the name of the affected system and the component.

3. DFS NO.
Enter the Departure From Specification (DFS) number obtained from the Departure From Specification Log.

4. SYSTEM CERTIFICATION AUTHORITY POC
Enter the name and code of the SCA representative whom the command has contacted by phone and check the appropriate SCA command, NAVSEA or NAVFAC.

5.a. TYPE
Check the appropriate type of departure, Major or Minor
MAJOR - A DFS which affects performance; durability; reliability or maintainability; interchangeability; effective use or operation; weight or appearance (where a factor); health or safety; system design parameters such as schematics, flow, pressures or temperatures; or component arrangements or assigned function. Major DFSs require SCA and CO approval. Examples of major DFSs would be wall thickness reduction below the minimum acceptable specification, or repairs or material replacements and maintenance which do not meet specification within the SOC in accordance with the "As Built" drawings, parts list or technical manuals.
MINOR - Requires CO approval only. These include any departure which could be considered a Major DFS except for the fact that specific and definite SCA guidance is available based on documented action for another identical (same component, same application) DFS. Minor DFSs would also include any permanent repair of systems not resulting in a change in configuration to a system or component not involved in unit or personnel safety or not involving integrity or operability of equipment essential to the DLSS. Examples of minor DFSs would be the installation of a substitute software, or the incorrect torque values. Enter what the actual condition is and include sketches, drawings, QA forms, etc., if they clarify the description of the non-conforming condition.

NOTE: If a question exists concerning the type of Departure From Specifications which applies to a given situation, contact the SCA prior to submission of this report.

5.b. DEGREE OF NON-COMPLIANCE
Describe in detail which specifications (e.g., dimensions, material, manufacturer, etc.) do not comply with the system drawings. State the specification required by the drawing and also the specifications to be used. Attach drawings/sketches as required to describe the degree of non-compliance.

6. APPLICABLE SPECIFICATIONS
Fully explain the specifications which were not met. Enter the reference which provided the specification and the applicable specifications which were not met and include the joint number or part applicable. EXAMPLE: Sheet 2 of 4 of block 8 states maximum o-ring groove depth is .075 for joint identification number (JID) 132.

7. DRAWING/REFERENCES
Enter the drawing number that shows the component or system on which the DFS is initiated and/or the technical manual that describes the applicable specification.

8. COMMENTS/RECOMMENDATIONS (TEST CONDUCTED, AFFECTED SYSTEMS)
Enter comments/recommendations pertinent to the job. The comments will include recommendations and technical justification for **approval** of the DFS. Enter tests conducted and the results, SAT or UNSAT. Include any other information which will aid in determining a final disposition.

9. MASTER DIVER/SENIOR DIVE SUPERVISOR
Enter the printed name, signature and date the Master Diver/Senior Dive Supervisor verified that the technical information on this form is accurate.

10. DIVING OFFICER
Enter the printed name, signature and date the Diving Officer verified completeness of this form.

11.a. CO APPROVAL/DISAPPROVAL AND REMARKS
The CO, or designated authority, will acknowledge the receipt of the DFS report and issue directions (approved/disapproved). This block will contain a positive statement for clearance of the DFS (e. g. approved as a temporary repair, to be restored to specifications during next refit).

11.b. CO SIGNATURE
The Commanding Officer/designated representative will enter printed name, signature, title or code and date.

12.a. SYSCOM TECHNICAL AUTHORITY
The SCA will acknowledge the receipt of the DFS report and issue directions (approved/disapproved). This block will contain a positive statement for clearance of the DFS (e. g. approved as a temporary repair, to be restored to specifications during next refit).

12.b. TECHNICAL AUTHORITY SIGNATURE/SCA CONCURRENCE
The appropriate SYSCOM (NAVFAC or NAVSEA) Technical Authority/designated representative will enter printed name, signature, title or code and date on the appropriate line. The SCA shall then enter the same information in the concurrence line below.

APPENDIX B

OBJECTIVE QUALITY EVIDENCE

B-1 Introduction

When repairing or replacing equipment within the SOC, or constructing new systems, the SCA requires documentation, or Objective Quality Evidence (OQE), that verifies the proper materials, tests and procedures were used in completing the work. The OQE may be supplied by the equipment vendors or the activity receiving the material and/or the activity installing the material. However, it is the responsibility of the activity presenting the system for certification (the applicant) to ensure that all of the required OQE is available to the SCA during certification surveys.

B-2 Pre-Fabrication OQE

The attributes described below should be accomplished prior to system fabrication or component/material installation.

a. Manufacturing Material Identification - Retain material mfg/ vendor/ supply/ receipt inspection documents (e.g., O-ring package, Navy supply system material receipt (NAVSUP Form 1250), vendor certificate of conformance) in the REC package. If not required in the REC package, material receipts from the supply system or component vendor shall be retained in a central location. See contract documents for identification of REC package requirements.

b. Mechanic Material Verification - The installing mechanic (or QA Inspector) shall document (by mfg P/N and/or MIL-SPEC and/or FSN, as applicable) material which is being installed and which drawing or technical manual calls out the material being installed. The mechanic or inspector shall sign and date a document that indicates the installation of the proper material. This action must be performed at the time the material is installed.

c. Chemical Composition - Quantitative analysis showing that the chemical composition of a material is within acceptable limits defined in the specification. This verification shall normally be provided by MIC level I certification or by an authorized materials laboratory.

d. Physical Properties - Quantitative analysis showing that the physical properties of a material are within acceptable limits defined in the specification. This verification shall normally be provided by MIC level I certification or by an authorized materials laboratory.

e. Dimensional Verification - Verification that dimensions of actual material complies with approved system or manufacturer’s drawings as applicable. This

verification should be performed during receipt inspection or prior to installation of the material in the system.

B-3 Fabrication OQE

The attributes described below shall be accomplished at the time of production work.

a. Controlled Work Procedure - Step by step procedures to be followed for removal, disassembly, repair, reinstallation (or in-kind replacement) and testing of components. These procedures must reference all drawings, technical manuals, test memos and other documentation required to be followed during fabrication and testing. If formal repair procedures already exist (e.g. MRC Card or equipment technical manual), a statement, signed by the person performing the work or the responsible QA inspector, that those repair procedures were followed is acceptable.

b. Mechanical/Weld/Braze Connection Assembly Records – Verification that welded/brazed piping joints and mechanical assembly connections (e.g. shaft couplings, gear trains, etc.) are fit-up and assembled in accordance with manufacturer's specifications, Naval Ships' Technical Manual and/or system drawing/technical manual requirements.

c. Weld/Braze Procedure/Qualification Records - Verification that weld/braze procedures used have been approved by NAVSEA, NAVFAC or their designated representative (as appropriate). Also, verification of welder/brazer qualification records showing that persons performing these operations are qualified in the procedure for the metals being joined.

d. Mechanical Joint Torque - Verification showing that the actual mechanical joint torque is within the specifications called out in drawings and other technical documents (NAVSEA S9086-RK-STM-010/CH-505, Naval Ships' Technical Manual Chapter 505, provides instructions for torquing of union joints). This verification must include calibration data and the serial number for the measuring device.

e. Cable Fabrication Qualification - Verification that all personnel who fabricate load-bearing cable for a man-rated weight handling system are qualified to NSTM Chapter 613.

B-4 Post-Fabrication OQE

The attributes described below shall be accomplished after production work is completed.

*NOTE: The test pressures, durations, and performance criteria provided below and indicated with an asterisk are the typical industry and NAVSEA requirements. In some cases the test pressures, durations, and performance requirements may be changed to meet other acceptable industry standards as allowed by the GENSPECS. In these

cases the requirements must be agreed upon, in writing with SCA concurrence during the design phase and prior testing.

a. Nondestructive Testing (NDT) Documentation - Actual NDT documentation and verification of satisfactory results. NDT inspector qualification records must be available for review. NDT requirements shall be adhered to when required by system drawings, technical manuals and/or applicable fabrication specification. This must include calibration data and serial number for NDT devices, when required. The specific NDT method shall normally be specified by the applicable system drawings or MIL-STD.

b. Cleanliness Verification - Quantitative analysis showing that cleanliness levels are acceptable. System drawings should always state cleanliness requirement. In general, diving and hyperbaric life support systems must meet the requirements of MIL-STD-1330 or MIL-STD-1622 and hydraulic systems must meet the requirements of MIL-STD-419 and/or NAS 1638. The fabrication/repair activity must develop formal cleaning procedures, using the above specifications as a basis, and submit their procedures to NAVSEA or NAVFAC (as appropriate) for approval. The fabrication/repair activity also has the option of using currently approved procedures developed by other activities. However, specific approval from NAVSEA or NAVFAC must still be obtained by the activity desiring to use the procedure.

c. Continuity Verification - Readings verifying that an electrical circuit is not open and that components are connected properly in the circuit. The individual system technical documentation should specify the maximum continuity resistance. This verification must include calibration data and serial number for the measuring device.

d. Insulation Resistance - Readings verifying that the insulation resistance of an electrical component or system wiring is within acceptable limits. The individual system technical documentation should specify the minimum insulation resistance. This verification must include calibration data and serial number for the measuring device.

e. Hydrostatic Strength Test * - Verification that a strength test to 150% of maximum operating pressure, using a compatible incompressible fluid, has been satisfactorily conducted. Hydrostatic tests conducted on components prior to installation in the system shall have a duration of at least 5 minutes. Hydrostatic tests of components after installation in the system shall have a duration of at least 15 minutes, followed by time to inspect each component and joint for external leakage and deformation. Acceptance criteria for hydrostatic testing are zero leakage and no permanent deformation. Flexible hose assemblies shall be tested to 200% (Metal PTFE and Thermoplastic hose shall be tested to 150%) of maximum operating pressure and are subjected to special hydrostatic test and inspection criteria in accordance with NAVSEA S6430-AE-TED-010 or applicable Preventive Maintenance System requirements. System gas flasks manufactured IAW MIL-F-22606 shall be hydrostatically tested to 167% of maximum system operating pressure. Other non-DOT or MIL-F-22606 flasks may require different flask testing requirements. Test

documentation must include calibration data and serial number for the measuring device.

f. Joint Tightness Test * - Verification that a mechanical joint tightness test using system fluid (except in O_2 systems where N_2 shall be used, or in HeO_2 systems where He shall be used as a test medium) has been conducted on all mechanical joints to 100% of the maximum operating pressure. Joint tightness tests conducted on components prior to installation in the system shall have a duration of at least 5 minutes. Joint tightness tests of components after installation in the system shall have a duration of at least 15 minutes followed by time to inspect each mechanical joint. Acceptance criterion is zero leakage for all systems, except when helium is used as a test medium (allowable leakage when using helium is 0.6 cc/minute) unless otherwise stated in system drawings. Verification must include calibration data and serial number for the measuring device.

g. Seat Tightness Test * - Verification that isolation valves actually seal against system pressure. The acceptance criterion for seat tightness tests is the same as for joint tightness tests. Test pressure shall always be 100% of maximum operating pressure and shall be applied for a minimum of 5 minutes using system fluid (except in O_2 systems where N_2 shall be used and in HeO_2 systems where He shall be used as a test medium). Pressure is always applied at the component inlet port(s) in the direction of the valve flow arrow (except check valves that are seat tightness tested in the opposite direction as the flow arrow). For valves without flow arrows (bi-directional), pressure must be applied from each port of the valve at separate times. Verification must include calibration data and serial number for the measuring device.

h. Relief Valve Pressure Setting - Verification that system relief valves have been set in accordance with system drawing requirements. Both the relief valve cracking pressure and reseat pressure shall be recorded. Verification must include calibration data and serial number for the measuring device.

i. Flow Rate/Efficiency Test - System flow rate tests are required to verify that system pressure regulators and/or modified piping systems can achieve their required flow rates at system operating pressure. Compressor efficiency tests are required to verify that new or rebuilt compressors can deliver an adequate supply of air/gas to meet system requirements. Verification must include calibration data and serial number for the measuring device.

j. Pressure Drop * - Pressure Drop tests are only required when major work has been accomplished on an entire system. An entire system is defined as removal/ installation of the system gas flasks or fabrication of 10 or more welded, brazed and/or mechanical joints or the installation of a new system, which does not contain gas flasks. Pressure Drop testing shall be conducted at 100% of operating system pressure.

(1) Following major repairs on all dive systems and recompression chamber compressed gas systems, the acceptance criteria for a Pressure Drop test are as follows:

(a) Compressed air/exhaust systems less than 1,000 psi: a 6-hour pressure drop test with an allowable pressure drop of 5 percent of the test pressure (corrected for temperature) is required to be satisfactorily completed on the entire system.

(b) Compressed air/exhaust systems 1,000 psi or greater: a 24-hour pressure drop test with an allowable pressure drop of 1 percent of the test pressure (corrected for temperature) is required to be satisfactorily completed on the entire system.

(c) Oxygen/Helium/Mixed Gas compressed gas systems: a 24-hour pressure drop test with an allowable pressure drop of 1% of test pressure (corrected for temperature) is required for an entire system.

k. Extended Tightness Test * - Extended system tightness tests are required only when major work has been accomplished on a partial or modified system. Major work on a partial or modified system is defined as disturbing one or more welded/brazed joint or ten or more mechanical joints in an existing system, but where the gas flasks have not been removed, or where the gas flasks have been removed and fewer than 10 mechanical joints have been disturbed. When fewer than 10 mechanical joints are disturbed in an existing system the scope of work is considered minor. The criteria for testing minor work shall be the same as “Joint Tightness Testing.” The exception to this rule is when gas flasks are installed in a saturation gas diving system; 24 hours for pressure drop/extended tightness testing are required regardless of the number of joints affected. Extended Tightness Testing shall be conducted at 100% of operating system pressure.

(1) Following major repairs on all dive systems and recompression chamber compressed gas systems, the acceptance criteria for an Extended Tightness Test are as follows:

(a) Compressed air/exhaust systems for all systems: a 90-minute extended tightness test, with no leakage allowed (corrected for temperature), is required to be satisfactorily completed on the partial or modified system.

(b) Oxygen/Helium/Mixed Gas compressed gas systems: a 6 hour extended tightness test with no leakage allowed (corrected for temperature) is required for a partial or modified system.

NOTE: Prior to starting any pressure drop or extended tightness test, the temperature of the system piping must be allowed to stabilize. Test documentation shall include calibration data for test instrumentation. Test results shall show the correction for temperature changes in the piping system.

Table B-1 *. Acceptance Criteria for Joint Tightness, Extended Tightness, and Drop Tests

TEST	DURATION	Criteria
Joint Tightness		
- Shop test	5 min	0 Leakage
- Installed test (soak time)	15 min	0 Leakage
- When He is test medium	15 min	0.6 cc/min
Extended Tightness		
- Air Systems	90 min	0% Drop
- O2/He Systems	6-hr	0% Drop
Drop Test		
- Air Systems < 1,000 psi	6-hr	5% Drop
- Air Systems > 1,000 psi	24-hr	1% Drop
- O2, He, He/O2 Systems	24-hr	1% Drop

l. Gaseous Contaminants Verification - Commonly referred to as bomb or gas sampling. Verification that a compartment (e.g., recompression chamber) or life support gas system is free of contaminants that are harmful to the operators or occupants. The type of work accomplished on the system determines what contaminants the gas sample is examined for. Upon completion of repairs on an air compressor (involving the removal of the compressor heads), a gas sample is inspected for hydrocarbons and particulates. Upon completion of repairs and interior painting of a compression chamber, a gas sample is examined for off-gassing paint and cleaning solution contaminants. Upon completion of repairs and/or hydrostatic testing of any system gas flasks, gas samples shall be inspected for residual cleaning/hydrotest solution, hydrocarbons and particulates. If piping systems have been cleaned, the entire piping system shall be examined for off-gassing cleaning solution, hydrocarbons and particulates. When the system or compartment being sampled comprises a portion of a saturation diving system, an extensive and formalized gas sampling program shall be sent to the SCA for review and approval. Gas samples shall be taken in accordance with approved NAVSEA instructions and the system from which the samples are obtained shall normally be pressurized for 24 hours prior to obtaining the sample. The exception to this requirement is examining an air/gas compressor discharge after repairs.

m. Implosion/External Leakage Test * - Verification that hard piping and non-pressure compensated mechanical and electrical components, which may be subjected to greater external than internal pressure during system operation, have been satisfactorily tested to ensure that they are acceptable for use. Acceptance criteria for non-pressure compensated components and submerged electrical cable is nine cycles to 150% of full submergence pressure, held for 10 minutes at depth and one cycle to 150% of full submergence pressure held for one hour at depth with no leakage or deformation. Verification must include calibration data and serial number for the measuring device.

n. Operational Test - Verification that the replaced or repaired component operates correctly and that the system parameters (e.g., pressure, temperature, amperage, voltage, etc.) are within acceptable operating ranges. This verification includes ensuring that rotating machinery is turning in the proper direction.

o. Static Load Test * - Verification that a weight handling system can hold 200% of its maximum rated load. Acceptance criteria are no slippage of the load and no cracks or permanent deformation in the load bearing members. For testing of load bearing cables, the static load test and inspection criteria shall be in accordance with NSTM Chapter 613.

p. Dynamic Load Test * - Verification that a weight handling system can raise and lower 150% of system rated load. This test need not be performed at rated speed of the system. Acceptance criterion is the smooth, controlled raising and lowering of the weight handling system with no binding, deformation or cracks in the structural load bearing members.

q. Rated Load Test * - Verification that a weight handling system can raise and lower 100% of its rated load at its maximum rated speed. The acceptance criterion is raising and lowering at maximum rated speed.

NOTE: When new components are installed due to system configuration changes or SHIPALTs, additional material OQE may be required by the SCA. The SCA shall be notified by the applicant of all system configuration changes within the Scope of Certification. The SCA shall then specify any additional material OQE, if any, to be documented when installing new equipment procured as a result of these configuration changes.

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APPENDIX C

DESIGN GUIDELINES FOR DIVER HANDLING SYSTEMS

C-1 Introduction

Diver Handling Systems include any weight handling systems that are used to launch and recover divers through the air/sea interface from a support ship. Inspection and load testing requirements apply to diver handling operations and should not be used for general crane applications. The user should use Naval Ships' Technical Manual Chapter 589, Cranes, for general crane requirements. Diver Handling Systems may consist of a simple block and tackle arrangement, using a davit and capstan to raise and lower a diver stage, or may consist of a complex A-frame system that is used to launch and recover manned tethered underwater vehicles, such as the Pressurized Rescue Module (PRM). It is therefore prudent for the Acquisition Manager to discuss the certification requirements that are specific to the handling system with the SCA.

a. This appendix contains certification parameters for handling systems employed in the launch and recovery of manned Diving Systems from support ships. The methods of design and fabrication are discussed, and their required verification OQE is identified. Preventive maintenance documentation, which is influenced by, and evolved from the basic design concepts as well as operational documentation, is also outlined.

b. Diving System handling equipment to be certified under these requirements includes, but is not limited to, cranes, booms, davits, and A-frames; plus their associated winching and rigging components. Hydraulic, electrical, and pneumatic subsystems are also considered part of the handling system.

c. All critical items, as defined in paragraph C-2.b, shall be included in the SOC. The SOC will also contain all items necessary to ensure compliance with the objective and intent of certification as described in Chapter 1.

d. Weight handling components are typically included within the SOC for the Diving System. When the weight handling system is portable, it must be included within the SOC for each diving system it will be used to support.

C-2 Definitions

a. Added Mass Effect. The mass of water particles surrounding an object immersed in water that is accelerated with the object as the object is accelerated through the water. When a body is accelerated in a fluid, it behaves as though its mass is greater than it actually is due to the effect of the surrounding fluid. This additional mass must be added to the actual body mass to account for the change in inertia.

b. Critical Item. Any item within a system, equipment, or component whose failure would endanger the occupants of the Diving System. These failures may include uncontrolled dropping, shifting, or other sudden movement of the Diving System when it is supported by the handling system.

c. Design Load. The maximum force due to the rated load plus some or all of the following: (1) added mass effects, (2) entrained water, (3) any external payloads, (4) drag or wind loads, and (5) dynamic loads which are derived with the aid of the dynamic load factor.

d. Dynamic Load. The load imposed on a system due to accelerations of gravity and ship motion. It is dependent upon the magnitude and frequency of ship motions, ship attitude, and the location of the handling system on the ship.

e. Dynamic Load Factor. A calculated number given in acceleration units, g, where 1g is the acceleration of gravity. The force exerted by the system on its supports is determined by multiplying the dynamic load factor by the weight of the system.

f. Fail-safe. Components within the handling system that are designed to prevent uncontrolled dropping, shifting, or sudden movement of the Diving System during a hydraulic or electrical system failure or component/equipment malfunction.

g. Handling System. The mechanical, electrical, structural equipment and rigging used on board a support ship to launch and recover divers or a manned Diving System.

(1) Load Bearing. Those components of the handling system that support the loads resulting from launching and recovering of a manned Diving System.

(2) Load Controlling. Those components of the handling system that position, restrain, or control the movement of a manned Diving System. Towing is excluded from the SOC.

h. Operational Load. The maximum weight that will be lifted during diver handling operations. This is normally the weight of the stage plus three fully dressed divers.

i. Rated Load. The maximum weight that may be lifted by the assembled handling system at its rated speed and under parameters specified in the equipment specifications (e.g., hydraulic pressures, electrical current, electrical voltages, etc.).

j. Rigging. Running rigging consists of the rope (wire rope or synthetic line) and end fittings intended to handle the Diving System that passes over sheaves or through rollers. Standing rigging is rope that is stationary and provides mechanical support to the handling system.

k. Static Test Load. A weight equal to 200 percent of the Operational Load of the handling system. It is used to physically verify the structural integrity of the handling system, and the adequacy of its brakes and fail-safe components.

l. Support Ship. Any platform used to transport, launch, and retrieve a Diving System. Ships, boats, vessels, barges, and submarines are included in this definition. An example of a submarine support platform is one modified to carry a Dry Deck Shelter for operations with Swimmer Delivery Vehicles.

C-3 Design Criteria and Guidelines

C-3.1 Equipment Design Criteria

This section provides guidelines and criteria for the design and analysis of Diver Handling System components and associated structures within the SOC. Alternatively, the Acquisition Manager may elect to impose commercial design criteria administered by the American Bureau of Shipping (ABS). If the ABS Rules are used, the Acquisition Manager must obtain initial certification for the handling system from ABS. Once ABS certification is obtained, the Acquisition Manager shall use ABS to conduct periodic surveys. When ABS is used to certify the handling system, the Acquisition Manager shall include the SCA in all design reviews to ensure that all issues concerning interfacing with the diving system are accounted for. The Acquisition Manager is cautioned that after commercial certification to commercial standards has been achieved, it may not be possible to revert to using the criteria in this manual to recertify the system under U.S. Navy requirements.

C-3.1.1 Types of Loads

The initial step in designing any handling system is to determine the design load that the system will encounter. The design load is derived from a combination of forces under worst-case operating conditions. Components should be sized according to the greatest design load, or combination of loadings that will be encountered. The following loads and forces should be considered when designing Diver Handling Systems:

a. Asymmetric loads. When sizing structural members for handling systems that employ more than one load carrying member to support their payload, consideration should be given to factors which might cause asymmetric loading. Such factors affecting the Diving System that would result in asymmetric loading include, but are not limited to, the following: external water, free surface effects in the internal tanks, a shift in ballast, and external payloads.

b. Dynamic loads. In addition to the load generated by lifting the normal rated capacity of the handling system, dynamic forces due to wave induced motions on the support vessel must also be considered. Analysis should be conducted in accordance with DOD-STD-1399, Section 301A or equivalent, unless support vessel motions are known. If support vessel motions have been measured at sea, or have been determined through the application of proven computer programs, the results can be used in lieu of DOD-STD-1399, Section 301A.

c. Dead loads. The minimum dead load consists of the weight of the structural parts of the Diver Handling System and materials permanently attached to the structure.

d. Wind Forces. The wind loads on the projected area of the handling system structure and on the Diving System, appropriate to the design conditions, are to be considered.

e. Maximum Forces. Structural members are to be sized using the appropriate loads and factors of safety. The general requirements in applying factors of safety to all U.S. Navy weight handling systems that perform manned lifts are presented in paragraph C-4.1.1.1 and Table C-1.

C-3.1.2 Environmental Considerations

Diver Handling Systems are subjected to extremely harsh and powerful environmental factors that significantly impact the operational and maintenance characteristics of the system. Environmental factors which should be considered in the system design parameters are sea state, air temperature, water temperature, precipitation (rain and snow), ice, wind velocity, currents, and the corrosive affects of the salt water environment.

C-3.1.2.1 Sea State

For the operational sea state specified, the uppermost value for the wave heights of the significant wave or the 1/10th highest wave should be taken as the design wave. The period of maximum energy of the sea spectrum should be chosen as the design period.

C-3.1.2.2 Air and Water Temperature

The maximum and minimum design operating temperatures of both the air and water must be taken into account during handling system design. This is particularly important for hydraulic systems where hydraulic fluid may become too viscous in extreme cold or lose its lubricating properties in extreme heat. Additionally, extremely cold air temperatures may affect the ductility of some metals and render structural members unsafe if not adequately designed.

C-3.1.2.3 Precipitation

The effect of rain, snow, sleet and ice can be dramatic on topside equipment not designed for it. Electrical connectors, junction boxes and motors that are not rated for harsh outside environments often fail in shipboard service. All pivoting or sliding load bearing surfaces should either be sealed from the weather or be designed to permit thorough inspections and be provided with an adequate number of lubrication fittings. Waterproof grease is required for these applications. Also, steels must have a protective coating of paint designed for a salt air environment.

C-3.1.2.4 Wind Velocity

Side loads may be induced in the handling system by high winds. This loading may be significant if either the Diving System or the handling system itself has a large surface area. The prudent designer will account for possible wind related effects in the system design.

C-3.1.2.5 Ocean Currents

In the same manner that wind affects the handling system topside, ocean currents affect any submerged components of the Diving System. Drag effects caused by ocean currents may be significant depending on the geometry of the Diving System and/or any submerged portions of the handling system. Drag effects must be taken into account in the design of the handling system.

C-3.1.2.6 Corrosion

Each component should be carefully reviewed for its susceptibility to corrosion, with special attention given to those components immersed in salt water. Furthermore, care should be taken to avoid galvanic corrosion when several different kinds of metals are in physical contact. Galvanic series charts or tables should be consulted when utilizing dissimilar metals.

C-3.1.3 System Considerations

The operation of the handling system is an integral part of the total Diving System, and as such, is limited by the coordination of personnel on deck and interface of the Diving System, handling system, and support vessel. For safe and efficient launch and recovery evolutions, the following items must be considered when developing a Diver Handling System:

a. Positive Control. The motion of the Diving System during launch and recovery operations must be under positive control at all times.

b. Fail-Safe. A provision designed to automatically stop or safely control any motion when a hydraulic or electrical failure occurs. The Diver Handling System shall be provided with interlocks, safety devices, and protective devices so that it will be fail-safe.

c. Motion effects. The physical location of the handling system on board the support ship should be such that the effects of the ship's motions on the Diving System during handling evolutions are minimized.

d. Weight. The weight of the Diver Handling System should be minimized to limit the weight added to the support vessel and the adverse effects on its sea keeping ability.

e. Shock mitigation. Dynamic motions of the support ship at-sea can cause shock loads to the Diving System and its personnel through the handling system. Motion compensating devices shall be considered to minimize these shock loads.

C-3.2 Human Engineering and Operational Design Considerations

Diver Handling Systems are designed to transport personnel in a restricted and hazardous environment under the direct supervision and control of support personnel. A human engineering evaluation should be conducted to ensure the ability of support personnel to control and supervise the safe and coordinated movement of the Diving System. The following are some critical areas that should be addressed in the evaluation:

a. Hazardous exposure. Due to the nature of handling system operations, some evolutions will be inherently hazardous. However, hazards should be eliminated whenever possible. There should be a minimum of support personnel exposed to hazardous operations during handling evolutions. There should be minimal diver/swimmer involvement during launch and recovery of the Diving System.

b. Coordination and control. Safe and timely operation of handling systems requires precise control and coordination of all personnel involved. The system arrangement should facilitate simplicity and require minimal supervision to attain this goal.

c. Communication. In addition, there must be clear communications between Diving System handling support personnel, the support ship personnel responsible for maneuvering the ship and the Diving Supervisor.

d. Monitoring equipment status. Control and support personnel responsible for the operation of the handling system should have access to monitoring devices to enable them to evaluate the status of the equipment. This is to ensure the system is operating within its capability limits (e.g., speed, load, pressure, temperature, etc.). These factors, along with the observed sea state, can then be evaluated to determine their effect on the operating parameters of the Diving System.

e. Manning. Minimizing the number of personnel required to operate and maintain the system should be considered.

C-3.2.1 Emergency Conditions and Reduced Operating Capability

The Diver Handling System shall be designed to minimize the effects of component failures. To identify and define the failures, and to determine how to resolve them, a hazard analysis shall be performed in accordance with MIL-STD-882, System Safety Program Requirements, or an approved industrial standard. The system hazard analysis can also be used to evaluate the system's capability to continue to operate and safely recover Diving System personnel. All handling system components shall be operable in sea states specified by the mission profile. In the event of a control console failure, an alternate or backup means of system operation is required.

C-4 Design and Testing Requirements

a. NAVSEA design and testing requirements of Diver Handling Systems shall be met as stated in this section. Alternatively, the Acquisition Manager may elect to impose commercial design and testing criteria administered by ABS. However, the use of ABS and ABS standards must be negotiated with and concurred with by the SCA and the NAVSEA Technical Authority for Handling Systems. Any additional OQE requirements shall be included in the Contract Work Specification between the Program Manager and ABS. Should the SCA concur with the use of ABS standards, initial certification must be obtained from ABS. Once ABS certification is obtained ABS criteria, as supplemented by any additional OQE requirements, shall be used to conduct periodic surveys. NAVSEA certified systems shall meet NAVSEA periodic testing requirements.

b. Load bearing component requirements are discussed in Section C-4.1, and cover structural, rigging, and machinery component criteria; hydraulic and pneumatic system requirements are discussed in Section C-4.2; and electrical power requirements and controls are discussed in Section C-4.3.

c. Design analyses for Diver Handling Systems must be based on recognized engineering analytical methods and standards. Loads imposed by the environmental conditions specified in the requirements documentation must be included in the analyses. The design of all load bearing and load controlling elements that are within the SOC boundaries must be submitted to the Acquisition Manager and SCA for review and approval.

C-4.1 Load Bearing Component Requirements

All elements of the handling system that support the weight of the Diving System when occupied by personnel shall be designed, fabricated, and maintained in accordance with the following requirements:

C-4.1.1 Load Bearing Component Design

a. Design analyses must indicate forces, loads, shears, and moments for all structural members, welds, and connections including interaction forces with the supporting deck and ropes. Components shall be analyzed considering tensile, compressive, bending, shear, and torsional loadings. Structural members subject to pure compression shall be evaluated in accordance with either DDS-100-4 or AISC Manual of Steel Construction, Specifications and Codes. (Note that the allowable stresses and safety factors used therein shall be revised as required to meet the safety factors specified in Section C-4.1.1.1). Analyses for rigging gear must also be included in the design documentation.

b. Calculations shall take into account the wet and dry weight of the Diving System, entrained water weight, added mass effects (if applicable), crew and payload weights, the dynamic affects due to the motion of the support ship and Diving System at sea, and the effects of the wind forces. The support ship's motions shall be analyzed

for the maximum operating sea conditions, sea state or swells specified in the requirements documentation. The worst-case loading due to heave, roll, pitch, or any combination thereof, shall be used in the calculations.

C-4.1.1.1 Design Factors of Safety

Factors of safety for Diver Handling Systems are based on Navy engineering practices, and are related to the material used and the operating environment conditions. Relatively high safety factors are necessary, even though the materials and their properties are well known, because they are used in uncertain environments and are subjected to uncertain stresses. Material justification will be required in accordance with Appendix A to certify handling system components within the SOC, even when the design meets the requirements of this section. Items requiring material justification will be identified during the conceptual design phase and during initial certification meetings.

a. Structural and machinery components

(1) For surface support ships, the factor of safety for all structural and machinery components shall be 2.5 on material yield strength, or 4 on material ultimate tensile strength; whichever is greater.

(2) For submarine support ship applications, the factor of safety shall be 3 on material yield, or 5 on material ultimate tensile strength; whichever is greater.

The above factors of safety shall be based on the design load.

b. Rigging and Fittings

(1) Factors of safety for wire and synthetic rope are given in Table C-1. These factors shall be based on the design load of the Diver Handling System and the specified nominal breaking strength for wire rope or average breaking strength for synthetic rope.

(2) If galvanized wire rope is used, reduce the nominal breaking strength by 10 percent to account for the effects of galvanizing.

NOTE: If drawn galvanized wire is used, no reduction in breaking strength is necessary.

(3) Rope break test. Each rope is to have a certificate of break indicating the load at which the test sample broke. The break test for synthetic fiber line shall be in accordance with FED-STD-191, ASTM D4268, or the Cordage Institute Standard Test Method for Fiber Rope. The break test for wire rope shall be FED-SPEC RR-W-410D, Wire Rope and Strand, or an approved industrial standard. OQE must be provided to relate the rope(s) purchased to the certificate of break test. In addition, the certificate of break test shall indicate the date of test, rope size, number of strands, number of wires per strand, quality of wires, and the load at which the test sample broke.

(4) When used with wire or synthetic rope, the factor of safety for fittings shall be equal to or greater than the commercial rating for the Diving System design load.

Table C-1. Factors of Safety for Rigging

Material Application	Critical Component	Noncritical Component	D/d Ratio[1]
Wire rope standing rigging	5	5	-
Wire rope running rigging	6	5	18:1
Rotation resistant wire rope			
- standard construction	7[2]	6	34:1
- formed through a die	6	5	18:1
Synthetic rope[3]			
- Braided	7	5	8:1
- Twisted/Plaited	7	5	10:1
- Aramid (kevlar)	6	5	20:1

[1] Ratio of sheave or drum diameter (D) to wire rope or synthetic line diameter (d).

[2] This factor of safety is for rotation resistant wire rope supporting a free hanging load. If a guideline system is used that does not allow the load to rotate, this factor of safety can be reduced to 6. Under no circumstances shall the factor of safety for wire ropes be less than 6 for manned lift systems.

[3] When wet, the safety factor for nylon rope shall be applied to the breaking strength minus 15 percent unless a suitable marine overlay finish is used.

C-4.1.2 Submission of Drawings and Calculations for Load Bearing Components

The Design Agent shall submit the design of Diver Handling System to the Acquisition Manager and SCA for review and approval. As a minimum, the following material shall be submitted:

a. Design analyses and calculations that provide the basis for the system design, including all assumptions governing the design. The analyses must include the following when results of computer calculations are submitted: input data, summaries of input and program assumptions, output data, and summaries of conclusions drawn from the output data.

b. General arrangements showing equipment locations and the rated capacity of the system.

c. Details showing sizes, sections, and locations of all structural members.

d. Details of all reeving components showing sizes, safe working loads, materials, manufacturer, and part number.

e. For synthetic rope: length, size, material, construction, average breaking strength, manufacturer, and specification (if applicable).

f. For wire rope: length, size, construction, preformed or non-preformed, lay, finish, grade (IPS, EIPS, or traction steel), core type, lubrication, and manufacturer.

g. Foundation and support arrangements.

h. Structural material specifications.

i. Drawings must show all welding proposed for the principal parts of the structure. The welding process, filler metal, and joint design are to be shown on detail drawings or in separate specifications.

j. The areas to be nondestructively inspected and methods of inspection are to be shown on the drawings, or in separate specifications.

k. Winch drum details.

l. Type and size of bolts.

m. Reeving diagram.

n. Testing requirements and procedures.

o. List of all materials and fittings, for all components.

p. The components within the SOC must be identified.

C-4.1.3 Divers Handling System Pre-Mission Inspection

The purpose of the Divers Handling System (DHS) Pre-Mission Inspection is to ensure the safety of the DHS prior to operation. This includes; reviewing the operational, maintenance, and personnel training records; conducting a visual inspection of the DHS components; and ensuring components are within their life cycle for safe use prior to operation of the system. This is accomplished by reviewing all operating, maintenance and training records and by conducting a visual inspection of the DHS components IAW with the Pre-Mission Inspection Checklist (Figure C-2).

The Pre-Mission checks shall be conducted prior to initial use by a diving detachment or when the DHS is suspected of damage. Initial use is defined as; prior to an operational mission, pre-deployment training, installment on a vessel/craft of opportunity, or when receiving the system from anyone other than your detachment.

When System Load Bearing Tests are required the Pre-Mission Inspection shall be conducted prior to the load bearing tests and the checklist shall be included as Enclosure (2) of the Controlled Work Package (Figure C-1).

C-4.1.4 System Testing for Load Bearing Components

a. All new Diver Handling Systems must be tested prior to initial certification and operational use. In addition, all modified or extensively repaired handling systems shall be inspected and tested as required in Section C-4.1.4.c. These tests are intended to confirm the adequacy of the design, the operational characteristics, and the validity of the operating procedures. For modified or repaired systems, the purpose of these tests is to verify the adequacy of the work performed, and to ensure the handling system continues to meet its design and certification criteria.

b. All Diver Handling Systems shall have static, dynamic, and rated load tests conducted on the following occasions: after being installed on a support ship, upon completion of an overhaul, and at intervals not to exceed 5 years. In addition, a static load test, dynamic load test, rated load test, and/or no-load test shall be accomplished, as required, after repair or replacement of system components in accordance with paragraph C-4.1.4.c.

c. Maintenance Testing Requirements. Conducting the full range of load tests (i.e., static, dynamic, and rated load tests) is not always necessary after completing corrective maintenance actions or some repair tasks. Table C-2 identifies the tests required after performing various tasks on structural, rigging, or machinery components. Some handling systems have unique components and may require additional or modified testing. The test documents for those tests shall be submitted to the Acquisition Manager for review and approval on a case basis. The system drawings/specifications should be consulted for further testing requirements. The tests specified in Table C-2, and the applicable tests specified by a drawing or specification shall be conducted for each maintenance task identified. If there is a conflict between the tests specified in Table C-2 and the test specified by the applicable drawing or specification, then the requirements of this document take precedence, unless specifically authorized by the Acquisition Manager.

d. If the system is certified to ABS requirements fully documented maintenance actions and testing is still required to be submitted to the Acquisition Manager and retained for review by the SCA.

e. Test procedures for all load tests and System Operational Tests (SOTs) shall be submitted to the Acquisition Manager for review and approval. The SCA shall also review these test procedures.

f. The following paragraphs identify the requirements for conducting static, dynamic, and rated load tests. In addition, maintenance testing requirements after completing maintenance tasks are also addressed.

(1) No Load Test. No load tests are conducted to evaluate the functionality of the Diver Handling System. The Diver Handling System shall be operated at a minimum of one complete cycle through its full range of motions and directions. If more cycling is necessary to ensure safe operation or troubleshoot the operators should cycle as required. Check for unusual noise, vibration, or overheating in machinery and control components. Also check for proper operation of all indicator lights and gages.

(2) Static Load Test. A static load test physically verifies the structural integrity of the fully assembled Diver Handling System. Test loads may be applied with certified test weights or by mechanical devices with calibrated load measuring gages.

(a) The static test load shall be equal to 200 percent of the operational load of the handling system, and shall be held for a minimum of ten minutes by the brake without power to the system. (See Controlled Work Package for testing procedures) No evidence of structural or rigging component deformation, or brake slippage is allowed.

(b) Upon completion of the static load test, the critical load bearing components and strength welds of the handling system shall be inspected to verify there is no permanent set, deformation, cracking, or other damage to any part of the structure, foundations, machinery, and reeving components. For initial certification, or if load bearing component repair or modification work was accomplished, the level of inspection shall be as specified on the drawings or in separate specifications to include MT or PT as applicable.

(c) End fittings on ropes included in the test shall be inspected for slippage and damage.

(d) Verify the system will hold the static load for one minute without power to the system.

(e) The static load test shall be conducted when the support ship is pier-side and experiencing no significant motion. The handling system shall be tested in the position of maximum loading.

(3) Dynamic Load Test. A dynamic load test demonstrates the capability of the Diver Handling System to operate with the rated load under the dynamic conditions of the support ship's motions at sea. The test shall demonstrate the handling system's overload capabilities throughout its complete operating range. Care must be taken to ensure specific operating limits of the components being tested are not exceeded.

(a) The dynamic load test shall be equal to 150 percent of the rated load of the handling system. Test loads shall be moved through one complete cycle of the handling system, with all limits of its operating modes (raising, lowering, traversing, traveling, rotating, etc.) included in the test. The handling system, with the test load, shall be stopped at least three times in each direction to ensure proper brake operation.

No speed is specified; however, the maximum speed attainable with the test load shall be used.

(b) During the dynamic load test, the handling system shall be checked for any signs of binding, abnormal noise or vibration, and overheating. As a minimum, the following equipment parameters shall be recorded during the test: motor amperage, hydraulic fluid temperatures and pressures (including main loop, servo, and replenishing pressures), operating speeds for all modes of operations (i.e., booming out, booming in, and/or raising and lowering, etc.). In general, the following shall be verified and noted: smooth operation, and proper stopping and holding of the test weight.

(c) Upon completion of the dynamic load test, the handling system shall be inspected for any indications of the following: warping or permanent deformation; leaking hydraulic fluid from any component or connections; wear patterns on sheaves, ropes, and gear trains; and proper drum spooling.

(d) The dynamic load test shall be conducted when the support ship is pier-side and experiencing no significant motion.

(4) Rated Load Test. A rated load test demonstrates the capability of the Diver Handling System to operate with its intended load at its rated speed. It also verifies that all hydraulic and electrical components operate within their specified operating limits.

The rated load test shall be equal to 100 percent of the rated load of the Diver Handling System. Test loads shall be moved completely through the handling system's full operating range, and within limits of all operating modes (raising, lowering, traversing, traveling, rotating, etc.). The system shall be capable of hoisting the Diving System at the system's rated speed when the hoist wire rope or synthetic line is on the outermost layer of the drum. The test load shall be run through at least three cycles to demonstrate proper operation. Each cycle is to be run at the specified normal operational speed of the handling system.

C-4.2 Hydraulic and Pneumatic System Requirements

Hydraulic systems shall be designed and tested in accordance with the requirements of this subsection. These requirements can also pertain to pneumatic systems; however, it is recommended that the Acquisition Manager and the appropriate NAVSEA technical authority discuss any unique requirements prior to initial design efforts.

C-4.2.1 System Design

a. Hydraulic and pneumatic systems and components shall be designed to operate the rated load at the rated speed when the differential pressure across the actuator is not more than two-thirds of the maximum operating pressure. This will ensure the handling system will operate efficiently under dynamic conditions at sea as well as when undergoing load testing.

b. Hydraulic and pneumatic systems and components shall be designed in accordance with MIL-HDBK-2193, Hydraulic System Components, Ship; with piping, valves, fittings and gasket material selected from MIL-STD-777, Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships (or MIL-STD-438 for submarine applications), or an approved industrial standard. Naval Ships' Technical Manual Chapter 556, Hydraulic Equipment (Power Transmission and Control); Naval Ships' Technical Manual Chapter 505, Piping Systems; or Naval Ships' Technical Manual Chapter 551, Compressed Air Plants and Systems, can be used as guidance.

Hydraulic and pneumatic systems and components shall be designed such that they are fail-safe and the brake on any winches, traction machines, cranes, or elevators shall set and stop motion if there is a loss of power.

Table C-2. Maintenance Testing Requirements - Load Bearing Components

Maintenance Task	Test Requirements
1. Drum or sheave repair, replacement, or modification	Static load test,[1] Dynamic load test, Rated load test
2. Hook[2] repair, replacement, or modification	Static load test[1]
3. Main lift rope(s) replacement (wire rope and synthetic line)	Pull test,[3] No-load test
4. Coupling, shaft, or bearing repair or replacement	Dynamic load test, Rated load test
5. Non-load bearing shafts or bearing repair or replacement	No-load test
6. Gear repair and replacement (load bearing or load controlling only)	Static load test,[1] Dynamic load test, Rated load test
7. Gear bearing oil-seal replacement	No-load test
8. Hydraulic cylinder repair or replacement (when the cylinder is used to support the weight of the Deep Submergence Vehicle, as in the case of an A-frame and elevator)	Static load test,[1] Dynamic load test, Rated load test

[1] Only the repaired, replaced, or modified component needs to be statically load tested. If the affected component can be rigged such that the 200 percent test load can be applied to it only, then that test would suffice for the static load test.

[2] "Hook" in this document is a generic term for the interface device between the Diving System and the handling system.

[3] All wire rope end fitting installations must be pull-tested to either 200 percent of the design load of the handling system, or to 40 percent of the nominal breaking strength of the wire rope. All synthetic line eye splices shall be proof tested to 200 percent of the design load of the handling system. A certificate of Break is required.

c. Acquisition Managers may also elect to design the Diver Handling System in accordance with the requirements of Title 46, Code of Federal Regulations (CFR), Subchapter F, Marine Engineering, or an approved industrial standard. However, applicable parts and subparts of the commercial specification must be defined by the Design Agent and Acquisition Manager and concurred with by the SCA prior to initiating the design.

d. As a minimum, the following documents shall be submitted to the SCA for review and approval:

(1) Design analyses and calculations that provide the basis for the system design, including all assumptions governing the design. The analyses must include the following when results of computer calculations are submitted: input data, summaries of input and program assumptions, output data, and summaries of conclusions drawn from the output data.

(2) Plan showing manufacturer's ratings, braking capabilities and power drive requirements for hydraulic equipment.

(3) Plan showing details on emergency source of power.

(4) Hydraulic schematic that shows:

(a) Relief valve settings

(b) Material specifications, size, and pressure ratings of all pipe fittings, valves, flexible hoses, pumps, filters, and accumulators

(c) Testing and cleaning requirements

(5) Drawings and design calculations, or a Certificate of Compliance (COC) from the manufacturer is required for each hydraulic or pneumatic cylinder to identify its burst pressure.

(6) Testing procedures

(7) The components within the SOC must be identified

C-4.2.2 System Testing

a. Hydraulic and pneumatic systems and components shall be tested in accordance with the requirements of this subsection. However, systems designed to the requirements of Title 46, CFR Subchapter F, Marine Engineering or an approved industrial standard may be tested to the requirements of those standards, providing the Design Agents can show there will be no detrimental effect on system safety. Applicable parts and subparts are to be defined by the Design Agent and Acquisition Manager and approved by NAVSEA prior to initiating the design.

b. All test procedures for items within the SOC, including Factory Acceptance Test (FAT) procedures, shall be submitted to the Acquisition Manager for review and approval. The SCA shall also review and approve the testing requirements.

C-4.2.2.1 Hydrostatic Testing Requirements

a. All new piping and pressure-containing components shall be hydrostatically tested. In addition, any piping, pressure-containing components, or tanks (accumulators, cylinders, etc.) that have been subject to repairs or modifications affecting its structural integrity (such as welding, brazing, or reboring) must be retested to verify the work has had no detrimental effect.

b. Hydrostatic test pressure for piping and piping components shall be 150 percent of maximum operating pressure. The pressure used to perform the test shall be within ± 3 percent (but no greater than ± 100 psig) of the designated test pressure, unless otherwise specified.

c. The duration of hydrostatic tests for pipe and piping components, including piece parts, conducted in a shop or on a test bench shall be not less than 1 minute, plus the time required for inspection.

d. The duration of hydrostatic tests for pipe and piping components, including piece parts, conducted in the as-installed configuration shall be not less than 15 minutes, plus sufficient time for inspection of mechanical joints and components within the test boundaries.

e. Hydrostatic testing of hydraulic system piping should be performed with system fluid. However, water or other flushing fluids are permissible when accomplished in accordance with MIL-STD-419, Cleaning, Protecting, and Testing Piping, Tubing, and Fittings for Hydraulic Power Transmission Equipment or an approved industrial standard. Hydrostatic tests of installed systems shall be conducted with system fluid only. However, hydrostatic testing of pneumatic systems should be conducted with demineralized water.

f. For flexible hoses the hydrostatic test procedure and pressure shall be in accordance with paragraph 8.2 of NAVSEA S6430-AE-TED-010, Piping Devices, Flexible Hose Assemblies or an approved industrial standard.

g. Acceptance criteria for hydrostatic tests shall be no permanent deformation as determined by visual inspection. Leakage past mechanical joints or valve seats during the test shall not be cause for rejection as long as the test pressure can be maintained. However, any leakage shall be noted in the test results section of the test procedures.

C-4.2.2.2 System Tightness Testing Requirements

a. All new and repaired pipe and piping components shall be subjected to a tightness test prior to operating the system.

b. The tightness test pressure shall be 100 percent of the maximum allowable working pressure (MAWP). The pressure used to perform the test shall be within ± 3 percent (but no greater than ± 100 psig) of the designated test pressure, unless otherwise specified.

c. The duration of tightness tests for pipe and piping components conducted in the as-installed configuration shall be not less than 15 minutes soak time at system operating pressures and temperatures, plus sufficient time for inspection of mechanical joints and components within the test boundaries.

d. Tightness testing should be conducted using system fluid.

e. Acceptance criteria for tightness testing of joints being accepted by the test shall be zero external leakage.

C-4.2.2.3 Maintenance Testing Requirements

Table C-3 identifies system level tests required after performing various hydraulic system maintenance tasks. Some handling systems have unique components and may require additional or modified testing. The test procedures for those tests shall be submitted to the SCA for review and concurrence. The tests specified below and tests specified by drawing or specification shall be conducted for each maintenance task identified. If there is a conflict between the tests specified below and the test specified by the applicable drawing or specification, then the requirements of this manual take precedence.

Table C-3. Maintenance Testing Requirements - Hydraulic Systems

Maintenance Task	Test Requirements
1. Hydraulic pump or hydraulic motor repair or replacement	Dynamic load test, Rated load test
2. Servo valve, high pressure piping, and components repair or replacement	No-load test
3. Hydraulic Cylinder repair or replacement (when the cylinder is used to support the weight of the Diving System)	Static load test, Dynamic load test, Rated load test
4. All other hydraulic system components and piping repair or replacement	No-load test
5. Major brake repair or replacement	Static load test, Dynamic load test, Rated load test
6. Routine adjustment or alignment of brake	Rated load test

C-4.2.3 Relief and Counter-Balance Valves

Relief valves and counter-balance valves require special attention and shall meet the requirements of this section. The safety of Diving System personnel depend on the proper operation of these valves. Relief valves are used in motion compensation circuits as well as for protecting the hydraulic system from over pressurization. Counter-balance valves are used to stop the Diving System from moving uncontrollably in the event of a sudden loss of system pressure.

a. The following shall be accomplished for all new relief valves and counter-balance valves, and existing relief and counter-balance valves that have been subjected to repairs, modifications or corrosion that would affect the structural integrity of the valve. Prior to system operational use, they shall be:

(1) Cleaned,

(2) Seat tightness tested, and

(3) Have their cracking pressure verified.

NOTE: Seat tightness testing and cracking pressure verification may be accomplished after installation while the system is being adjusted.

b. The duration of seat tightness tests conducted in a shop or on a test bench shall be not less than 5 minutes.

c. The duration of seat tightness tests conducted in the as-installed configuration shall be based on the time necessary for the minimum leakage to be detected at the point of observation or monitoring.

d. Acceptance criteria for seat tightness testing shall be zero leakage or that allowed in the manufacturer’s specifications or approved test documents.

e. The seat tightness test shall be conducted at a pressure equal to the maximum allowable working pressure.

f. System fluid is the preferred test medium for seat tightness testing.

g. Cracking pressures shall be verified in accordance with system drawings or manufacturer’s specifications. The actual cracking pressure and date verified shall be etched or stamped on a metal or plastic tag and affixed to the component.

h. Operating characteristics of relief valves and counter-balance valves shall be verified by either test bench methods or when adjusting the system during installation or maintenance.

C-4.2.4 Cleaning, Flushing, and Preservation

a. Cleaning, flushing, and preservation of hydraulic system piping and components shall be in accordance with ASTM D4174, Standard Practice for Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems, or an applicable commercial specification, subject to concurrence by the SCA. The maximum allowable particulate contamination level shall be specified on system drawings or in the technical manual.

b. Cleaning and flushing of pneumatic systems shall be accomplished using best commercial practice and using compatible cleaning agents to remove all loose scale, rust, grit, filings, oil and grease.

c. If hoses are flushed with water before installation, they must be blown dry with dry air. Filtered system fluid should be used for flushing, rather than water, following the general guidance in MIL-STD-419 or an approved industrial standard.

C-4.3 Electrical Power Requirements and Controls

Attention should be given to each component's electrical power requirements in view of the total system power drain on the support vessel or independent power source. When the Diving System mission requires that the Diving System must be lifted from the water in order for the Diving System operator(s) to disembark, two separate and independent power sources shall be provided to support operation of the Diver Handling System.

C-4.3.1 System Design

a. Design and installation of the handling system electrical power distribution system shall be in accordance with the requirements of Title 46, Code of Federal Regulation (CFR), Subchapter J, Electrical Engineering, or an approved industrial standard.

Electrical systems and components shall be designed such that they are fail-safe and the brake on any winches, traction machines, cranes, or elevators shall set and stop motion if there is a loss of power.

b. The controls shall be service-proven, and meet U.S. Coast Guard regulations or other authoritative specification.

(1) All controls used during the normal handling system operating cycle shall be located within easy reach of the operator while at the operator's station.

(2) Control levers shall return automatically to their center (neutral) position when released.

(3) Control operations and functions shall be clearly marked and easily visible from the operator station.

c. Control system plans and information submitted to the Acquisition Manager, for review and approval, shall be in accordance with Title 46, CFR, Subpart 110.25-1 of Subchapter J, as determined to be applicable by the Design Agent. The components within the SOC must be identified.

C-4.3.2 System Testing

a. Electrical system and component testing and inspection shall be in accordance with Title 46, CFR, Subpart 110.30 of Subchapter J. Additionally, each major component shall have a COC that shows the component meets specific requirements acceptable to the Navy.

b. All test procedures for items within the SOC, including FAT procedures, shall be submitted to the Acquisition Manager for review and approval. The SCA shall review test procedures for all components within the SOC.

c. As a minimum, the following tests shall be conducted after the Diver Handling System is installed on board a support ship:

(1) Continuity and insulation resistance (IR) checks.

(2) System Operational Test (SOT) and/or System Integration Test (SIT) as applicable.

C-4.3.2.1 Maintenance Testing Requirements

The following table identifies the functional tests required after performing various electrical system maintenance tasks. Some handling systems have unique components and may require additional or modified testing. The test procedures for these tests shall be submitted to the Acquisition Manager for review and approval on a case basis. The tests specified below, and the applicable tests specified by a drawing, specification or technical manual shall be conducted for each maintenance task identified in Table C-4. If there is a conflict between the tests specified in Table C-4 and the tests specified by the applicable drawing, specification or technical manual, then the requirements of this document take precedence.

Table C-4. Maintenance Testing Requirements - Electrical Systems

Maintenance Task	Test Requirements
1. Power distribution system repair	Continuity checks, Insulation resistance checks, Voltage readings, No-load test
2. Electrical control circuitry adjustments, alignments, or repairs	No-load test
3. Electric motors for HPUs:	No-load test, Rated load test
4. Limit switch repair or replacement	No-load test

C-5 Certification Requirements

a. This section describes OQE necessary to achieve and sustain U.S. Navy certification. These requirements are in addition to those requirements identified previously in this appendix.

b. The certification process in Chapter 2 shall be followed. This appendix provides clarification to some of those requirements, as directly related to Diver Handling Systems.

c. If the Acquisition Manager elects to use the services of ABS to conduct initial and/or sustaining certification surveys, this section shall be used as a guide to ensure that all SCA certification issues are adequately addressed.

C-5.1 Initial and Sustaining Certification Requirements

The OQE and processes identified below are required for initial certification, reinstatement of certification, and sustaining certification. OQE for repaired, refurbished, or replaced items and material will be reviewed and evaluated during periodic (normally annual) sustaining certification surveys. Alterations to items within the SOC must have prior SCA approval.

a. Design

(1) The design of all items within the SOC shall be approved by the Acquisition Manager. This includes calculations and/or drawings. In the design phase, for building or modifying a handling system, the information identified in the preceding sections of this appendix must be submitted to the Acquisition Manager and SCA for review and approval. It is recommended that the Design Agent allow sufficient lead time for the Navy to complete its review, and to address any revisions before the working drawings are needed for production. During the initial design phase, an initial design meeting should be held between the Design Agent, the Acquisition Manager and the SCA to ensure all of the requirements for certification are understood.

b. Fabrication

(1) All fabrication, welding and inspection of material within the SOC shall be in accordance with the latest revision of NAVSEA S9074-AR-GIB-010/278, Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels, or NAVSEA T9074-AD-GIB-010/1688, Fabrication, Welding, and Inspection of Submarine Structure, or MIL-STD-1689 , or an approved industrial standard.

(2) Systems to be certified to ABS Rules may use the above military standards, or the ABS Rules for Building and Classing Steel Vessels or equivalent for welding procedures and welder qualifications. Nondestructive testing inspection is to be in accordance with the above military standards, the ABS Rules for Nondestructive Inspection of Hull Welds, or equivalent. The applicable portions of the commercial

specifications which will be used for fabrication, repair, and maintenance of items in the SOC are to be defined by the Design Agent and Acquisition Manager and concurred with by ABS. This should be accomplished prior to the start of construction.

(3) The system shall be fabricated and installed in accordance with U.S. Navy (and ABS where ABS certification is applicable) approved drawings and manufacturing processes. The components, materials, and system configuration of the handling system shall be in accordance with applicable drawings. The documentation shall provide verification that work has been accomplished in accordance with fabrication requirements. All fabrication records required by the fabrication specifications and drawings shall be completed, signed, dated, and available for review by the SCA prior to certification.

c. Material Control

(1) For load bearing components whose catastrophic failure would endanger the safety of Diving System personnel, the industrial or maintenance facility, or applicant shall implement a system to document the identity of tested and approved materials. Controls shall be established to ensure the correct materials and components were received and installed. OQE demonstrating that the correct materials were received and installed shall be retained as directed by the Acquisition Manager or applicant, as applicable.

(2) For all other material in the SOC, activities shall be able to demonstrate that all material used is in accordance with the specifications, drawings and technical manuals.

d. Quality Assurance

(1) The Quality Assurance Program shall be a planned, documented, and have a systematic approach to all the actions necessary to provide adequate confidence that a handling system conforms to established technical requirements. The QA program shall contain provisions that result in recorded data related to:

(a) Organization

(b) Design and Drawing Control

(c) Material Control

(d) Fabrication and Manufacturing Control

(e) Technical Evaluation

(f) Personnel Qualifications

(g) Inspection

(h) Testing and Test Control

(i) Calibration

(j) Audits

e. Ropes

(1) Information for synthetic ropes used to support the Diving System shall include the following:

(a) Fiber type

(b) Size

(c) Length

(d) Average breaking strength

(e) Construction

(2) Information for wire ropes used to support the Diving System shall include the following:

(a) Size (diameter)

(b) Length

(c) Direction and type of lay

(d) Nominal breaking strength

(e) Construction and grade

(3) Each new synthetic and wire rope is to have a certificate of break to ensure that the safety factor is as designed. The break test shall be in accordance with FED-STD-191, Cordage Institute Standard Test Method, or ASTM D4268 for synthetic ropes, and FED-STD-191 for wire ropes. The certificate of break must be furnished by the manufacturer, supplier, or applicant.

(4) Documentation must be provided to substantiate the above information for each synthetic or wire rope. In addition, OQE must be provided that traces the above information to the installed rope.

f. Testing

(1) Test procedures required by the applicable sections of this appendix shall be reviewed and approved by the Navy (and ABS where applicable). All tests

shall be satisfactorily accomplished. The results of the completed tests must be reviewed and found acceptable by the testing activity prior to certification.

g. System Maintenance

(1) Critical components must be monitored for wear and deterioration by periodic inspections and scheduled maintenance. The Design Agent shall ensure that system and component maintenance requirements are incorporated into a maintenance plan. Maintenance plans and procedures must be reviewed and approved by the Acquisition Manager prior to initial certification. After certification has been granted, any changes to the maintenance procedures or periodicities must also be reviewed and approved by the Acquisition Manager. There shall be an auditable system of scheduling, performing and recording maintenance requirements established by the Applicant. There shall be a written maintenance, repair and replacement record of all items within the SOC.

h. Operational Demonstration

(1) For initial certification, static, dynamic, and rated load tests, paragraphs C-4.1.3.d(1), (2) and (3) shall be witnessed by a third party or command designated safety representative.

i. Operating and Emergency Procedures

(1) The Acquisition Manager shall submit operating procedures and emergency procedures to the SCA for review and approval. This documentation must include: normal and emergency procedures, and pre-launch, launch/recovery and post recovery procedures and inspections. After certification has been granted, any changes to these procedures must also be reviewed and approved by the SCA. The procedures utilized shall be the procedures approved by the SCA.

j. Documentation

(1) Documentation for all repaired or refurbished items must include the following, as a minimum: (This satisfies the requirements of the work control section of Chapter 5). Appendix A should be used as guidance. This documentation is required whether the system is certified by the SCA or by ABS.

(a) Description of the work performed, the reason the work was accomplished, and verification that the work was performed in accordance with requirements.

(b) Description of any replacement parts, including the part number from the applicable drawing or manufacturer's brochure.

NOTE: COCs and invoices must also identify the part. The purpose of this data is to be able to ensure the replacement part is equal to or better than the part it replaced.

(c) Installation requirements (if applicable).

(d) Description of testing performed to ensure the system operates properly and is in accordance with its design parameters. Documentation shall provide verification that testing has been satisfactorily accomplished in accordance with the requirements.

(e) Documentation of work and testing shall be sufficient to relate the work, testing and replacement parts.

(2) Documentation of construction, maintenance and operations shall be retained. Operating records shall be retained on-board from survey to survey. Routine maintenance documentation shall be retained for three years or until re-performed, whichever is longer. Construction and maintenance documentation other than routine shall be retained until the documentation is superseded. The intent is to have all documentation on the current condition of the installed equipment.

k. Reports

(1) Report all material casualties within the SOC, including launch aborts. Provide post casualty/mission abort/launch abort analysis, including recommended corrective action, to the Acquisition Manager and SCA by the fastest means possible.

C-5.2 Certification Surveys

a. The initial certification survey will be in accordance with Chapter 4. The PSOB for this survey will be developed in accordance with Chapter 2 and Appendix B.

b. Diver Handling Systems shall undergo periodic (normally annual) sustaining certification surveys to ensure maintenance, repairs, and operations have been performed in accordance with approved requirements. The survey will consist of three inspection categories: examination of all system logs or records, a visual inspection of the handling equipment, and a no-load test. If the handling system is portable, these surveys will be conducted whenever the system is installed on the support vessel.

(1) The system logs or records to be reviewed include operating logs, maintenance logs, and training logs. The purpose of this part of the survey is to ensure that the operator is adequately conducting maintenance, repair, and replacement of all items within the SOC. It is also to ensure that launch and recovery operations and inspections have been performed safely and properly, and that handling system operators are following the approval operating procedures.

(2) The purpose of the handling system visual inspection and no-load test is to satisfy the surveyor that the system has been properly maintained and is in good working condition.

c. Survey Plans

(1) The survey plan at the end of this appendix, Figure C-1, can be used for conducting existing Diver Handling System periodic surveys. It may need to be revised to be used on a new system for periodic surveys.

With the exception of the valley break replacement criteria (for wire ropes), the rope inspection and replacement criteria tables, Tables 1 and 2 in Figure C-1, contained in this plan exist in other military specifications. As such, this is the governing specification for valley break replacement criteria only. The tables in this manual may not be updated as the other specifications change, however, the tables shall be updated when using this survey plan to conduct a periodic survey.

(2) For other than periodic surveys after the initial certification survey, the PSOB generated in accordance with Appendix B for the initial certification survey shall be utilized. The PSOB shall be updated with all work accomplished since the previous survey. The updated PSOB shall be submitted for review and approval by the SCA.

d. Prior to the SCA survey, the applicant is expected to conduct an internal survey to an internally generated survey plan, the PSOB generated in accordance with Appendix B and updated as applicable, or in accordance with the survey plan at the end of this appendix.

C-5.3 Suspension of Certification

Certification may be suspended by the SCA when any of the following events cause a reduction in the material or procedural adequacy of the Diver Handling Systems:

a. Violation of any of the terms or conditions of certification;

b. Recognition of the existence of an unsafe condition; or

c. Overhaul or other major repair period.

The SCA will reinstate certification when the cause of the suspension has been thoroughly investigated, satisfactorily corrected, and the material and procedural adequacy of the system has been re-established.

CONTROLLED WORK PACKAGE

1. COMMAND/UNIT	2. PACKAGE NO.	REV

LOAD BEARING TESTS OF DIVERS HANDLING EQUIPMENT

REFERENCES

(a) USN Diving and Manned Hyperbaric System Certification Manual, SS521-AA-MAN-010
(b) NSTM, Chap 589
(c) CINCLANTFLT/CINCPACFLT 4790.3, Vol. 4, Part 1, Chap 30
(d) PMS, Decompression Stage, MIP 5921/152-B8

ENCLOSURES

(1) Rated Load Test
(2) Divers Handling System Pre-mission Inspection Checklist
(3) System Configuration Drawing

PROCEDURE

IAW Ref (a), Appendix C, Ref (b) encl. (2)

PARTS/MATERIALS

(List all machinery and hardware used to configure the system)

PRECAUTIONS/PREREQUISITES

Personnel conducting tests will wear hardhats and steel toe boots.

WORK PROCEDURE

Handling systems shall be tested in the position where the highest stresses occur. I.e. Boom fully extended. See enclosures (1) and (2).

Figure C-1. Controlled Work Package and Rated Load Test Report

RATED LOAD TEST REPORT

1. COMMAND UNIT	2. PACKAGE NO.	REV
3. SYSTEM/COMPONENT	4. DESCRIPTION OF ITEM	

5. DESCRIPTION OF TEST

Step 1. Perform No Load Operation Test in accordance with Ref a. The divers handling system shall be required to function through full operating ranges in all directions specified for the equipment. During the test, operation of the travel limit switches, overtravel limit switches, emergency stop and (if applicable) emergency run switches and limit switch recovery features shall be demonstrated. The divers stage shall be attached to the weight handling equipment and lowered and raised from the deck level to the waters edge for one cycles.

SAT____ UNSAT_____ INITIALS:_____

Step 2 . Perform Static Test in accordance with Ref a. The handling system equipment shall be static-tested to 200 percent of the Operating Load of the when used for diver handling. 125% of the operating load shall be lifted by the system to a height to demonstrate the brake capacity. Once the load is lifted the remaining 75% shall be added by other mechanical means (a second crane is the preferred method). The power to the system shall be shut down and the load shall be held for 10 minutes to demonstrate the holding capacity of the brake. No visible permanent deformation should result from this test.

Static Load:_____lbs SAT____ UNSAT____ INITIALS:_____

Step 3. Perform Overload (Dynamic) Test in accordance with Ref a. The handling system shall be run through one complete cycle of its operation with 150 percent of the rated load. A complete cycle includes unloading from the stowed position, moving the load to the water, releasing, retrieving and restowing.

Over Load:_____lbs SAT____ UNSAT____ INITIALS:_____

Step 4. Perform Rated Load Weight Test in accordance with Ref a. The handling system shall be run through at least three complete cycles of its operation with its rated load at the specified normal operating speed of the equipment.

Rated Load:_____lbs SAT____ UNSAT____ INITIALS:_____

6. TECHNICIAN	7. WITNESS
PRINT_____ DATE_____	PRINT _____ DATE_____
SIGN_____	SIGN_____

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

DIVING SUPPORT SHIP NAME: _____
DATE OF SURVEY:_____ LOCATION:_____
SURVEYOR:_____ REVIEWED WITH:_____

System logs were reviewed starting from _____ (date of last survey) through _____ (date of the last time the Diver Handling System was used. This could have been to launch and recover the Diving System, or for maintenance or testing purposes.)

List the logs or records reviewed during this survey:

(Review them in accordance with para. I.A., I.B., and I.C. -- see next page)

(1)_____sat/unsat

(2)_____sat/unsat

(3)_____sat/unsat

(4)_____sat/unsat

(5)_____sat/unsat

(6)_____sat/unsat

(7)_____sat/unsat

(8)_____sat/unsat

Figure C-2. Diver Handling System Pre-Mission Inspection Checklist

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

I. EXAMINATION OF SYSTEM LOGS OR RECORDS

A. OPERATING LOGS/RECORDS

Review operating logs for the following:

(1) Completeness.	Have all steps requiring signatures been signed off? Are pre- and post-launch procedures complete?
(2) Consistency.	Are applicable entries, including dates, consistent with other logs?
(3) Discrepancies.	Are there any discrepancies related to abnormal operating conditions, or inoperability of any safety device or load controlling component noted in the logs. If so, were all discrepancies satisfactorily resolved prior to the next dive?
(4) Briefings.	Are there records of the pre-evolution briefings and watch station assignments?

B. MAINTENANCE DOCUMENTS

Review maintenance logs for the following:

(1) PMS.	Ensure that periodic preventive maintenance is in progress.
(2) Accountability.	Sample component accountability for maintenance on SOC items, including periodicity. (i.e., ensure that manufacturers maintenance requirements, including periodicity, are met.)
(3) Inspections.	Have periodic inspections been performed? Required inspections include daily (pre-operational), weekly, and all other inspections listed in the documentation.
(4) Repair and Replacement	Review records for any SOC items that have been repaired or replaced. Is there proper documentation to ensure the component is equal to what is required in the applicable drawing(s)? (i.e., material and strength). Was the component installed and tested properly? Have all material casualties been reported to NAVSEA?

C. TRAINING RECORDS

Review training documentation for the following:

(1) Adequacy.	Have the DSS handling system operators been properly trained IAW the training documentation?

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

II. VISUAL INSPECTION OF DIVER HANDLING SYSTEM

Perform the following component inspections:	**SAT**	**UNSAT**
A. Structure (includes handrails, ladders, and walkways; however, the main emphasis is on load bearing structure).	_____	_____
Inspect for:		
(1) Damage, cracking, and corrosion	_____	_____
(2) Loose fasteners	_____	_____
(3) Cracked welds	_____	_____
B. Support Pins, Bushings, and Retainers.		
Inspect for:		
(1) Proper installation	_____	_____
(2) Wear and distortion	_____	_____
(3) Lubrication	_____	_____
C. Machinery (includes machinery components and foundations).		
Inspect for:		
(1) Distortion	_____	_____
(2) Cracked welds	_____	_____
(3) Misalignment	_____	_____
(4) Corrosion	_____	_____
(5) Bearing surfaces of fasteners	_____	_____
(6) Missing or defective fasteners	_____	_____
(7) Alignment, damage, and fastener tightness on any gear covers.	_____	_____
(8) Damaged lubrication lines and damaged or missing fittings.	_____	_____
(9) Damaged linkage or signs of binding.	_____	_____
(10) Loose, damaged, or corroded couplings and signs of binding.	_____	_____
(11) Uneven wear of brake linings. Also check for full lining contact, and missing or broken parts.	_____	_____
(12) Uneven wear of gear teeth, and adequate lubrication.	_____	_____
D. Sheaves and Rollers.		
Inspect for:		
(1) Wear and damage.	_____	_____
(2) Worn bearings and pins.	_____	_____
(3) Damaged or missing lubrication fittings.	_____	_____
(4) Wear in rope grooves.	_____	_____
(5) Corrosion.	_____	_____
(6) Lubrication.	_____	_____
(7) Loose or damaged sheave guards.	_____	_____

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

	SAT	UNSAT
E. Hoist Drums.		
Inspect for:		
(1) Cracks or distortion	_____	_____
(2) Missing or loose fasteners	_____	_____
(3) Cracked welds	_____	_____
(4) Lubrication	_____	_____
F. Hydraulic Systems (including the HPU).		
Inspect for:		
(1) Leaking seals	_____	_____
(2) Loose connections	_____	_____
(3) Proper fluid level in the reservoir	_____	_____
(4) Verify that all gages and meters are within calibration date.	_____	_____
(5) Inspect all tubing and hoses for correct installation.	_____	_____
(6) Cylinders for pitting or faulty seals	_____	_____
(7) Cylinder mountings and pins.	_____	_____
(8) Filter indicators.	_____	_____
(9) Proper mounting of components.	_____	_____
G. Electrical System (including components on HPU).		
Inspect for:		
(1) Weather damage or moisture.	_____	_____
(2) Frayed and cracked insulation.	_____	_____
(3) Loose wires and connections.	_____	_____
(4) Damaged covers.	_____	_____
(5) Verify that all gages and meters are within calibration date.	_____	_____
(6) Verify all electric motors are properly lubricated.	_____	_____
(7) General condition of motors and motor controllers.	_____	_____
(8) Adequacy of normal and emergency lighting.	_____	_____
H. Control Console.		
Inspect for:		
(1) Deterioration.	_____	_____
(2) Corrosion.	_____	_____
(3) Loose fasteners and components	_____	_____
(4) Missing label plates	_____	_____
(5) Verify all gages and meters are within calibration date	_____	_____

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

	SAT	UNSAT
I. Operator Control Station.		
Inspect for:		
(1) Leaks	_____	_____
(2) Broken Glass	_____	_____
(3) Corrosion	_____	_____
(4) Proper communications to the bridge and to other cognizant Diver handling system personnel.	_____	_____
J. Synthetic lines.		
Inspect for:		
(1) See Table 1.	_____	_____
(2) Number of Cycles: _____		
(2 yrs or 500 lift cycles)	_____	_____
K. Wire Rope. (See Table 2 for wire rope replacement criteria)		
Inspect for:		
(1) Reduction of nominal rope diameter due to loss of core support or internal or external corrosion or wear of individual outside wires.	_____	_____
(2) Number of broken outside wires and degree of distribution or concentration of broken wires.	_____	_____
(3) Corroded, pitted, or broken wires at end connections.	_____	_____
(4) Corroded, cracked, bent, worn, slipped, or improperly applied end connections.	_____	_____
(5) Severe kinking, crushing, or distortion of rope structure.	_____	_____
(6) Evidence of heat damage from any cause.	_____	_____
(7) Verify internal inspections have been conducted in accordance with PMS 5921/005 A-1R and S-1R or equivalent MSC maintenance and inspections.	_____	_____
(8) Verify the wire rope is less than 5 years old.	_____	_____

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

TABLE 1 - SYNTHETIC LINE INSPECTION CRITERIA

Characteristic	Resplice (if localized)	Discard
1. Rope suspected of being shock loaded		X
2. Rope that has exceeded 75% of its minimum breaking strength		X
3. Bulk of surface yarns or strands reduced by 50% or more for a linear distance equal to, or greater than, four times rope diameter.	X	X
4. Three or more adjacent cut yarns in the strands of ropes to 4-1/2 inch circumference.	X	X
5. Four or more adjacent cut yarns in the strands of ropes 5-inch circumference and over.	X	X
6. Stretchout: Circumference reduced by 5% from circumference when new. (Measured under a slight tension 200*D^2 in pounds.)		X
7. Cockling.	X	
8. Oil and grease.	Wash in mild detergent	
9. Heavy surface fuzz progressive.	X Remove source of abrasion	X
10. Burns or melting visible for a length of over four times the rope diameters.	X	X
11. Rust on nylon.	X (or clean)	
FOR BRAIDED ROPES:		
12. More than four adjacent pulled cover strands, which cannot be reincorporated into cover braid).	X	X
13. Core visible through cover because of cover damage (except single braids).	X	X
14. Core damage -- pulled, cut, abraded, or melted strands.		X
15. Damage to female side of eye.	X	
FOR 3-STRAND AND 8-STRAND PLAITED ROPES:		
16. Damage in valley between strands.	X	X
17. Powdering between adjacent strand contract surfaces.	X	X
WHEN IN DOUBT, REMOVE FROM SERVICE!		

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

Wire Rope Replacement Criteria:

(1) The nominal diameter of the rope is reduced by more than the amount shown in the table below:

TABLE 2 - Wire Rope – Maximum Allowable Diameter Reduction

Rope Diameter (Inches)	Maximum Allowable Nominal Diameter Reduction (Inches)
5/16 and smaller	1/64
3/8 to 1/2	1/32
9/16 to 3/4	3/64
7/8 to 1-1/8	1/16
1-1/4 to 1-1/2	3/32
1-9/16 to 2	1/8
2-1/8 to 2-1/2	5/32

(2) Six broken wires in one rope lay length, or three broken wires in one strand lay length.

(3) One broken wire within one rope lay length of any end fitting.

(4) Wear of 1/3 the original diameter of outside individual wires.

(5) Evidence of pitting due to corrosion.

(6) Evidence of heat damage from any cause.

(7) Kinking, crushing, or any other damage resulting in distortion of the rope structure.

(8) Evidence of internal corrosion, broken wires on the underside of strands, excessive nicks or core failure.

(9) Fatigue Fractures (broken wires in the valleys or on the crowns).

DIVER HANDLING SYSTEM PRE-MISSION INSPECTION CHECKLIST

III. FUNCTIONAL TEST OF THE EMERGENCY CONTROLS (If applicable)

Operate the Diver Handling System with the emergency controls to evaluate their performance.

Emergency controls were operated and found (sat/unsat)

IV. CORRECTION OF DISCREPANCIES

List of discrepancies below:

_____
_____
_____
_____
_____
_____
_____

List corrective action for each discrepancy below:
(include REC # where applicable)

_____
_____
_____
_____
_____
_____
_____
_____

The above DIVERS HANDLING SYSTEM ANNUAL SURVEY PLAN was completed and was found to be in satisfactory condition except where noted.

PRINT _____

SIGN _____ DATE _____

BIBLIOGRAPHY

The publications listed below are representative of those, which may be useful in preparing the Diving System certification. Unless otherwise indicated the most recent issue or revision of each shall be used.

REFERENCE

ABS Rules for Building and Classing Steel Vessels

ABS Rules for Nondestructive Inspection of Hull Welds

AISC Manual of Steel Construction, Specifications and Codes

ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Unfired Pressure Vessels, and Division 2, Alternative Rules for Pressure Vessels

ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

ASME B31.1, Power Piping

ASME/ANSI PVHO-1, Safety Standard for Pressure Vessels for Human Occupancy

ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems, Standard Practice for,

ASTM D4268, Testing Fiber Ropes, Standard Test Methods for,

Cordage Institute Standard Test Method for Fiber Rope

DDS-100-4, Strength of Structural Members

DOD Directive 5000.1, Defense Acquisition

DODINST 5000.2, Defense Acquisition Management Policies and Procedures

DOD-STD-1399-301A, Interface Standard for Shipboard Systems Section 301A Ship Motion and Attitude (Metric)

DOT-E Composite Flask

FED-SPEC-RR-W-410D, Wire Rope and Strand

FED-STD-191, Textile Test Methods

MIL-DTL-31000, Technical Data Packages

MIL-F-22606, Flask, Compressed Gas, and End Plugs for Air, Oxygen, and Nitrogen

MIL-HDBK-2036, Preparation of Electronic Equipment Specifications

MIL-HDBK-2193, Hydraulic System Components, Ship

MIL-STD-22D, Welded Joint Design

MIL-STD-419, Cleaning, Protecting, and Testing Piping, Tubing, and Fittings for Hydraulic Power Transmission Equipment

MIL-STD-438, Schedule of Piping, Valves, Fittings and Associated Piping Components for Submarine Service

MIL-STD-777, Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships

MIL-STD-882, System Safety Program Requirements

MIL-STD-1330, Standard Practice for Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen, and Hydrogen Systems

MIL-STD-1622, Cleaning of Shipboard Compressed Air Systems

MIL-STD-1689, Fabrication, Welding, and Inspection of Ships Structure

MIL-T-16420, Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy numbers 715 and 706)

MIL-V-24439, Valves, Oxygen, Helium and Helium Oxygen Mixture, High Pressure for Gas Services

NAS 1638, Cleanliness Requirements of Parts Used in Hydraulic Systems

NAVEDTRA 43910, PQS for Diving Salvage Warfare Specialist (DSWS)

NAVFAC MO-406, Hyperbaric Facilities Maintenance Manual

NAVFAC P-1045, Pre-Survey Outline Booklet for Shore-Based U.S. Navy Surface Supported Diving Systems

NAVFAC P-1046, Pre-Survey Outline Booklet for Shore-Based U.S. Navy Recompression Chamber Systems

NAVFAC UFC 4-159-01N, Design: Hyperbaric Facilities Manual

NAVSEA 0900-LP-001-7000, Fabrication and Inspection of Brazed Piping Systems

NAVSEA S6430-AE-TED-010, Piping Devices, Flexible Hose Assemblies, Technical Directive for; Volume 1

NAVSEA S9AA0-AB-GSO-010, General Specifications for Overhaul of Surface Ships (GSO)

NAVSEA S9074-AQ-GIB-010/248, Welding and Brazing Procedure and Performance Qualification, Requirements for

NAVSEA S9074-AR-GIB-010/278, Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels, Requirements for

NAVSEA S9086-RK-STM-010/CH-505, Naval Ships' Technical Manual Chapter 505, Piping Systems

NAVSEA S9086-SY-STM-010/CH-551 Naval Ships' Technical Manual Chapter 551, Compressed Air Plants and Systems

NAVSEA S9086-S4-STM-010/CH-556, Naval Ships' Technical Manual Chapter 556, Hydraulic Equipment (Power Transmission and Control)

NAVSEA S9086-T4-STM-010, Naval Ships' Technical Manual Chapter 589, Cranes

NAVSEA SS521-AG-PRO-010, U.S. Navy Diving Manual

NAVSEA SL720-AA-MAN-010, Fleet Modernization Program Management and Operations Manual

NAVSEA T9074-AD-GIB-010/1688, Fabrication, Welding, and Inspection of Submarine Structure, Requirements for,

NAVSEA TS500-AU-SPN-010, U.S. Navy General Specifications for the Design, Construction and Repair of Diving and Hyperbaric Equipment

NAVSEAINST 4000.6A, Data Management Program

NAVSEAINST 10560.2, Diving Equipment Authorized for Navy Use (ANU)

OPNAVINST 3150.27, Navy Diving Program

OPNAVINST 4790.4, Ships' Maintenance and Material Management (3-M) Manual

OPNAVINST 5100.19, Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat

Title 46, Code of Federal Regulations (CFR), Subchapter F, Marine Engineering

Title 46, Code of Federal Regulations (CFR), Subchapter J, Electrical Engineering

GLOSSARY OF TERMS

Accessibility to vital equipment	The ability to reach, read, and/or operate vital equipment and devices.
Acquisition Manager	The government individual responsible for the procurement and certification of a new construction diving system.
Accident	A happening that is not expected, foreseen, or intended under normal circumstances.
Alteration	A change from the as-certified design, material, configuration, or performance.
Applicant	The organization or activity responsible for presenting a diving system to the SCA for system certification.
Appurtenance	An accessory added to a major component (e.g., view-ports, hatches, jettisoning equipment, support rails, connectors, piping, etc.)
Authorized for Navy Use (ANU)	Equipment authorized for Navy Use. Equipment procured for use in the U.S. Navy has been tested under laboratory and field conditions to ensure that it will perform according to design specifications. A vast array of equipment and tools are applicable for use in diving operations. The NAVSEA/00C Diving Equipment Authorized for U.S. Navy Use (ANU) list identifies much of this equipment and categorizes diving equipment authorized for U.S. Navy use.
Breathing gas supply equipment	Equipment that is used to compress, condition, mix, store, or otherwise handle breathing gas.
Builder	Contractor or agency who constructs the Diving System.
Critical component	Any component which, in the event of failure, could cause serious injury/death to the user.
Casualty	An incident which causes damage to or interruption of the normal operation of the Diving System and which may result in physical injury to personnel.
Catastrophe	Any great or sudden disastrous malfunction which jeopardizes the safety of the Diving System personnel.

Certifiable	See System certification.
Certificate	The document attesting to the system certification granted by the SCA.
Certification	See System certification.
Certification scope	See Scope of Certification.
Certification Scope Notebook	Contains the basic subsystem diagrams that outline those structures, subsystems, and equipment that are within the SOC as described in the PSOB.
Continuance of certification	An extension by the SCA of the system certification period beyond that initially granted.
Decompression chamber (DC)	The DC furnishes a dry environment for accomplishing decompression and, if necessary, recompression.
Diving System	Any manned or on-bottom habitat, hyperbaric facility, deep diving system, or diving, equipment, including attendant systems providing or supporting the ability of naval personnel to operate under water or elevated pressure.
Diver	An individual who is qualified in accordance with current Department of the Navy requirements.
Emergency	A sudden, unexpected malfunction or other set of circumstances in the Diving System operation which requires immediate attention.
Explodable items	Any item containing a non-compensated volume which has the potential for failure under internal pressure.
Fire resistant	A material that will immediately self- extinguish when the source of ignition is removed, when tested in an atmosphere representative of its intended use environment.
Fixed shore-based facilities	See shore-based facilities/systems.
Framing Systems	The hull structure for a shore-based system.

Flotation system	The materials, tanks, piping, components, or equipment that provide buoyancy to the Diving System as may be applicable.
Foundation	The permanently installed part of a Diving System which serves exclusively to support the Diving System.
Handling system	That system or subsystem of the Diving System which is used in storing, deploying, operating, and retrieving the Diving System and is intimately related to safety of Diving System personnel.
Hard structure	Pressure resistant structures, including reinforced openings and penetrations, but other than the pressure vessels, which may experience high differential pressure and that are designed to the same criteria as the pressure vessel (e.g., buoyancy or variable ballast tanks).
Hazard Analysis	Description of the possible effects of a mechanical failure or operator error for each component or assembly.
Heat resistant	A material that does not give off noxious fumes at its operating temperature or at any temperature below 200F and which is not -degraded in respect to performing its intended function when exposed to a temperature of 400F for 5 minutes.
Hull structure	Nonpressure structure which will not experience.differential pressure (e.g., floodable structure supporting equipment and including hydrodynamic fairing). For shore-based facilities the appropriate term is framing system.
Hyperbaric chamber	Pressure-resistant structure, including pertinent reinforced openings, penetrations, and hatches, which experiences high differential pressure and which provides space for personnel.
Hyperbaric facility	A complex, for operation at pressures above atmospheric, in which the magnitude and rate of change of the pressure and the composition and temperature of the confined atmosphere and/or water can be accurately controlled.
Implodable item	Any item containing a noncompensated compressible volume which has the potential for failure under external pressure.

Life-support system	A system that provides a livable environment.
Material adequacy	Designed and constructed of proper materials and (materially adequate) performance tested in accordance with accepted engineering principles to provide for safety of the Diving System personnel.
Maximum operating pressure	The highest pressure that can exist in a system or subsystem under normal (non-casualty) operating conditions. This pressure is determined by such influences as pump or compressor shut-off pressures, pressure regulating valve lockup (no-flow) pressure, and maximum chosen pressure at the system source.
Maximum system pressure	The highest pressure that can exist in a system or subsystem during any condition. Normal, abnormal and emergency operation and casualty conditions shall be considered in determining the maximum system pressure. In any system or subsystem with relief valve protection, the nominal setting of the relief valve, as described in subparagraph covering relief valve setting and installation herein, shall be taken as the maximum system pressure (relief valve accumulation may be ignored).
Mission Configuration Matrix	A certification tool that provides a list of equipment required, optional, or not required to be operational to conduct each mission.
Nominal operating pressure	The approximate pressure at which an essentially constant pressure system operates when performing its normal function. This pressure is used for the system basic pressure identification.
Nondestructive testing (NDT)	All methods of testing used to detect or measure the properties or performance capabilities of material, parts, assemblies, equipment, or structures which do not impair the serviceability of the parts tested.
Occupant(s)	Any person occupying the Diving System.
Operator(s)	1. The organization, agency, or firm having responsibility for the operations, repair, and maintenance of the Diving System. 2. The personnel who physically control the operating parameters of the Diving System.

Objective Quality Evidence (OQE)	Any statement of fact, either quantitative or qualitative, pertaining to the quality of a product of service based on observations, measurements, or tests which can be verified.
Penetration	The assembly, component, shaft packing gland, seal, or other device which penetrates the pressure-resistant structure (e.g., pressure vessel or hard structure).
Pressure Boundary Integrity Surveillance Program	The evaluation and assessment of those attributes and the satisfactory performance of the required testing to ensure a safe and effective pressure boundary within the design parameters.
Pressure vessel	See definition of hyperbaric chamber.
Pre-Survey Outline Booklet (PSOB)	A checklist that identifies those areas to be reviewed as part of the certification process for a specific Diving System.
Procedural adequacy	The procedures used in the operation and maintenance of the Diving System, suitable and sufficient to provide for the safety of the occupants and operators of the system, before, during, or after any credible operational/emergency evolution.
Procedures	Instructions, checklists, and maintenance guides, prepared in a manner that provides the occupants and operators a detailed, safe sequence of operations of the Diving System in all of its various normal and emergency operating codes.
Re-Entry Control (REC) package	Required documentation to ensure that the previous level of integrity of a certified system is restored to its originally certified condition when work is accomplished within the Scope of Certification boundary.
Recertification	A new certification of system adequacy of a Diving System whose system certification has expired or been terminated.
Recompression chamber	Recompression chambers are used for the treatment of decompression sickness, for surface decompression, and for administering pressure tests to prospective divers. Recompression chambers equipped for hyperbaric administration of oxygen are also used in medical facilities for

	hyperbaric treatment of carbon monoxide poisoning, gangrenous tissue, and other diseases.
Repair	A restoration to the original condition or replacement which does not change the original material, configuration, or performance, using procedures previously approved.
Replacement-in-kind	Replacement with parts or components meeting original specification requirements.
Scope of Certification (SOC)	A list defining those systems, subsystems, components, portions of the Diving System, maintenance, and operational procedures which are needed to preserve the physical well-being of the Diving System personnel.
Shore-based facilities/systems	Those diving and hyperbaric systems that have a dedicated land based mission. These systems are typically permanently installed in or attached to permanent structures.
Sponsor	The system sponsor is the organizational unit responsible for funding the development, construction, operation, repair, alteration and/or maintenance of the diving system. For a system under development, the sponsor is normally the NAVSEA or NAVFAC Acquisition Manager. For systems already in existence and having achieved initial certification (see Chapter 3), the sponsor is normally the Type Commander, or a subordinate command of the Type Commander for afloat systems. For shore-based systems, the parent command is typically the system applicant.
Survey	To examine, inspect, and review in detail all items falling within the scope of certification to determine their material and procedural adequacy.
Survey team	The personnel representing the System Certification Authority to perform the on-site verification of the Diving System survey.
Suspension of certification	The temporary revocation of certification which does not require full recertification. Manned use of the system during suspension is not authorized.
Sustaining system certification	Actions required of the applicant to assure the SCA that the Diving System remains in the as-certified condition for the tenure of certification.

System certification	The procedure including application, independent technical review, survey, and approval to ensure the adequacy of the Diving System to safely perform over its operational/emergency spectrum. System certification is a combination of two major areas of review: material adequacy and procedural adequacy. This replaces the old term “material certification.”
System Certification Authority (SCA)	The code within either NAVSEA or NAVFAC as applicable, that has been delegated, through the Navy chain of command, the responsibility to conduct the Certification process.
Tenure	Tenure of Certification is the length of time for which certification is granted.
Termination of certification	The cancellation of system certification, requiring full system review to recertify.

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